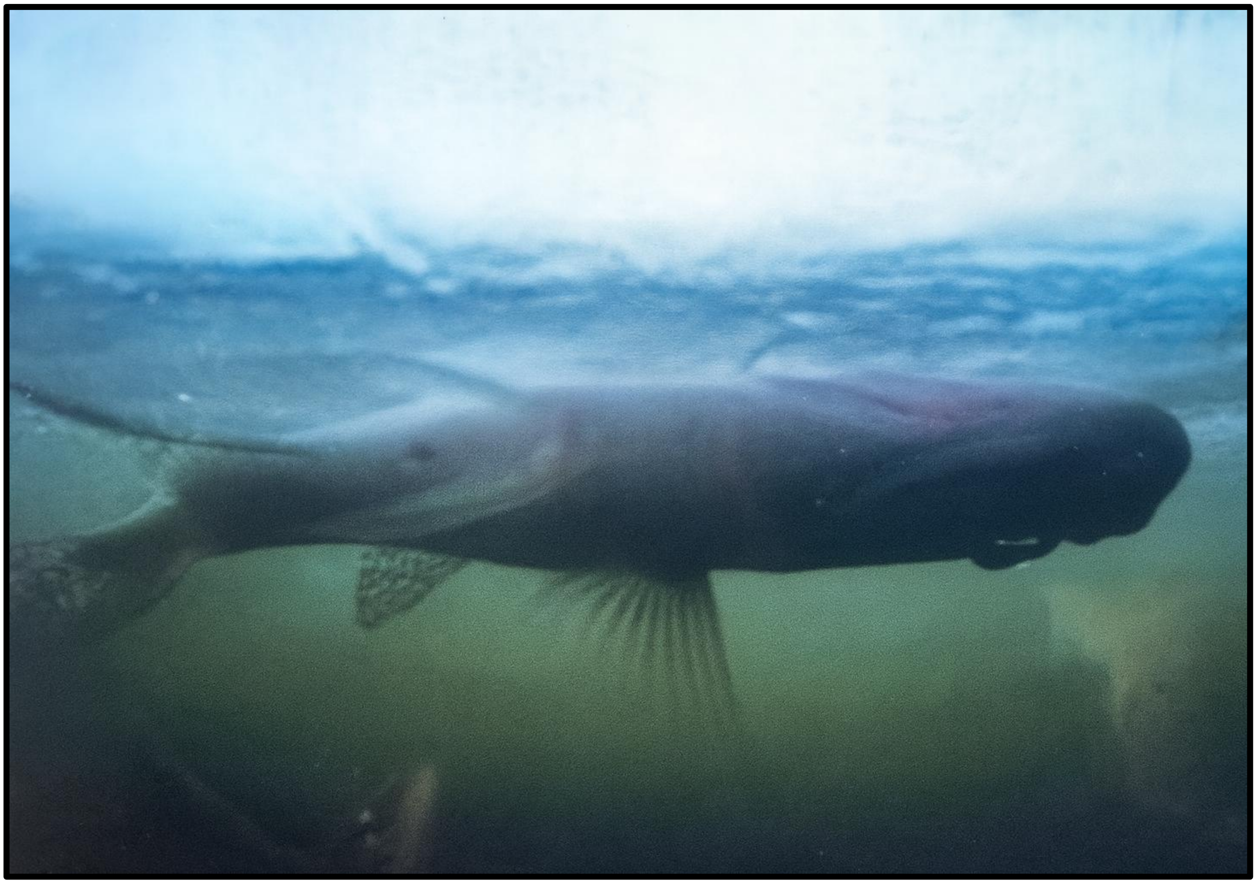
Assessing the effects of capture depth, handling time, and descending devices on barotrauma and release success of ice-angled Black Crappie



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Executive Summary

Black Crappie (*Pomoxis nigromaculatus*) are abundant in Manitoba's Eastern Region and are often targeted by ice anglers practicing catch-and-release. Anglers have reported seeing barotrauma injuries—such as hemorrhaging, bulging eyes, and stomach eversion—in Black Crappie caught in deep basins (e.g., 25–35 ft). However, the extent that barotrauma occurs at these depths and the effect that it has on release success and survival is not well understood.

In this study, Black Crappie were ice-angled at depths of 12 ft (3.5 m), 21 ft (6.5 m), 26 ft (8 m), and 31 ft (9.5 m) to assess the frequency and severity of barotrauma as well as release success (i.e., returning to depth and showing positive recovery behaviour). Black Crappie were assessed for barotrauma symptoms and subjected to either a *high handling* treatment (60–90 seconds, including a submerged orientation test) or a *low handling* treatment (≤ 30 seconds). Black Crappie were then released on a tethering system, which kept fish near the release hole so they could be monitored in real time. Fish descent was tracked using forward-facing sonar, and post-release recovery behaviour was observed using an underwater camera. A 26 ft *untethered* control group was used to measure the effect that the tethering system had on fish descent and behaviour. Weighted descending devices were also tested to see if they would improve release success for fish experiencing barotrauma.

The frequency and severity of barotrauma symptoms in Black Crappie increased with angling depth, with severe barotrauma injuries first occurring in fish caught at the 26 ft site (mean capture depth = 24.7 ft/7.5 m). Fewer fish were able to swim back to their capture depth as angling depth increased. Of these, about one-third of the fish at the 26 ft and 31 ft sites (high handling and low handling) were later observed lying sideways and unresponsive on bottom or floating back to the surface. Release success improved with reduced handling time, but failed releases were still common at the 26 ft and 31 ft sites. Weighted descending devices also improved release success, yet over a quarter of descended fish were still observed lying on bottom or floating back to the surface. The tethering system did not affect the rate at which fish returned to depth compared to the untethered control (26 ft) but did increase descent times, and thus results should be viewed as an overall trend rather than exact post-release estimates.

We recommend that catch-and-release anglers avoid targeting Black Crappie inhabiting depths of ~25 ft (8 m) or greater and keep fish that are exhibiting severe barotrauma injuries when possible. Anglers should also limit handling times—regardless of angling depth—to minimize stress and energy loss and maximize the odds of a successful release. By following these best practices, catch-and-release anglers will greatly improve release success and minimize mortality risk when ice fishing for Black Crappie.

Introduction

Black Crappie in the Eastern Region

The Black Crappie (*Pomoxis nigromaculatus*) is a prized sportfish in Manitoba known for its year-round accessibility and quality as a food fish. Black Crappie are especially popular to target in the winter when they can be found congregating in the deep basins of lakes and rivers. Several systems in the Eastern Region are trophy Black Crappie destinations, and catches exceeding 38 cm (15 in) are not uncommon. As catch-and-release (C&R) angling continues to grow in popularity, there is potential for more and larger fish to be caught. However, C&R angling is most effective as a conservation tool when survival rates are high. As Black Crappie are often targeted in deep basins, anglers should be aware of the existence of barotrauma and the risks it can pose to fish caught in deep water.

What is barotrauma?

Barotrauma describes the many injuries fish may experience when subjected to a sudden change in water pressure. As fish are pulled from deep water (high pressure) towards the surface (low pressure), gases in their blood, body tissues and swim bladder expand. If fish are unable to relieve this pressure, it can cause injuries such as bulging eyes, damage to nerves and organs, and internal bleeding. The swim bladder—a gas-filled organ that helps fish regulate buoyancy—can also overexpand to the point of rupture or displace the fish's stomach out of its mouth. Some fishes, such as catfish and trout, can release excess gases in their swim bladder through a duct connected to their throat. In contrast, sunfishes such as Black Crappie can only release these gases using blood vessels lining their swim bladder, a process which can take several hours (Jones 1952; Stewart and Hughes 2014). Although swim bladder overexpansion and other barotrauma symptoms may be relieved if the fish returns to its holding depth, lingering injuries and stress can be crippling or even fatal.

Barotrauma and Black Crappie

Prior research suggests that Black Crappie may show early signs of barotrauma when caught at depths as shallow as 20–23 ft (6–7 m) (Althoff *et al.* 2021). Many lakes in the Eastern Region reach depths of 23 ft (e.g., Caddy Lake, North Cross Lake, White Lake), while others can exceed 30 ft (e.g., Big Whiteshell Lake, Lac du Bonnet Lake, Lee River). Observations by both fisheries staff and the public indicate that barotrauma occurs in some of these waterbodies. However, the extent that barotrauma occurs in Black Crappie caught at these depths and the risk that it poses to their health and survival is not well characterized. To address this knowledge gap, we ice-fished for Black Crappie in depths ranging from 12 ft to 31 ft (approx. 3.5 m to 9.5 m) and assessed them for barotrauma. Fish were then released on a tethering system and monitored with forward-facing sonar and an underwater camera to evaluate post-release movements and recovery behaviour. We also tested several weighted descending devices to evaluate their effectiveness in returning fish to depth and mitigating the effects of barotrauma. Findings from this study will provide a better understanding of how Black Crappie are impacted by barotrauma and at what depths they can be safely and sustainably caught and released.

Methods

Study Design

We ice fished for Black Crappie in March and December of 2023 and January of 2024 in 12 ft, 21 ft, 26 ft, and 31 ft of water (about 3.5 m, 6.5 m, 8 m, and 9.5 m, respectively). We selected waterbodies whose deepest basins (within about a 1 km radius) matched these target depths to ensure that fish did not originate from deeper water. Consequently, Jessica Lake (12 ft site), North Cross Lake (21 ft site), and the Lee River (26 and 31 ft sites) were selected as angling locations. Black Crappie were targeted using tungsten jigs and spoons on light or ultralight ice fishing combos spooled with 4-10 lb test line. Each angler used a personal ice fishing sonar unit and recorded the depth at which fish first appeared on the screen, described hereafter as the 'capture depth'. Fish were reeled to the surface with a steady retrieve (fight time ≤ 30 seconds) and, if caught outside, were immediately delivered to a central tent for processing. All fish were captured using barbless hooks.

Barotrauma Assessment

Fish caught in March of 2023 were assessed for the presence or absence of three barotrauma symptoms: exophthalmia (bulging eyes), stomach eversion, and hemorrhaging around the mouth, gills, and fins (Figure 1). These symptoms were scored for severity the following winter (December and January 2024), where: 1 = mild; 2 = moderate; and 3 = severe (Table 1). In both years, Black Crappie were subjected to either a *high handling* treatment or a *low handling* treatment. Black Crappie in the high handling treatment (60–90 seconds of handling, ≤ 30 seconds of continuous air exposure) were measured for fork and total length, assessed for barotrauma, and submerged upside down in a tub of water as part of an orientation test. Fish that could not reorient within ten seconds of submersion were considered impaired due to barotrauma. Fish that swam aggressively while in the tub were recorded as displaying vigorous behaviour, regardless of their ability to reorient. Black Crappie in the low handling treatment (≤ 30 seconds of handling) were not subjected to the orientation test and were only measured for fork and total length after post-release monitoring.

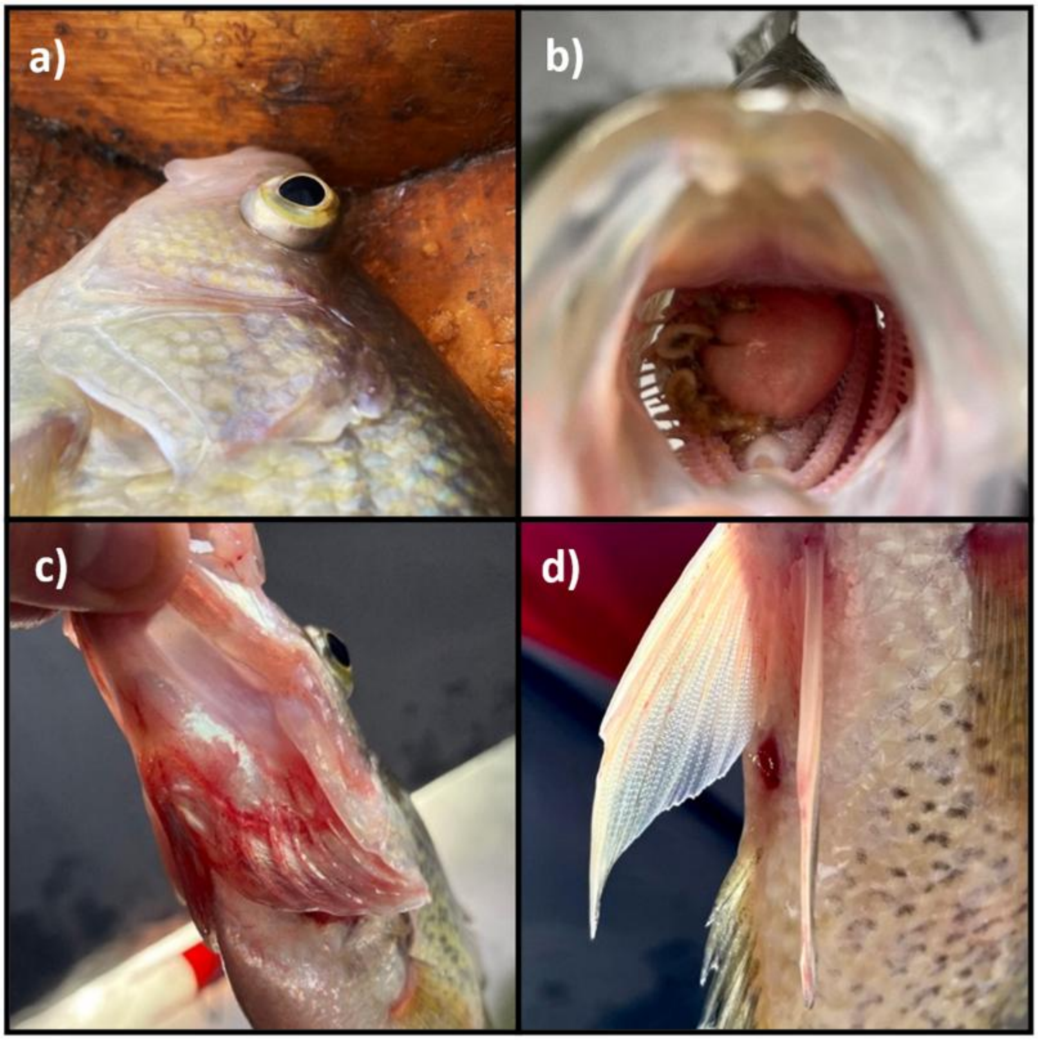

Figure 1. Examples of barotrauma symptoms observed during this study: **a)** exophthalmia (bulging eyes); **b)** stomach eversion; **c)** hemorrhaging around the mouth and gills; and **d)** hemorrhaging of the fins and anus.

Table 1. Scoring criteria for barotrauma severity in Black Crappie caught ice fishing in December 2023 and January 2024, where 0 = absent, 1 = mild, 2 = moderate, and 3 = severe. Note that exophthalmia and stomach eversion are still significant barotrauma injuries regardless of their assigned score.

Symptom	Severity			
	0	**1**	**2**	**3**
Exophthalmia	Normal eye dimensions and movement	Exposed sclera, eye movement is impeded	Protrusion exceeds scleral ring	Protrusion reaches posterior curve of eye
Stomach eversion	Esophagus is clear	Stomach is visible at esophagus entrance	Stomach obscures esophagus entrance	Stomach fills about one-third of buccal cavity
Hemorrhaging	Vessels are not compromised	Contusions around mouth, gills, and fins	Hematomas around mouth, gills, and fins	Severe hematomas around mouth, gills, fins and anus

Post-Release Monitoring

In addition to tracking fish movements after release, we wanted to visually observe the behaviour and health of fish that successfully returned to their capture depth. To achieve this, we created a tethering harness consisting of 50 cm (20 in) of 4 lb test line; a small neutrally buoyant plastic guide to prevent tangling; and a fluorocarbon mainline (80 lb test) anchored to bottom (Figure 2). This design allowed fish swimming at a downwards angle to maintain constant vertical travel while remaining near the release hole, and thus fish could be observed with an underwater camera upon returning to depth. Fish from the high handling and low handling treatments were attached to the tethering harness with a small safety pin attached to the corner of their upper jaw, inspected to ensure that their mouths were free of slush, and released back into the water. Fish descent was monitored with a forward-facing sonar unit (Garmin LiveScope™ system with an LVS32 transducer), and fish that returned to their capture depth were observed with an AquaView HD7i underwater camera. Fish that returned to their capture depth were assigned a recovery outcome of '2' if they were seen actively swimming on the camera; a value of '1' if they were upright and resting; and a value of '0' if they were lying on their side, motionless. As the tether was an additive stressor that affected fish descent, an *untethered* control was included at the 26 ft site to evaluate the effects of the tethering system on fish swimming performance and behaviour. Fish in this control group were released without being attached to the tether and were monitored with forward-facing sonar, but they were not observed with an underwater camera.

Delayed Recovery

To assess the potential for a delayed recovery response, a subsample of Black Crappie from the 26 ft and 31 ft sites that had poor post-release outcomes were held for additional monitoring. Twelve fish that were observed lying on bottom (recovery outcome of 0) after returning to their capture depth were monitored for 30 minutes to see if their condition improved. Likewise, 21 fish that floated beneath the ice after a failed release were given an additional 30 minutes to recover and return to depth.

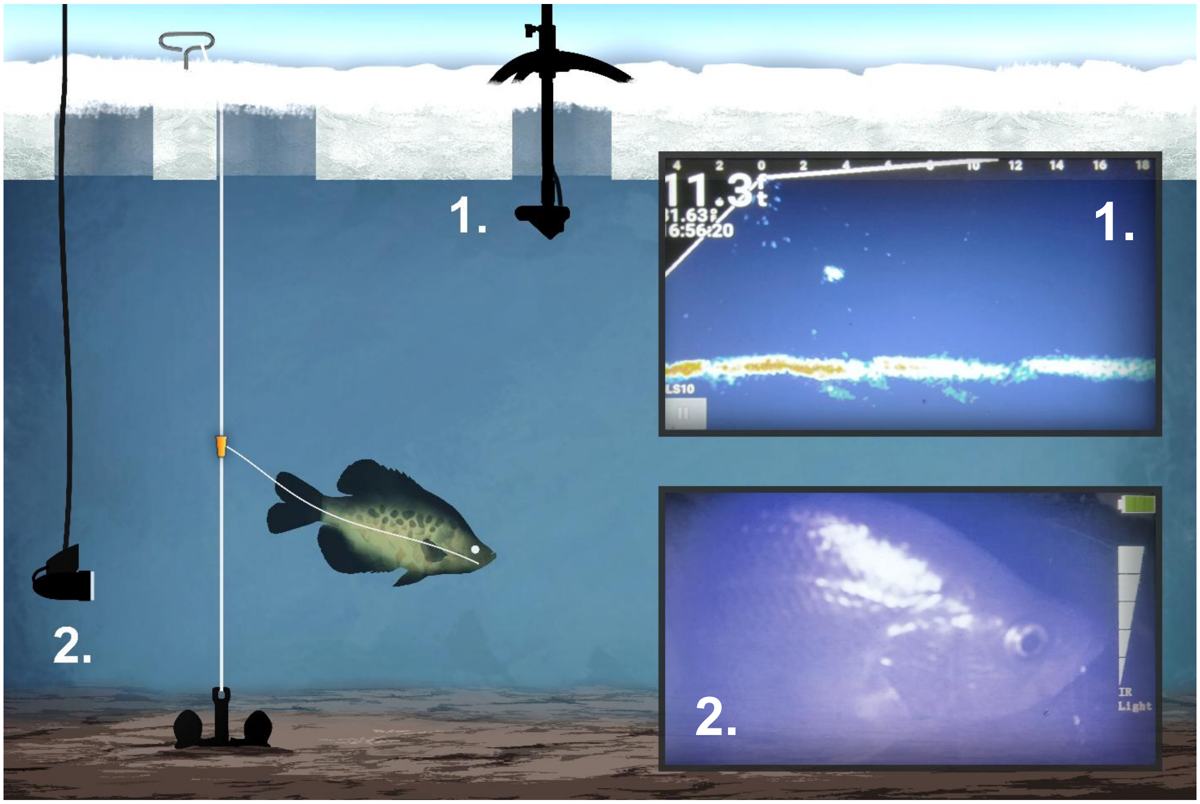

Figure 2. Diagram of the tethering system setup used in this study for post-release monitoring. Fish descent was tracked with a forward-facing sonar unit **(1)**, and fish health and recovery behaviour were monitored with an underwater camera **(2)**.

Descending Device Efficacy

To evaluate if fish descenders improve release success in deep-caught Black Crappie, we returned some fish to their capture depths using weighted descending devices. In the first scenario, a subsample of 45 fish captured across all sites were descended if they failed to return to depth on their own (*delayed descent* group). In the second scenario, 25 fish from the 26 ft site were quickly descended after barotrauma assessment (≤ 30 seconds of handling) as part of an *immediate descent* group. Fish were descended using either a Shelton SFD™ Fish Descender fitted with a 2 oz lead weight or a custom 1 oz descending device (Figure 3) connected to a heavy power ice fishing rod and reel spooled with 20 lb test line. The custom descending device was rarely heavy enough to descend Black Crappie longer than

28 cm at the 26 ft and 31 ft sites, so the Shelton SFD™ was used to descend all fish exceeding this length. Fish were secured to the descending device by threading the needle portion of the tool through soft tissue on the lower jaw, descended to depth at a rate of 1.5–2.5 ft per second, and released with a swift pull of the rod. Fish in both groups were descended while connected to the tethering system, and thus post-release outcomes were monitored and scored in the same manner as undescended fish.

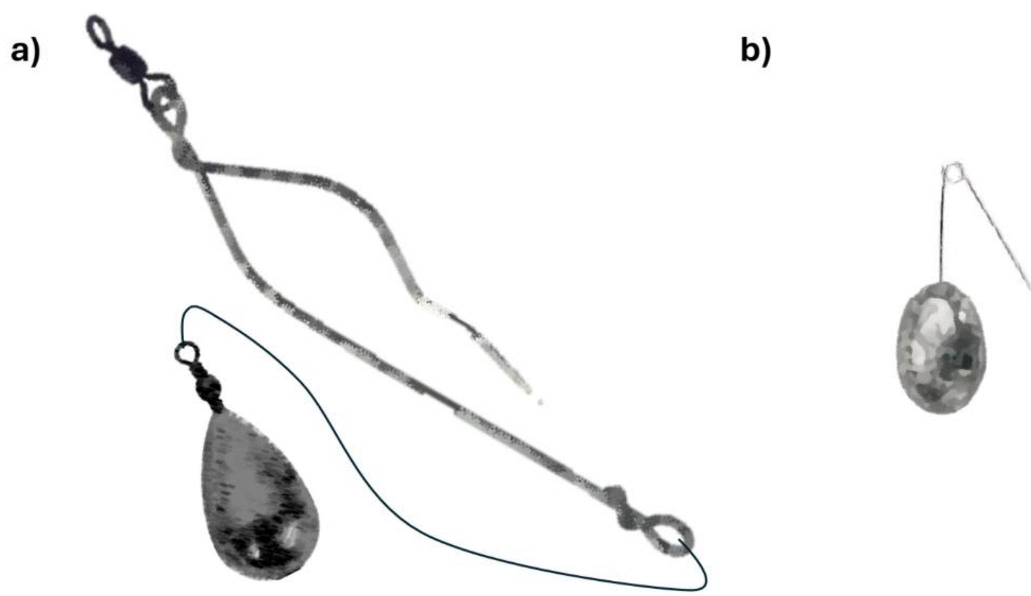

Figure 3. Weighted fish descenders tested during this study: **a)** Shelton SFD™ fish descender with 2 oz weight, and **b)** a custom 1 oz descending device.

Results

In total, 258 Black Crappie were caught and assessed across all sites and handling treatments (Table 2). Most fish in this study had a capture depth within three feet from the bottom (12 ft = 64%, 21 ft = 90%, 26 ft = 97%, 31 ft = 91%; Table 2), and all fish that returned to or exceeded their capture depth swam within one foot of bottom before settling at their preferred depth.

Table 2. Average lengths and capture depths of ice-angled Black Crappie, grouped by site depth and handling treatment. Capture depth is defined as the depth at which caught fish were first observed on a sonar unit.

Site	**Treatment**	***N***	**Mean total length (cm)**	**Mean capture depth (ft)**
12 ft	High handling	30	31.7	8.2
	Low handling	25	30.5	7.9
	Combined	***55***	***31.2***	***8.1***
21 ft	**High handling**	**30**	**24.4**	**19.4**
26 ft	High handling	30	28.5	24.9
	Low handling	30	25.2	24.9
	Untethered	30	26.4	24.3
	Immediate descent	25	26.4	24.9
	Combined	***115***	***26.6***	***24.7***
31 ft	High handling	30	27.1	29.5
	Low handling	28	25.3	29.5
	Combined	***58***	***26.2***	***29.5***

Barotrauma Symptoms

Barotrauma symptoms increased in frequency and severity as capture depth increased. Barotrauma injuries occurred in 45% of fish caught at the 21 ft site, 79% of fish at the 26 ft site, and 96% of fish at the 31 ft site (Figure 4). One Black Crappie at the 12 ft site had a damaged blood vessel on its throat that was recorded as hemorrhaging but was not consistent with the bleeding observed at deeper sites. Barotrauma injuries at the 21 ft site were usually limited to mild bruising around the mouth and gills, whereas severe hemorrhaging, exophthalmia, and stomach eversion were first observed in fish at the 26 ft site and became more frequent at the 31 ft site (Figure 5). Barotrauma injuries also became more frequent and severe as fish size increased (Figure 6).

Black Crappie had difficulty reorienting and were less likely to display vigorous behaviour during the orientation test (high handling treatment) when caught at increasing depths. All fish caught at the 12 ft site displayed vigorous behaviour and passed the orientation test, and 74% of fish at the 21 ft site behaved vigorously and were able to reorient (Figure 4). In contrast, 33% of fish caught at the 26 ft site displayed vigorous behaviour and 7% passed the orientation test. Only 13% of Black Crappie caught at the 31 ft site behaved vigorously, and one fish (3%) was able to reorient. Black Crappie caught at the 21 ft, 26 ft, and 31 ft sites showed signs of excessive buoyancy and floated sideways at the surface of the tub when inactive. However, fish were observed to show less vigorous behaviour and made less of an effort to regain proper orientation as capture depth increased.

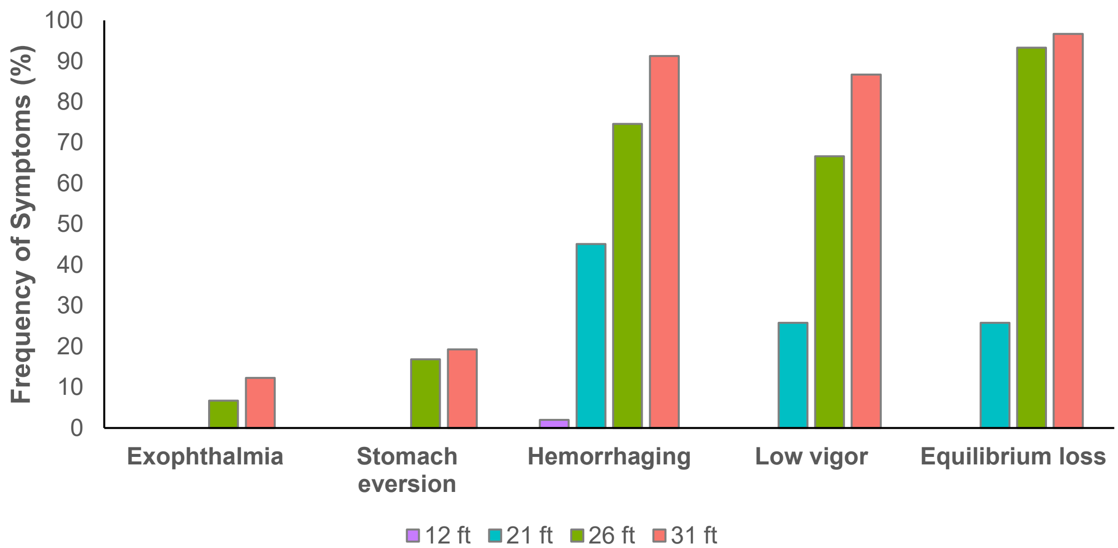

Figure 4. Frequency of barotrauma symptoms observed in Black Crappie caught ice fishing at depths of 12 ft (n = 55), 21 ft (n = 30), 26 ft (n = 115) and 31 ft (n = 58). Fish were determined to have lost equilibrium if they were unable to reorient within ten seconds of being placed in a tub of lake water (n = 30 for each site).

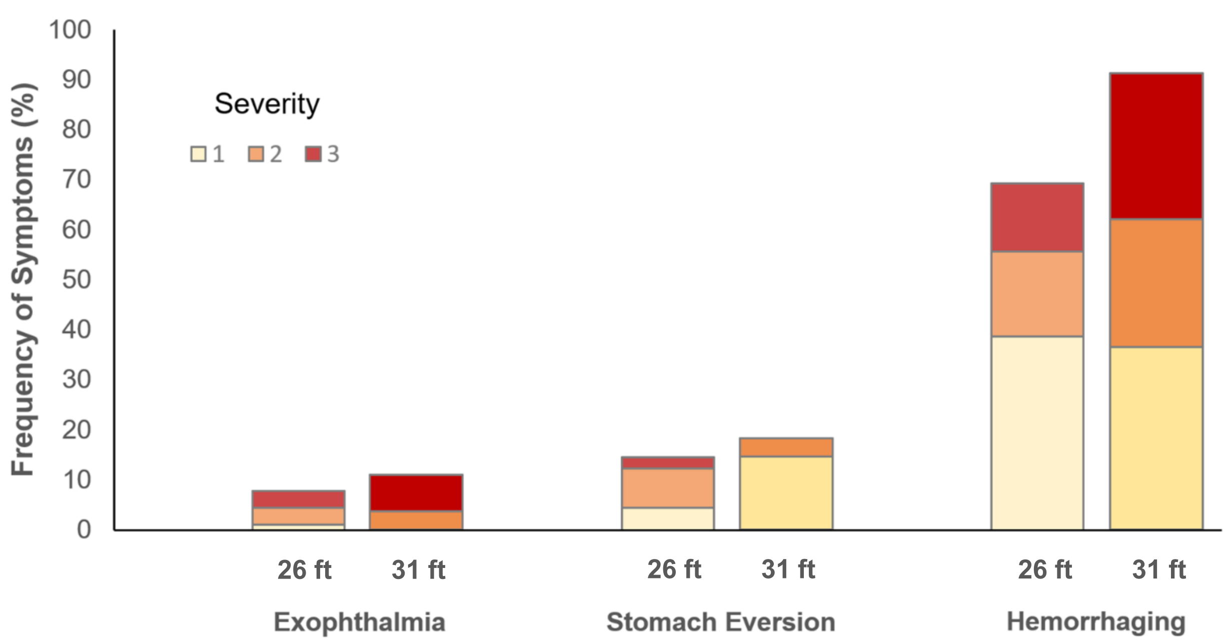

Figure 5. Frequency and severity of barotrauma symptoms observed in Black Crappie caught in 26 ft (n = 88) and 31 ft (n = 27). Severity is ranked as follows: 1 = mild, 2 = moderate, 3 = severe.

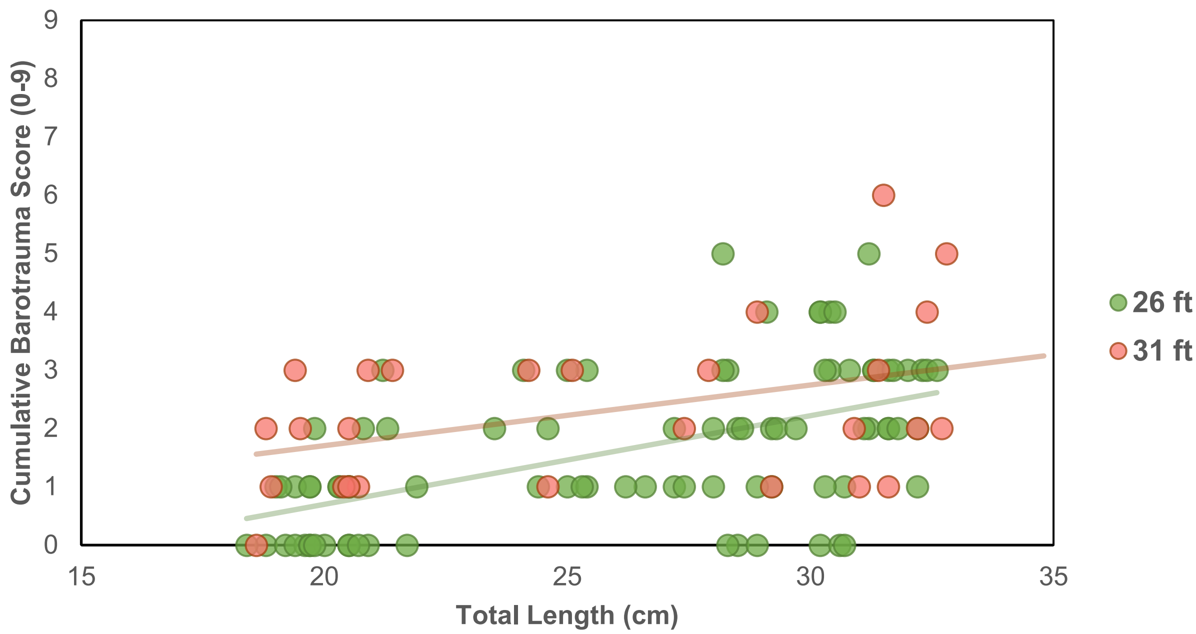

Figure 6. Cumulative barotrauma scores of individual Black Crappie caught in 26 ft (*n* = 88) and 31 ft (*n* = 27) in relation to length. Values are the sum of each barotrauma symptom score as described in Table 1.

Post-release Assessment

Fewer Black Crappie were able to return to their capture depth as angling depth increased. Across handling treatments, the proportion of fish that returned to their capture depth at the 12 ft, 21 ft, 26 ft, and 31 ft sites was 96%, 76%, 51%, and 25%, respectively (Table 3). The two Black Crappie that did not return to their capture depths at the 12 ft site were in the high handling treatment and were presumably exhausted or in shock. Likewise, fish that failed to return to their capture depth at the 21 ft site (*n* = 7) had been subjected to extended handling (i.e., the orientation test) and also made a limited effort to return to depth (Figure 7). In contrast, many fish caught at the 26 ft and 31 ft sites were unable to return depth regardless of effort, and numerous fish swam within a few feet of their capture depth before floating back to the surface (e.g., Figure 8-C). Three Black Crappie were eaten by Northern Pike (*Esox lucius*) across the 21 ft, 26 ft and 31 ft sites before they could return to depth and were not included in post-release assessment statistics.

Across sites, Black Crappie were more likely to return to their capture depth with reduced handling time. Fish in the low handling treatment returned to depth twice as often and in less time than fish in the high handling treatment at the 26 ft and 31 ft sites (Table 3). However, failed descent attempts were still common at these sites regardless of handling treatment. Success rates were similar between the low handling treatment (59%) and the untethered control (65%) at the 26 ft site, but fish in the untethered control group returned to depth faster (mean = 69 seconds, range = 34–195 seconds) than fish in the low handling treatment (mean = 117 seconds, range = 32–256 seconds; Figure 10).

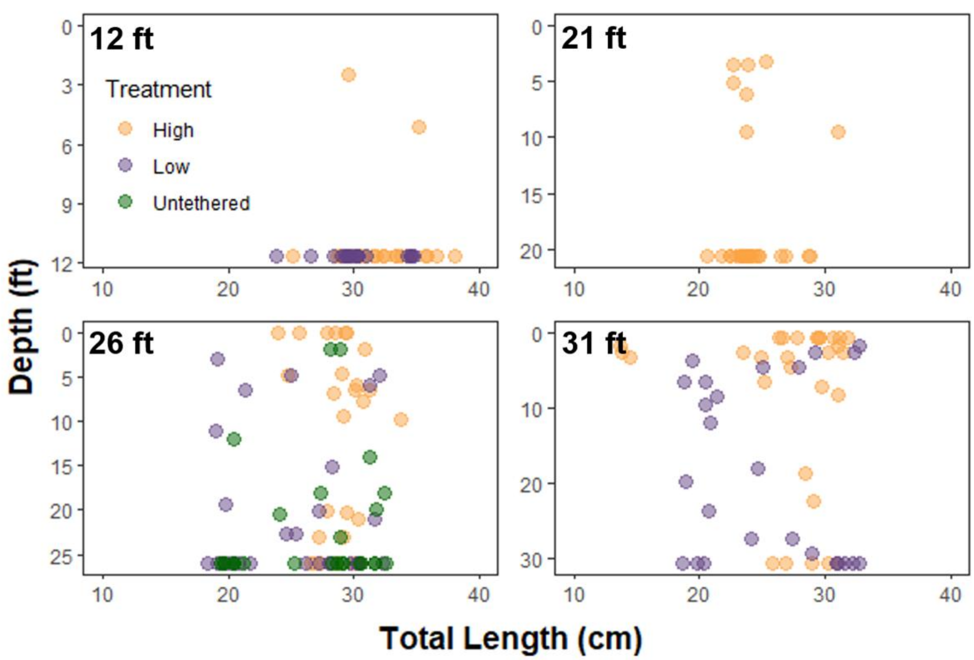

Figure 7. Maximum depths achieved by Black Crappie caught and released in 12 ft (n = 55), 21 ft (n = 29), 26 ft (n = 85), and 31 ft (n = 57) of water, grouped by handling treatment. All fish that did not swim within 1 ft of the bottom eventually floated back to the surface.

Table 3. Proportion of Black Crappie that successfully returned to their capture depth upon release, grouped by site depth and handling treatment.

Site	High handling	Low handling	Untethered	Combined handling
12 ft	28/30 (93.3%)	25/25 (100%)	-	53/55 (96.4%)
21 ft	22/29 (75.9%)	-	-	22/29 (75.9%)
26 ft	9/30 (30.0%)	17/29 (58.6%)	17/26* (65.4%)	43/85 (50.6%)
31 ft	5/29 (17.2%)	9/28 (32.1%)	-	14/57 (24.6%)

*4 fish exceeded the working range of the forward-facing sonar and were omitted from post-release statistics

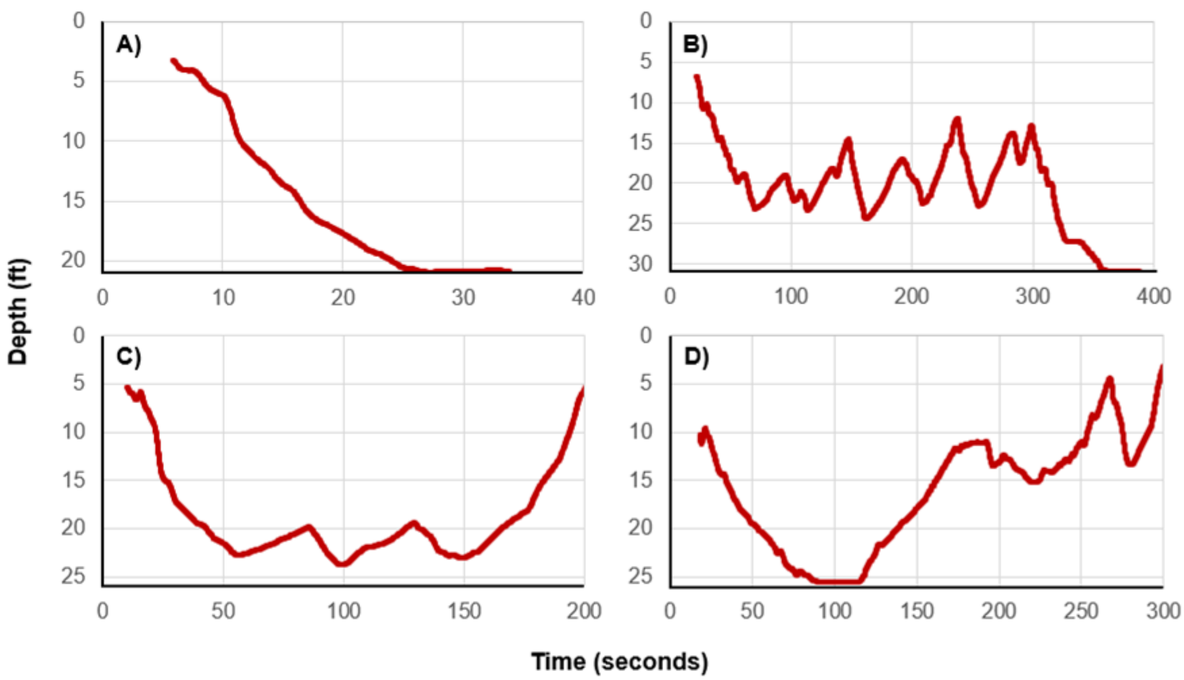

Figure 8. Examples of post-release movements of individual Black Crappie, visualized as depth in the water column over time. Plot **A)** depicts a fish in the 21 ft *high handling* treatment returning to bottom shortly after release. Plot **B)** shows a fish in the 31 ft *high handling* treatment that returned to its capture depth after a prolonged struggle with buoyancy and subsequently died. Plot **C)** depicts a fish in the 26 ft *low handling* treatment that swam within 3 ft of bottom and 1.5 ft from its capture depth before eventually floating to the surface. The fish in plot **D)** was released during the 26 ft *untethered* treatment and briefly returned to bottom before floating back to the surface. Tracking data were collected from forward-facing sonar footage in Adobe After Effects.

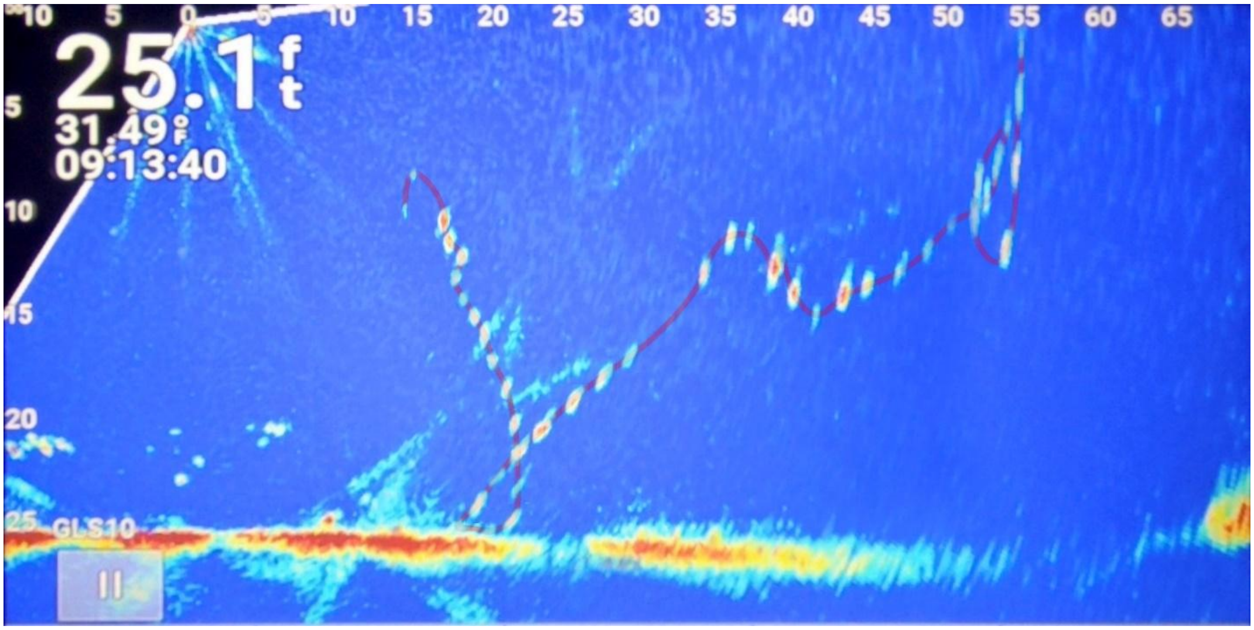

Figure 9. Vertical and horizontal progression of the fish plotted in Figure 8-D, as visualized on a Garmin ECHOMAP unit and LiveScope system. Fish movement was reproduced by superimposing individual video frames in Adobe Photoshop.

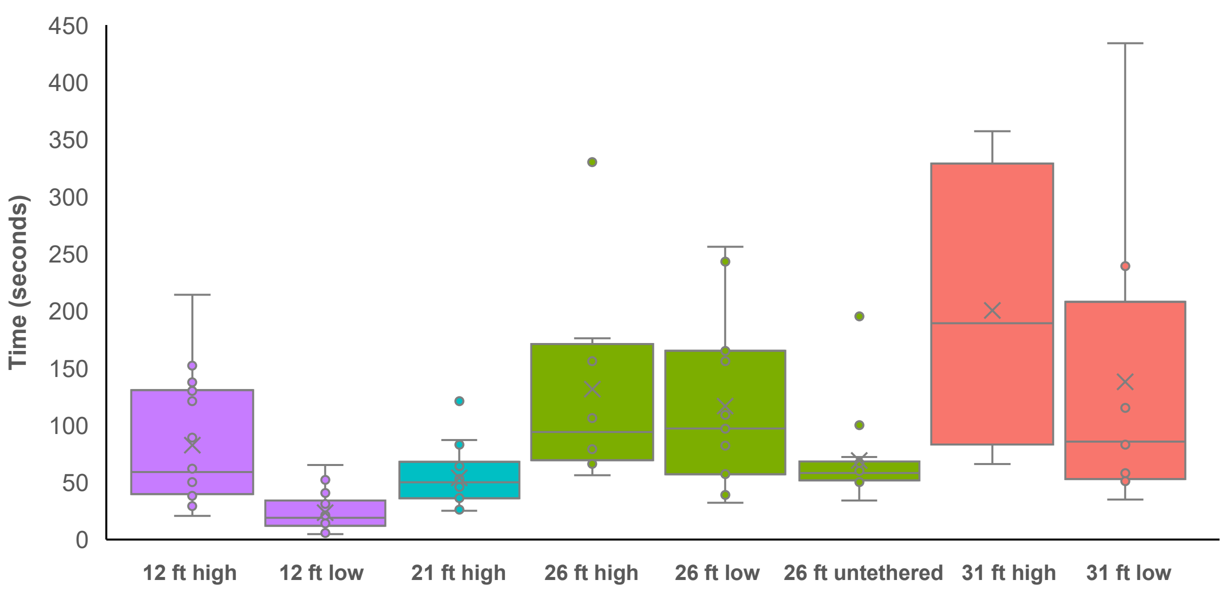

Figure 10. Average time taken for Black Crappie to successfully return to their capture depth upon release, grouped by site depth and handling treatment. Boxes represent the 25th through 75th percentile, and the *X* and horizontal line show the mean and median, respectively. Points represent descent times that were shared by two or more individuals.

A Black Crappie's ability to return to its capture depth was not a good indicator of immediate release success. All fish that returned to their capture depth at the 21 ft site and all but one fish at the 12 ft site showed positive recovery outcomes (swimming or resting) when viewed with an underwater camera (Table 4). In contrast, 33% of fish at the 26 ft site and 36% of fish at the 31 ft site were observed lying motionless on bottom (Figure 11). The proportion of fish with positive recovery outcomes at the 31 ft site was higher in the low handling treatment (83% positive) than in the high handling treatment (40% positive). However, fish that returned to depth at the 26 ft site had worse outcomes in the low handling treatment (53% positive) than in the high handling treatment (89% positive).

Delayed Recovery

We held a subsample of Black Crappie that did not return to their capture depth (26 ft site: *n* = 6; 31 ft site: *n* = 15) for an additional 30 minutes to see if they would swim back to depth in a later attempt. At the 26 ft site, one fish returned to depth after 30 minutes but died upon reaching the bottom, and another fish died while floating under the ice. None of the fish at the 31 ft site returned to their capture depth after 30 minutes, and two fish died beneath the ice.

A subsample of Black Crappie that successfully returned to depth but were observed motionless on bottom (26 ft site: *n* = 8; 31 ft site: *n* = 4) were also held for 30 minutes to monitor for a delayed recovery response. After 30 minutes, two fish at the 26 ft site recovered, and six did not. Of the six fish that did not recover, one died on the bottom; two were eaten by Northern Pike; and three floated back to the surface, of which one died. The four fish at the 31 ft site did not recover after 30 minutes, with one mortality. Recovery outcomes of Black Crappie in the untethered control (26 ft site) could not be monitored, but four fish were incidentally observed floating upwards after reaching their capture depth, three of which floated back to the surface and remained under the ice (see Figure 9 for an example).

Table 4. Proportion of Black Crappie that had a post-release recovery outcome of '0' (lying motionless on their side) upon reaching or exceeding their capture depth.

Site	High handling	Low handling	Combined handling
12 ft	1/28 (3.6%)	0/25 (0%)	1/53 (1.9%)
21 ft	0/21 (0%)	-	-
26 ft	1/9 (11.1%)	7/15 (46.7%)	8/24 (33.3%)
31 ft	3/5 (60.0%)	1/6 (16.7%)	4/11 (36.4%)

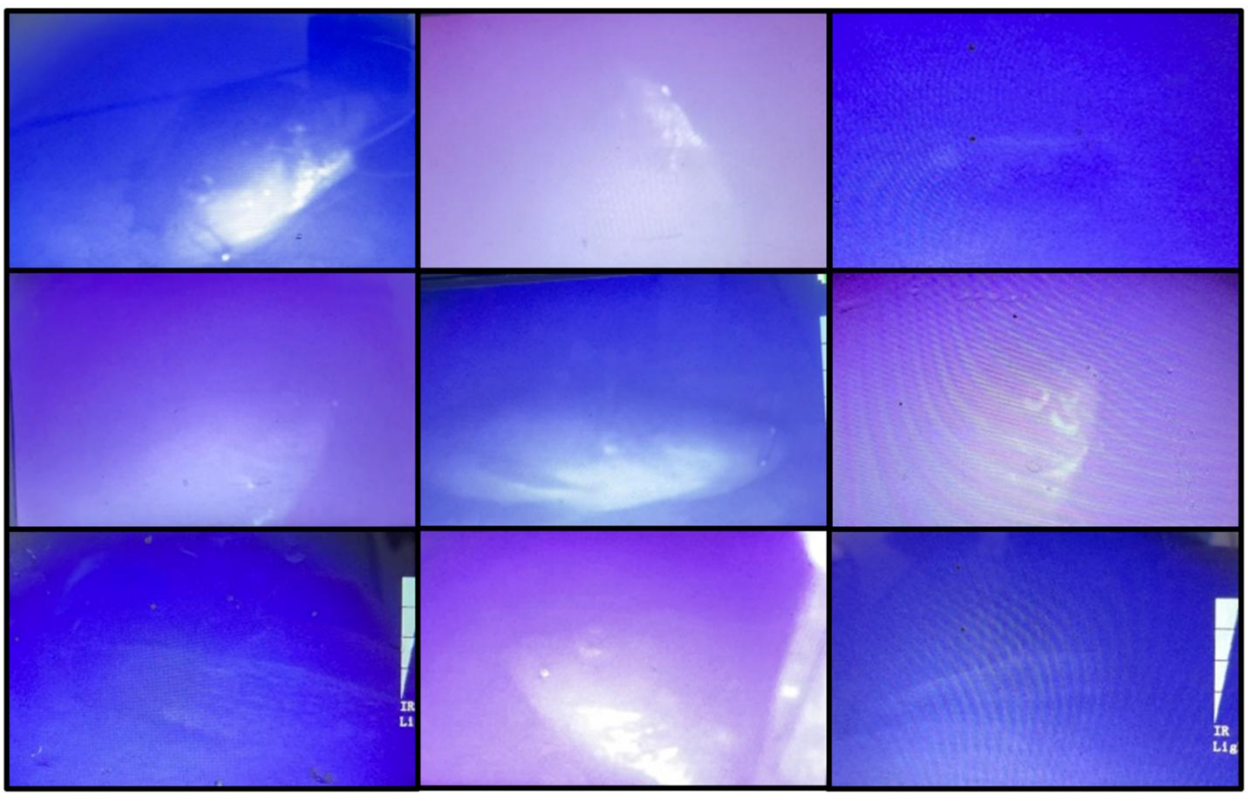

Figure 11. Examples of Black Crappie that returned to their capture depth but were observed lying motionless on bottom (post-release recovery outcome = 0) when viewed with an underwater camera.

Descending Device Efficacy

Descending devices were mostly effective at returning Black Crappie to their capture depth, but they did not guarantee that fish would be healthy upon doing so. Of the Black Crappie that were descended after a failed release (delayed descent group), 43%, 39%, and 72% of fish had a poor recovery outcome at the 21 ft, 26 ft, and 31 ft sites, respectively (Table 4). Of these, 48% were observed lying motionless on bottom and 52% floated back to the surface, sometimes as late as six minutes after descent. In the immediate descent group, 18 fish were successfully returned to their capture depth, but 7 fish came off the descending device prematurely or during device retrieval. Of the remaining 18 fish, 13 showed positive recovery behaviour and 5 were observed lying on bottom. After 30 minutes, only one of the five fish lying on bottom recovered.

Table 4. Proportion of Black Crappie released with a positive outcome (active or resting) after being assisted with a descending device. Fish in the *delayed descent* group were descended only if they failed to reach their capture depth under their own strength. Fish in the *immediate descent* group were descended as soon as they were caught and assessed for barotrauma (≤ 30 seconds of handling).

Site	Delayed Descent	Immediate Descent
12 ft	1/2 (50%)	-
21 ft	4/7 (57.1%)	-
26 ft	11/18 (61.1%)	13/18 (72.2%)
31 ft	5/18 (27.8%)	-

Discussion

Barotrauma Symptoms

Black Crappie showed increasingly frequent and severe barotrauma injuries as capture depth increased. Severe barotrauma also became more frequent as fish size increased, as has previously been observed in Black Crappie (Althoff *et al.* 2021) and in other freshwater species (Gravel and Cooke 2008). Severe hemorrhaging, exophthalmia, and stomach eversion first appeared at capture depths of about 25 ft and became more frequent as capture depth increased. Fish caught from these depths were also less likely to reorient or show vigorous behaviour during the orientation test, indicating elevated stress from barotrauma. It is worth noting that severe barotrauma injuries can still occur in fish caught at shallower depths if they have recently moved from deeper water, or may not appear in fish suspended over deep basins. Nevertheless, anglers can expect Black Crappie to begin showing severe barotrauma symptoms when captured from depths of 25 ft or more.

Post-release Outcomes

Black Crappie were less likely to successfully return to their capture depth as angling depth increased. Buoyancy was a major factor at the 26 ft and 31 ft sites, as numerous fish neared or even reached their capture depth before floating back to the surface. Return success also declined with longer handling times. Fish in the high handling treatments experienced more air exposure and handling time, which increased physiological stress and energy loss. Several Black Crappie were attacked by Northern Pike before they could return to their depth, suggesting that released fish may be more vulnerable to predation.

Even when fish did return to their capture depth, outcomes were often poor. About one-third of Black Crappie that returned to their capture depth at the 26 ft (33%) and 31 ft (36%) sites were later observed lying motionless on the bottom, and few of the fish that were observed for an additional 30 minutes recovered during that time. Necropsies of several fish revealed bleeding in their muscles and body cavity, which likely persisted or worsened as they struggled to return to depth (Rummer and Bennett 2005; Louison *et al.* 2023). Thus, some fish are likely impaired by exhaustion, stress, or injury upon returning to depth. Numerous fish also floated back to the surface despite initially reaching or surpassing their capture depth, which suggests that they could not maintain neutral buoyancy or were already positively buoyant as part of an active feeding strategy (Pelster 2009).

Descending Device Efficacy

Descending devices were generally effective at returning fish to their capture depth, which improved the chances of a positive post-release outcome. However, many descended fish still lay motionless on the bottom or floated back to the surface, few of whom recovered in the minutes after release. While descending devices can improve release success by returning fish to depths where neutral buoyancy is restored, they do not guarantee their recovery or survival. As such, descending devices should not used to justify the catch-and-release of Black Crappie in deep water but may prove useful if Black Crappie are caught incidentally while targeting other species.

Study Limitations

The tethering system had a noticeable effect on fish descent times and therefore affected swimming performance to some extent. Fish in the 26 ft low handling treatment and untethered control were similarly successful in returning to depth, but it took the tethered fish 63% longer on average to do so. The tethering system likely slowed swimming momentum due to added friction and drag, which would in turn increase energy expenditure. Fish may also have perceived resistance from the tether as a second angling event, though their swimming behaviour appeared similar to that of untethered fish when viewed with forward-facing sonar (e.g., Figure 8). Because the tethering system is not part of typical catch-and-release conditions, the post-release statistics presented should be interpreted as overall trends rather than exact estimates of release success or survival. Nevertheless, this study demonstrates that capture depth, handling time, and barotrauma incidence are all important factors that will influence the releasability and survival of ice-angled Black Crappie.

Conclusion

In this study, we ice fished for Black Crappie at depths of 12 ft, 21 ft, 26 ft, and 31 ft to characterize barotrauma incidence and fish releasability. We found that the frequency and severity of barotrauma symptoms increased with angling depth, with severe barotrauma injuries first occurring at capture depths of about 25 ft and becoming more frequent thereafter. Fewer Black Crappie were able to return to their capture depth as angling depth increased, and many of the fish that did reach their capture depth at the 26 ft and 31 ft sites were later observed lying motionless on bottom or floating back to the surface. Post-release outcomes were improved with reduced handling time, but failed releases were still common at the 26 ft and 31 ft sites. Descending devices do not guarantee fish recovery and are not a substitute for fishing in shallower water, but their use will increase the likelihood of survival in the event of incidental catches. Black Crappie are highly vulnerable to barotrauma and as such, they are poor candidates for release when caught in deep water. We advise that anglers practicing catch-and-release should avoid targeting Black Crappie holding in depths of 25 ft or greater whenever possible and be prepared to keep fish that are showing signs of severe barotrauma as regulations allow. Anglers should also minimize fish handling time and be prepared to move to shallower water if barotrauma is observed, regardless of angling depth. By following these best practices, anglers will greatly improve release success, minimize fish mortality, and ensure the long-term sustainability of Manitoba's Black Crappie fisheries.

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