

# Micro-Fishing as an Emerging Form of Recreational Angling: Research Gaps and Policy Considerations

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Photo credit: Ben Cantrell



Micro-fishing is an emerging form of recreational angling that targets small-bodied fish in inland and marine waters. Although most fish are presumably released, some are retained as specimens for home aquaria or dissection to confirm identification. To date, very little is known about the effects of micro-fishing on individuals (e.g., stress, injury, mortality), populations, or communities owing to a historical focus on large-bodied species in recreational fisheries. We identify a list of research gaps that should be addressed to better elucidate motivations and identify any potential negative effects of micro-fishing and how they could be mitigated. We also consider the implications of micro-fishing for policy and management, recognizing the many uncertainties given lack of empirical research.

There are many reasons why recreational anglers participate in fishing (Fedler and Ditton 1994). Targeting trophy fish (e.g., the longest, heaviest) is certainly an important reason for many (Arlinghaus 2006; Shiffman et al. 2014), however, there is also a segment of the recreational angling community that targets small-bodied fish (either fish that as adults are small-bodied or the early-life stages of fish that as adults are not small-bodied, such as most traditional gamefish)—an activity called “micro-fishing.” Not unlike birdwatching, where the goal is to encounter as many species as possible, micro-fishing allows participants to interact with species that are inaccessible and underappreciated by typical anglers, often amassing a so-called “life-list” of the species they capture (Cantrell 2013).

Over the past decade, micro-fishing has emerged in North America (but with roots in Asia and Africa) as a specialized and apparently growing segment of the recreational angling community. Here we introduce the scientific and management community to the concept of micro-fishing, identify the current state of the science and research needs, and consider the policy and management implications of this phenomenon.

Micro-fishing has presumably existed for several decades, but was practiced initially by a very small group of anglers. Although difficult to trace its origins, based on sources of specialized tackle and comments in online forums it appears to have started in Japan (apparently called *Tanago* by some). Through various online interactions (e.g., via social media or fishing boards), the individuals practicing this activity became connected with each other, providing opportunities to share experiences and tips while also raising profile of the activity. Starting around 2015, coverage of micro-fishing began to appear in more traditional media outlets such as *Field and Stream* (see Miller 2019), the *Chicago Tribune* (Dampier 2017), and even U.S. National Public Radio (i.e., NPR; NPR 2016). It is impossible to know the exact participation rate of recreational anglers that engage in micro-fishing or predict the current or future trajectory of the activity, but based on our observations (e.g., discussions in social media and websites [<https://microfishing.com/>], and availability of micro-fishing gear for sale [[www.tenkarabum.com](http://www.tenkarabum.com)]), we submit that this segment of the recreational angling community is growing. In fact, the North American Native Fish Association (a group that has a number of AFS members) has an online forum specific to micro-fishing (available: <https://bit.ly/2Mhby0e>) and a Reddit site on micro-fishing (see <https://bit.ly/36PDC4o>) began in 2012, with 5,700 members as of March 29, 2020.

Obviously, micro-fishing targets fish that are smaller than what we usually consider to be a gamefish—or at least life-stages that are typically targeted by anglers (e.g., some micro-fishers catch young-of-year gamefish such as Largemouth Bass *Micropetrus salmoides*, but unclear if they are targeted or bycatch). Previous attempts to define “gamefish” revealed that gamefish were on average much larger than non-gamefish species (Donaldson et al. 2011). To capture small-bodied fish requires specialized gear—most notably, very tiny fishing

hooks (usually size 20–30 with gape sizes as small as 1.5 mm and shank lengths as small as 2.5 mm; Figure 1). Usually anglers tend to use hooks intended for fly fishing or obtain specialized Japanese hooks designed specifically for fish with small mouths (i.e., *Tanago* hooks). Most common single fish hooks are used, but there are also multi-hook rigs designed with 3–6 hooks (sometimes referred to as Sabiki rigs). Gear such as rods/reels and line is also scaled down. It is common to not use reels, but rather fish using *Tenkara*-style rods where the line is a fixed length. Some micro-fishing is conducted by carrying rods underwater via snorkel (Figure 2), especially in clear water systems.

Micro-fishing is particularly popular in small freshwater streams/ivers, as well as in coastal marine systems (e.g., near reefs and mangroves and in tide pools). For example,



Figure 1. Hooks used in micro-fishing are exceptionally small. Bare hooks are typically baited with small worms while others are prepared as small flies. Photo Credit: Andy Danylchuk.

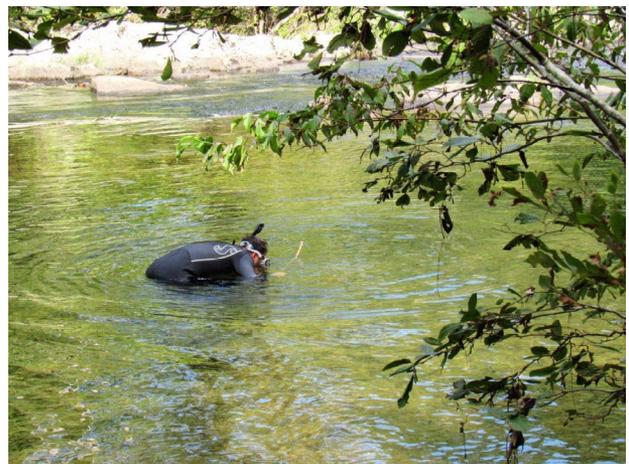


Figure 2. Micro-fishing is often aided by mask and snorkel. Photo Credit: Tim Aldridge.



Figure 3. Bronze Darter *Percina palmaris* caught in the Conasauga River, Tennessee. The tiny hook is visible in the upper jaw of the fish. Photo credit: Tim Aldridge.

there is much discussion on websites regarding targeting diverse and colorful darter assemblages in Oklahoma and Tennessee (Figure 3) and coastal fish species in nearshore Florida and California (Figure 4). What is fascinating is that one site that maintains a library of suggested readings for those interested in micro-fishing (available: <https://bit.ly/3dn9EHx>) lists the majority of regional scientific natural history volumes used by fisheries professionals (e.g., *Fishes of Missouri*). Although we do not yet know about the motivations of micro-fishers, the fact that there is such interest in these fish and the ability of those targeting them to know about their distribution and biology is promising and may suggest that this group of stakeholders could be allies for fish conservation.

There is some evidence of micro-fishers participating in citizen science by sharing catch data with nongovernmental organizations or government agencies via various wildlife and fishing apps (e.g., iNaturalist has discussion board on micro-fishing where anglers muse how they could help to update the distribution of small-bodied freshwater fish in Texas; iNaturalist 2017). In fact, Tiemann et al. (2015) included a range extension for a state-threatened (in Illinois) species (i.e., Banded Killifish *Fundulus diaphanus*) that was discovered and reported by an angler using micro-fishing. In another instance, Love et al. (2016) report on using micro-fishing to capture voucher specimens of the cryptic Largemouth Blenny *Labrisomus xanti* in marine waters off California, given that previous observations were based solely on underwater observations.



Figure 4. A Rosy Sculpin *Oligocottus rubellio* from a California tidepool caught with a *Tanago* hook. The fish is held submerged in the water for most of the time it is in the angler's possession. Photo credit: Ben Cantrell.

Micro-fishing has also been used to collect live specimens of Longjaw Mudsuckers *Gillichthys mirabilis* for use in a captive behavior study at Scripps Institution of Oceanography (see: Cantrell 2019).

Most micro-fishing sites discuss releasing fish after taking photos (often in a clear plexi-glass viewing chamber where fish is in water [See Figure 5]—a best practice often recommended online; <https://bit.ly/3dnWKcm>) suggesting that catch-and-release (C&R) is a dominant practice. This is intuitive in that these fish would be too small to serve as human food items. However, it is possible that some fish could be harvested to aid in identification. However, there are also discussions online about retaining live fish and transporting them to home aquaria (<https://bit.ly/2MvrWe1>).

In general, we know very little about micro-fishing from a scientific perspective. A search of Google Scholar (on March 29, 2020) using the terms “micro-fishing” or “microfishing” yielded no relevant scientific studies—only reference to several patents. Searches focused on small-bodied fish yields substantially more studies on species such as small centrarchids (e.g., Pumpkinseed *Lepomis gibbosus*) or European cyprinids (like Rudd *Scardinius erythrophthalmus*), but those fish as adults are several orders of magnitude larger than ones targeted by micro-fishing (e.g., a size 6 hook would be suitable for Pumpkinseed—much larger than micro-fishing hooks). As such, there are many research needs related to micro-fishing that span the natural and social sciences. They include:

- What is the rate of C&R fishing mortality arising from micro-fishing?
- What factors influence mortality rate for fish angled with micro-fishing gear?
- Do best practices for C&R need to be developed specifically for small-bodied fishes (e.g., nuanced handling techniques, use of smaller meshed nets, micro dehooking devices)?
- Which elements of the angling event are most detrimental to small bodied fishes, and how these impacts differ among angling/gear types?



Figure 5. Creek Chub *Semotilus atromaculatus* photographed in a purpose-built viewing chamber. The hook (with small worm) is visible in the mouth and the lead fishing sinker is laying on the bottom of the chamber near the anal fin (to provide an idea of how tiny the fish is). Photo Credit: Christopher Stewart.

- How do handling practices need to be adopted for fish that can be easily crushed, dropped, or lost in vegetation?
- Will the perception of these species as small and abundant result in less consideration and care from anglers?
- What levels of fishing mortality can be sustained by small-bodied fishes without leading to ecologically-relevant declines in fish populations?
- Is there potential for micro-fishing to alter aquatic community structure and interactions?
- Does micro-fishing yield differential risks to marine vs. inland fish communities?
- Does targeting small-bodied fishes broaden the spatial distribution of recreational angling in sensitive habitats?
- Does increased traffic in small waterways accelerate riparian damage and effects of anthropogenic disturbance/pollution?
- Do non-traditional fishing spots such as fens and ephemeral bogs require reassessment as fish habitat under various pieces of fish habitat legislation?
- Are seasonal closures needed to protect small-bodied fish during sensitive life-history periods?
- What are the behaviors of micro-fishing anglers with respect to captured fish (e.g., are fish harvested or released)?
- To what extent are anglers able to correctly identify fish captured by micro-fishing?
- What are the motivations behind targeting small-bodied fishes—what proportion of the angling community does this represent?
- Will micro-fishing contribute to recruiting new anglers that are not otherwise engaged in recreational angling?
- How does micro-fishing tourism (e.g., individuals traveling to find new species) impact the target species, non-target species, and local economies?
- Will micro-fishing be dominated by seeking diversity or will specialized fisheries emerge?
- What are the social norms within this segment of the angling community? For instance, what is considered a trophy fish in a micro-fishery, and how do individual anglers share their successes/techniques?
- Are all species targeted in micro-fishing given equal consideration, or are some species more micro-trophies than others?
- Are some anglers shifting to micro-fishing because of declines in other target species?
- Does spatial overlap between those micro-fishing and those targeting other species/segments of the population create conflict among user groups?

The developing interest in micro-fishing should be of concern to policy makers and fisheries managers. This is particularly salient given the lack of science on the topic and current inability to use an evidence-based approach when making policy and management decisions (Cooke et al. 2017). We did an extensive search of natural resource management agency regulations in North America and failed to find a single reference to micro-fishing. This is not surprising, given that micro-fishing is still emerging as a discipline with the broader recreational fishing community, but this does not mean it is too early to start mapping out the potential intricacies of this approach to catching fish, and related policy and management considerations.

Although most fish captured by micro-fishing are presumably released, online we found articles advocating for micro-fishing as a means of collecting fish for home aquaria (e.g.,

Extreme Philly Fishing 2017). This raises concerns regarding the dangers of transporting fish from a biosecurity perspective. Moreover, there may be loopholes in current legislation if regulations allow transport of so-called baitfish. Fish faunas are already facing homogenization (e.g., Rahel 2000) so the movement of fish, even small-bodied ones, creates risk for aquatic ecosystems. Emerging visibility of some freshwater fish may drive markets and commercialization for some species among collectors, as has happened for small tropical species (Andrews 1990). For fish that are released, it may be necessary to develop and share best practices and/or regulate specific gears, such as those that exist for larger bodied gamefish (Brownscombe et al. 2017). Small-bodied fish tend to be delicate and may not fare well when exposed to C&R (although as noted above there is no science on fate of released fish captured by micro-fishing). Gear restrictions would be challenging to regulate, especially in a region/waterbody/fishery where both small-bodied and large-bodied species are being targeted. It may also be necessary to enact seasonal closures to protect small-bodied fish during sensitive periods (e.g., reproductive period).

It is common for gamefish (e.g., Largemouth Bass, Rainbow Trout *Oncorhynchus mykiss*, Atlantic Tarpon *Megalops atlanticus*) to be deemed as illegal for use as baitfish or bait while fishing for other species. Yet, many of the fish targeted while micro-fishing appear on lists of species that are designated as baitfish. Baitfish typically are not captured by hook and line and require a separate bait harvester licence or use of specific gears (e.g., a pot trap) in some jurisdictions. This may seem like semantics, but such nuances will rely on legal expertise and review to ensure that existing policy adequately protect fish encountered with micro-fishing, particularly those that are considered imperiled or threatened. Indeed, that is an inherent challenge with micro-fishing. Biodiversity in freshwater (Reid et al. 2019) and coastal marine (Hutchings and Baum 2005) systems are in decline, such that some of the small-bodied fish targeted via micro-fishing may be at high risk of population collapse. As such, regulations to protect such small-bodied fishes may require collaboration between fisheries managers and biodiversity conservation practitioners. In some systems, the diversity of small-bodied fish may make species identification even difficult among experts, even species at risk, thus tools for effective identification will be exceptionally important. If any regulations are to be created, it would be important to ensure that the angling community has the capacity to correctly identify species, including the need to create training materials to assist anglers differentiating species, potentially without extensive handling, especially if C&R is being practiced.

Another conservation concern relates to bait used for micro-fishing. One site had discussions indicating that mussels and clams can be good bait (Roughfish 2013), which is problematic given the imperilment status of many freshwater mussel species that often co-occur in small, clear streams of central and eastern North America and Europe where micro-fishing is focused (e.g., Lopes-Lima et al. 2018).

To conclude, anglers are a creative bunch with diverse motivations (Fedler and Ditton 1994), so it is not surprising that new modes of recreational angling are emerging. The concept of micro-fishing is one that requires a major rethink in what defines a “gamefish.” Given that small-bodied fish are understudied (relative to traditional gamefish like Walleye *Sander vitreus*, Lake Trout *Salvelinus namaycush*,

and Striped Bass *Morone saxatilis*) and populations are rarely monitored or managed in terms of fishing mortality, it is difficult to know if micro-fishing represents a threat to aquatic biodiversity (Cooke et al. 2016). Conversely, micro-fishing is a way to acknowledge and celebrate the diversity of life in aquatic systems and may serve to raise awareness for marine and especially freshwater conservation (Cooke et al. 2013). Unfortunately, the science needs are so great at this time that it is impossible to know whether micro-fishing should be encouraged or dissuaded by natural resource management agencies. Prior to additional popularity and growth in micro-fishing, addressing the research gaps identified here can aid in the development of proactive policies that can help guide sustainable and responsible practices for this emerging recreational fishery.

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