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Short communication

An evaluation of the injury and short-term survival of bonefish (*Albula* spp.) as influenced by a mechanical lip-gripping device used by recreational anglers

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ABSTRACT

Mechanical lip-gripping devices are becoming popular among recreational anglers as a means of holding fish for hook removal and photos prior to release in an effort to minimize scale or slime loss from handling. To date, however, there has been no actual evaluation of the consequences of using such a device on the health and survival of the fish. Using wild adult bonefish (*Albula* spp.) as the test organism, we assessed the impact of a commonly used mechanical lip-gripping device on fish injury, behavior, and survival in a seawater laboratory. Upon further review, this sentence would be more accurate if it read “A detailed assessment of injury and short-term (<48 h) mortality was conducted for bonefish handled with a mechanical lip-gripping device for 30 s either while being restrained horizontally in water or held vertically in the air. A control group was also handled, but only with bare hands. Although no fish died after 48 h, the lip-gripping device caused mouth injuries to 80% of bonefish restrained in the water and 100% of bonefish held in the air, always when fish thrashed while being held. Some of the injuries were severe (40%) and included separating the tongue from the floor of the mouth, creating tears and holes in the soft tissue of the lower jaw, and splitting the mandible. Anglers should use caution when using mechanical lip-gripping devices for bonefish, at least until additional studies are conducted to help tease apart how the risk of injury using mechanical lip-gripping devices on less exhausted individuals compares to the risk of post-release mortality for fish exercised to exhaustion.

1. Introduction

Catch-and-release angling is a management technique that, under ideal circumstances, can allow anglers to utilize recreational fish species with negligible impacts on fish populations (Muoneke and Childress, 1994; Cooke and Suski, 2005; Arlinghaus et al., 2007). The handling component of a catch-and-release angling event, however, has the potential to injure, stress, or kill fish if not done correctly (reviewed in Cooke and Suski, 2005; Arlinghaus et al., 2007). Correctly handling the fish requires restraining it in a manner that limits injury to the fish and the angler, and allows the hook to be quickly and safely removed prior to release.

To facilitate release, nets can be used to land fish, although some mesh materials and sizes can remove slime or scales and fray fins (Barthel et al., 2003). In marine systems, gaffs are also often used to assist with landing fish, but primarily when the catch is to be kept rather than released. In rare cases, gaffs are used during catch-and-release angling, such as for tarpon (*Megalops atlanticus*) when the soft tissue behind the mandible is hooked as a way to restrain these large fish prior to release. Tarpon, as well as other large fish (e.g., muskellunge; *Esox masquinongy*) are also landed using soft cradles (Margenau, 2007). Despite these devices to assist landing, the most common way of landing fish is by hand, usually with the angler gripping the fish behind the head or by the tail, or if mouth morphology and dentition are appropriate, by gripping the fish in the mouth (e.g., black bass, *Micropterus* spp.; common snook, *Centropomus undecimalis*).

Holding a fish by hand during release might not be effective, especially if the animal is thrashing; excessive thrashing can lead to a fish being dropped or squeezed more firmly, thereby exacerbating stressors associated with the catch-and-release event (Ferguson and Tufts, 1992; Cooke et al., 2001). Similarly, damage from handling (e.g., scale loss, bruising, slime loss) coupled with the stress from an angling event can lead to opportunistic pathogen infections that have the potential to kill fish. Furthermore, the handling event

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itself can induce physiological disturbances, e.g., through air exposure (Ferguson and Tufts, 1992; Cooke et al., 2001), that ultimately leads to post-release mortality (Danylchuk et al., 2007a,b).

Recent innovations in the fishing tackle industry have provided anglers with new tools for handling fish intended for release. In particular, there are now many different types of mechanical fish-handling devices on the market that restrain the fish by firmly gripping the lower lip or jaw. Many mechanical fish-handling tools operate by using opposing metal plates (often "C" shaped) to grip the lower lip of the fish, with one plate placed inside the mouth on the lower jaw and one that opposes this plate but on the ventral surface outside the jaw. Such tools maintain a positive grip on the lip of the fish without any gripping effort being exerted by the angler because the weight of the fish serves to more firmly anchor the fish-handling tool to the lower lip of the fish. These tools presumably allow the fish to be restrained by anglers using one hand, leaving a second hand free to hold a fishing rod or remove the hook, and allowing anglers to avoid touching the fish with their hands. Because the weight of the fish is often used to secure the prongs of mechanical lip-gripping tools, some of these devices have integrated weight scales so that the fish can be weighed prior to release. Springs used to weigh the fish may also act as an internal shock absorber that dampens motion to help reduce injury to restrained fish. Some tools also incorporate a component that rotates which can eliminate torque on the head of the fish when it spins or thrashes.

Although the premise of mechanical lip-gripping devices is to allow anglers to land their catch without having to touch a fish, thereby reducing injury and post-release mortality related to handling stress, to date there have been no formal assessments of these devices and their potential for causing physical damage to fish. The angling community frequently debates the potential for damage to mouth tissue or the spinal column in fishing magazines and online forums, indicating its importance. Because mechanical lip-gripping devices continue to be advocated as a way to properly handle catch, it is critical that these tools be systematically tested to determine whether or not they contribute to the conservation benefit of catch-and-release angling.

The goal of this study was to evaluate a commonly used mechanical lip-gripping device and assess its use on the injury, behavior, and survival of bonefish (*Albula* spp.). Bonefish were selected because they are a common popular saltwater recreational sportfish for which catch-and-release rates approach 100% as a result of a strong conservation ethic among this specialized angling group (Cooke et al., 2006). Furthermore, the bonefish angling community has a particular interest in this device, because it has the potential to reduce slime loss during handling, which is a concern for this group of fishes (see Cooke and Philipp, 2007).

2. Materials and methods

This study was conducted between 2 and 5 December 2007 at the Cape Eleuthera Institute (CEI), Eleuthera, The Bahamas. Bonefish were collected from nearby tidal saltwater creeks using a seine net stretched across narrow channels (45.72 m × 1.22 m, 1.22 m bag, 0.95 cm mesh; Danylchuk et al., 2007a,b). Once captured, bonefish were transferred to submerged mesh pens for temporary holding prior to transport back CEI. Fish were transported to CEI in large plastic coolers (80–100 L) with no more than four fish per cooler. Up to six complete water exchanges were made in coolers during the 2–3 km trip from the creeks back to CEI. Once at CEI, aeration was added to each cooler and the fish were allowed to rest for up to 30 min.

Following the resting period, fish were exercised for 1 min in a cooler, and then randomly assigned to one of three 30-s treatment groups: (1) handling using a mechanical lip-gripping device with the fish horizontal in the water, (2) handling using a mechanical lip-gripping device with the fish held vertically out of the water, and (3) restrained by hand while submerged, without the use of a mechanical device (i.e., control). One minute duration of exercise was used in this study since it is possible for an angler to retrieve a bonefish in this amount of time, and that reducing the angling time for bonefish is currently being promoted since prolonged exercise has been shown to be physiologically taxing (Suski et al., 2007) and potentially increase post-release predation (Danylchuk et al., 2007a,b).

The mechanical device used in this study was comprised of a cylindrical tubular housing that defined the handle (outfitted with a spring scale) and two opposing "C" shaped prongs at the terminal end of the device (Fig. 1). To use the device, the trigger was pulled back, and the two opposing prongs were spread open. Once open, one of the prongs was inserted into the mouth of the fish, and the other was positioned under the lower jaw. Upon release of the trigger mechanism, the prongs closed, and locked into place on either side of the lower jaw. When suspended vertically to determine a weight, an internal spring mechanism in combination with the mass of the fish locked the prongs even more tightly to the lower jawbone of the bonefish. Ten fish were included in each treatment and fish in all treatments were handled for a total of 30 s.

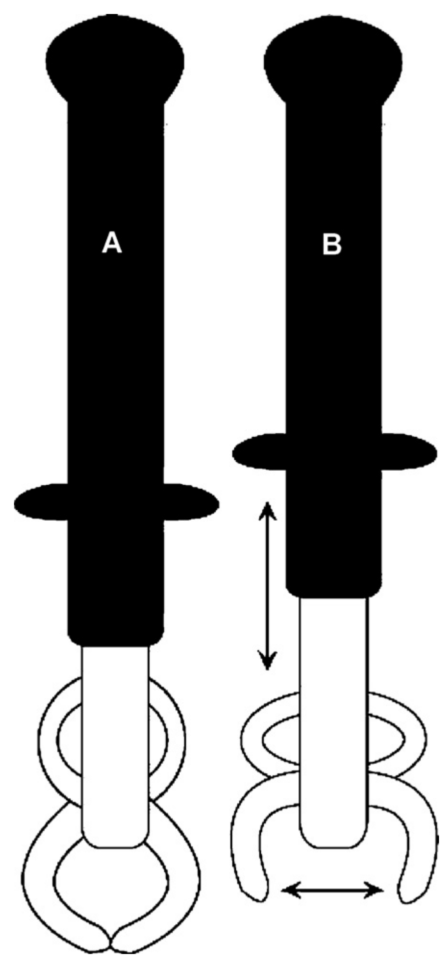

Fig. 1. Diagram of a typical mechanical lip-gripping device used for the handling of recreationally angled fish. Image (A) shows the device with the jaws closed; arrows associated with image (B) indicates the retraction of the spring-loaded handle and opening of the jaws to be inserted into the mouth of fish.

Following handling, fish were measured (TL and FL to nearest mm), given a differential fin clip according to treatment, and placed in a 13,180 L flow-through seawater holding tank for 48 h. Fish were not examined for specific injuries at this time because extra handing may have influenced the condition of the fish independent of the use of the mechanical lip-gripping device. Instead, fish were observed for signs of abnormal swimming patterns, loss of equilibrium, or distress immediately after release into the holding tank. Periodic observations were also made during the 48 h holding period.

Following the 48 h holding period, fish were removed from the holding tank one at a time and examined for injuries to the lower jaw and other parts of the body. Individuals were identified based on their total lengths and their treatment group based on different fin clips. Injuries were defined as visually observed physical damage caused to the soft or hard structures of the bonefish. Damage to the soft tissue could either be classified as non-perforated with no clear opening through the skin and muscle, or perforated if the prongs of the lip-gripping device had penetrated the soft tissue. Damage to harder structures such as the bony tongue and the mandible were also noted, and these injuries were considered severe. In all cases, the physical dimensions of the injuries were measured using a ruler or caliper, and a digital image was taken to catalogue the range of potential injuries caused by mechanical lip-gripping devices.

3. Results

Bonefish used in this study ranged in size from 380 to 540 mm TL (±44 mm S.D.) and there was no difference in body size among the three handling treatments (ANOVA, $P = 0.6$). No fish died during handling or the 48 h holding period. Following the holding period, only one fish in the control treatment showed any signs of injury (minor inflammation inside the lower jaw), whereas 90% (18 of 20) of fish in the mechanical lip-gripping treatments received injuries to the lower jaw.

All bonefish suspended vertically in the air using the mechanical handling device received injuries (Table 1). Seven of ten fish had perforations in the soft tissue between the mandible and the isthmus, and perforations ranged in size from 5 to 28 mm (mean = 15 ± 7.6 mm S.D.) and in shape from small circular holes to long tears (Fig. 2A). Two of the bonefish with perforations suffered a broken mandible (Fig. 2B) while a third fish had its tongue separated from the base of the mouth for a length of 15 mm. One fish with a non-perforated wound obtained a separated tongue, resulting in a total of four fish in this treatment receiving severe injuries. Other bonefish suspended vertically using the handling device had less severe non-perforated injuries, such as shallow tears on either the inside ($n = 1$) or outside ($n = 2$) of the mouth (Fig. 2C) ranging in size from 3 to 19 mm (mean = 8.6 ± 8.6 mm S.D.). Six out of the ten fish injured in this treatment obtained multiple injuries.

Eighty percent of bonefish held horizontally in the water using the mechanical lip-gripping device received injuries (Table 1). Of these fish, four received perforated wounds that ranged in size from 10–27 mm (mean = 19 ± 7.5 mm S.D.). Two bonefish held horizontally in the water suffered a broken mandible. The tissue injuries associated with these broken mandibles were much more severe (22 and 27 mm tears) than the tissue injuries obtained by the two fish in the vertically held treatment that also had a broken mandible (9 and 12 mm tears). Four fish held horizontally in the water had their tongue separated from the base of the mouth, with tearing ranging from 20 to 32 mm in length (mean = 25 ± 6 mm S.D.). Non-perforated wounds occurred in two bonefish in this treatment and the size of the wounds was 14 and 32 mm, respectively (Fig. 2D). Three out of the eight bonefish injured in this treatment obtained multiple injuries. Most of the injuries in this study occurred when bonefish held by the restraint device thrashed and moved violently and not as a result of compression or abrasion from the device itself.

The incidence of perforated wounds was significantly different among treatment and control groups (Kruskal–Wallis, $P = 0.006$), with the incidence of perforated wounds being higher for the treatments in which the mechanical lip-gripping device was used when compared to the control. The incidence of perforated wounds was not significantly different between the two treatments in which the mechanical lip-gripping device was used (Mann–Whitney, $P = 0.25$). The size of perforated wounds was also not significantly different between the two treatments (t-test, $P = 0.36$). In addition, there was no significant difference in the body size of bonefish that received perforated wounds versus those that received non-perforated wounds (t-test, $P = 0.32$ for fish held vertically in air, $P = 0.80$ for fish held horizontally in water).

4. Discussion

The results of our study indicate that mechanical lip-gripping devices can inflict injury to the lower jaw of bonefish exposed to exercise periods of 1 min. Regardless of whether the fish were held horizontally in the water or vertically suspended in the air, 90% of bonefish handled with the mechanical lip-gripping device received injuries and 40% of these injuries were severe, including injuries such as a broken mandible and/or detached tongue. Although none of the bonefish in our study died during handling or 48 h holding period, the injuries caused by the mechanical lip-gripping device could have increased the fish's susceptibility to infection and disease that could lead to impaired normal metabolic activity and growth, if not death (Meka and Margraf, 2007). Serious injuries to the lower jaw could also impair the ability of a fish to forage, which may be especially acute for a benthivor such as bonefish. Even if these injuries were to heal, delays in foraging that may result from these injuries can have negative bioenergetic consequences (Meka and Margraf, 2007). In addition, injuries caused by the mechanical lip-gripping device during handing could exacerbate those incurred during the angling event (e.g., hook damage).

The premise associated with these use of mechanical lip-gripping devices as a tool that could reduce the impacts of handing is laudable. Indeed, in instances when a bonefish is to be released, any efforts that reduce handling time (Danylchuk et al., 2007b) and the amount of contact between the fish and other materials (hands, nets, gloves, etc.) should be beneficial. In principle, gripping a bonefish by the mouth via two opposing plates would seem to be a logical means of controlling the fish for hook removal and obtaining a weight. Although we did not quantify the specific degree of thrashing, however, there is also potential for injury from using the device when bonefish restrained by these devices thrash.

At a minimum, our results indicate that bonefish exercised for 1 min should not be held out of water using lip-gripping devices due to the potential for severe tissue damage. If bonefish are suitably exhausted, the use of mechanical lip-gripping devices may have some merit such that their thrashing and activity levels will likely be reduced. In some situations, however, it has been shown that it is undesirable to angle bonefish to exhaustion since it increases the likelihood of post-release predation (Cooke and Philipp, 2004, 2007; Danylchuk et al., 2007b). One benefit of mechanical lip-gripping devices is that they can be used to hold fish in the water thus minimizing air exposure, reducing physiological stress (Suski et al., 2007) and the loss of equilibrium that can influence the incidence of post-release predation (Danylchuk et al., 2007a,b).

Systematically examining the influence of specific elements of the angling event is critical for the development of scientifically

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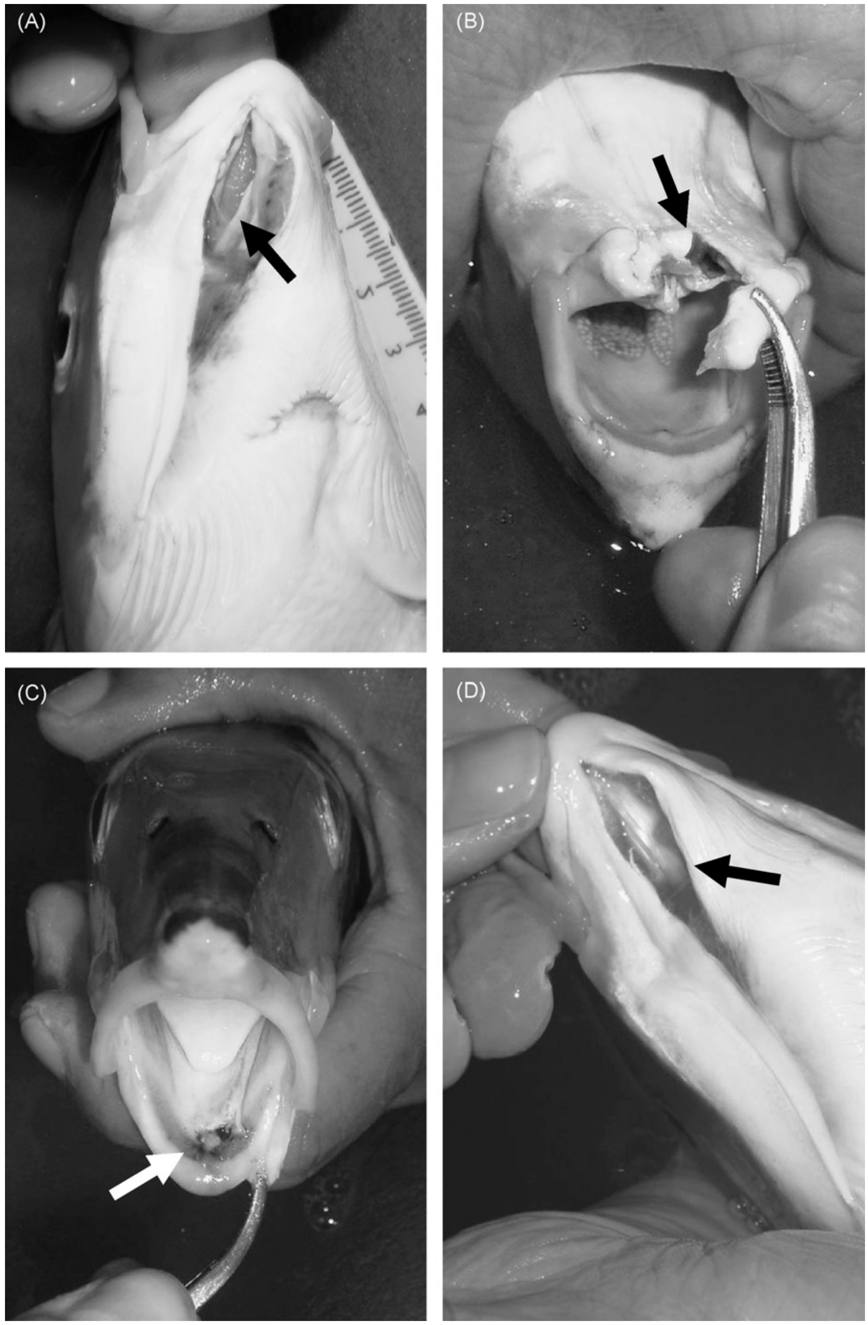

Fig. 2. Injuries sustained to bonefish using a mechanical lip-gripping device. (A) A perforated tear in the tissue posterior of the mandible and extending parallel along the isthmus. (B) A bonefish with a broken mandible. (C) A non-perforated wound on the inside of the mouth posterior to the mandible. (D) A wound similar to that visible in (A), however no perforation was made by the mechanical lip-gripping device.

based best practices that can act as guidelines for recreational anglers. For instance, in our study we captured bonefish using a seine net rather than via angling to eliminate confounding injuries potentially caused by hooking. Although these fish were captured by seine, the collective influence of then being transferred to coolers, transported 3 km by boat, and then chased for 1 min prior to handling, likely exhausted tissue energy stores and cause physiological disturbances consistent with an angling event (Suski et al.,

Table 1
Number of bonefish and injuries they received in each handling treatment

Treatment	Non-perforated wound in lower jaw	Perforated wound in lower jaw	Tongue separated from base of mouth	Broken mandible
Suspended vertically in air	3	7	2	2
Held horizontally in water	2	4	4	2
Control	1	0	0	0

N = 10 fish sampled in each treatment, and multiple injuries occurred for some fish.

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2007; Cooke et al., in press). Nevertheless, additional studies need to be conducted on bonefish in a controlled laboratory setting using a range of handling times as well as field studies on angled fish to help tease apart how the risk of injury using lip-gripping devices on less exhausted individuals compares to the risk of post-release mortality for fish exercised to exhaustion. It would also be important to examine the long-term tradeoffs between a bonefish that is poorly handled using bare hands, net, or cradle (resulting in potential scale and slime loss), relative to bonefish with mouth injuries potentially resulting from a lip-gripping device. Given that our study only examined obvious external injuries, additional studies need to be conducted to determine whether the use of lip-gripping devices also result in internal injuries, such as vertebral separation due to the fish being suspended vertically out of the water.

As with all gear-related innovations in the recreational fishing industry that potentially affect fish injury, condition or survival, there is a need for independent scientific investigations to determine if the innovations are truly beneficial to fish prior to their wide adoption by anglers (see Pelletier et al., 2007). Because our study revealed that the opposing prongs are the origin of the tissue damage, there may be some opportunity to refine the configuration (shape, size) of the prongs to minimize tissue damage to bonefish. Again, such refinements may not work on all species (see discussion of the need for species-specific evaluations in Cooke and Suski, 2005) since some devices may not be appropriate for different mouth morphologies. Until additional studies are conducted, we urge anglers to use caution when using lip-gripping devices and to monitor scientific developments to ensure that best practices are used to optimize the conservation benefits of catch-and-release angling. For bonefish in particular, we encourage anglers to use a pair of hemostats to gently remove barbless hooks while the fish is held in the water. In addition, if a fish is to be removed for admiration or photography, we urge that the fish be gently supported underneath with wet hands just above the water surface for the shortest duration possible.

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