DEPARTMENT OF NATURAL RESOURCES

Minnesota anglers' use of and attitudes toward live imaging sonar

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Executive summary

Live Imaging Sonar is a technology that provides an angler with a real-time image of the water and habitat near their location, including their bait and any fish that may be present. It differs from traditional sonar in that the image is "live", and the angler can see how fish react to bait, and that they can target individual fish. A robust debate exists about the ethics of LIS, and the potential impacts that it may have on fish populations and the angling experience. Despite growing interest in and concerns about LIS, there exist limited data about anglers' use of LIS or their attitudes toward it or its management. We conducted a survey of Minnesota anglers at the end of the 2025 license year to address these gaps.

We surveyed 17,000 randomly selected adult Minnesota resident fishing license holders using a mixed-mode design (mail and email contacts) and received 2,871 responses (18%).

Minnesota anglers' use of LIS

We estimated that 97% of those that held a fishing license in the 2025 license year fished (from here forward "2025"). Among those that fished, 84% reported that they fished from a boat, and 22% of those anglers used LIS while fishing from a boat at some point during the season. This equates to 18% of all license holders or 231,689 anglers. Among those that used LIS while fishing from a boat, 32% reported that they used the technology 90% of the time or more. Similarly, 56% of license holders that fished in 2025 reported going ice fishing, and 37% of those anglers reported using LIS to ice fish during the season. This equates to 20% of license holders or 259,773 anglers using LIS while ice fishing in Minnesota in 2025. Among those that used LIS while ice fishing, 22% reported using the technology 90% of the time or more. These estimates are for LIS use during the past season rather than possession and represent a likely upper bound on possession of LIS.

We estimated that 12% of all license holders or 152,595 anglers targeted walleye or sauger using LIS while fishing in Minnesota in 2025. This was followed by crappie (121,487), sunfish (63,439), and largemouth and smallmouth bass (45,134). Compared to these species, fewer anglers targeted muskellunge using LIS (16,925), though fewer anglers reported targeting the species in general.

Minnesota anglers' beliefs about and attitudes toward LIS

We presented anglers with a series of statements corresponding to the potential challenges and opportunities that stem from LIS and asked them to report on their agreement. Challenges reflected beliefs that LIS may negatively impact fish populations and the angling experience, while opportunities reflected beliefs that LIS may improve the angling experience for users and improve recruitment, retention, and reactivation efforts among other related topics respectively. In general, those that used LIS while fishing in Minnesota in 2025 were less likely to agree with statements regarding the potential challenges that LIS poses than those that did not, and more likely to agree with statements about the potential opportunities that LIS presents.

We asked anglers if they believed that those that use LIS catch "much fewer," "fewer," "about the same number of," "more," or "much more" fish than those that do not. Nearly three-quarters (74%) of anglers believed that LIS users catch "more" or "much more" fish than non-users. Nearly one-quarter (22%) of non-LIS users believed that LIS users catch "much more" fish than non-users, while 8% of LIS users believed the same.

Anglers reported their beliefs about the acceptability of using LIS to fish for various species or species groups and for all fish in general while fishing from a boat and through the ice. For all species, and for both fishing from a boat and through the ice, anglers that did not use LIS, on average, rated using LIS as slightly unacceptable, and significantly lower than those that did. Those that used LIS, on average, rated targeting all species with LIS as between slightly and moderately acceptable. Muskellunge was a point of interest as those that used LIS rated the acceptability of targeting muskellunge using LIS while fishing from a boat lower than for other species.

Anglers reported their perceptions of the degree of potential impact that LIS could have on populations of various fish species or species groups. Anglers that did not use LIS believed that LIS had the potential to have more negative impact on all species or species groups than those that did use LIS while fishing in Minnesota in 2025. More than one-quarter of anglers (27%) believed that LIS could have "a great deal of impact" on populations of walleye/sauger in the next 5 years. This was followed by crappie and muskellunge where 23% and 22% of anglers believed that LIS could have "a great deal of impact" respectively.

Anglers also reported their level of concern about the potential for LIS to negatively impact elements of fishing including "your fishing experience," "fishing heritage and tradition," "numbers of fish," "size of fish," "how easy fish are to catch," "the number of fish you'll catch in the future," and "mortality after fish are caught and released." A plurality of anglers (41%) expressed no concern that LIS would negatively impact their fishing experience, while 38% expressed either "moderate," "a fair amount," or a "great deal of concern." On the remaining issues, between 23% and 29% of anglers reported no concern, while 21% to 23% reported a great deal of concern. This pattern follows LIS use where those that used LIS to fish in Minnesota in 2025 expressed significantly less concern about its potential impact than those that did not use LIS.

Minnesota anglers' attitudes toward future applications of LIS

We asked anglers to rate the acceptability of several hypothetical applications of LIS that might emerge in the future. These included a LIS system that…: "…uses artificial intelligence to interpret images for the angler making it easier to identify fish species and size," "…links to the boat's trolling motor and locks on to and automatically follows an individual fish as it moves through a waterbody," "…can provide an angler with a real-time 360-degree view of the area underwater around their boat," "…can provide an angler with real-time images at much greater distances than is possible with current models," "…can provide an angler with real-time images at a much higher resolution than is possible with current models," and "…can provide an angler with enhanced visualizations like virtual reality or 3-D images of fish habitat or bait." Anglers that used LIS rated these scenarios as significantly more acceptable than those that did not. On average, those that did not use LIS in 2025 rated future scenarios as slightly unacceptable. On average, those that used LIS rated scenarios as slightly acceptable except in the case of an LIS system that would automatically follow a fish using the trolling motor. Regardless of current LIS use, anglers on average, felt that a system that would automatically follow a fish was unacceptable.

Minnesota anglers' attitudes toward general fisheries management techniques

We asked anglers about the appropriateness of several techniques that fisheries managers employ to manage fish populations in instances where they are concerned about the long-term sustainability of the population including: "limiting the use of certain fishing gears and technologies," "reducing the number of fish that ca be kept," "modifying the fishing season," "limiting the size of the fish that can be kept," "limiting the number of fish that could be caught and released alive," and "restricting where fishing can occur within a waterbody." Anglers

viewed reducing the bag limit and limiting the size of fish that could be kept as appropriate, and LIS users and non-users expressed similar attitudes toward these techniques. In the case of the remaining techniques, those that did not use LIS to fish in 2025 evaluated fisheries management techniques more positively than those that used LIS. On average, LIS users rated limiting gear and technology modifying the season, limiting the number of fish that caught and release alive, and restricting where an angler could fish in a waterbody as slightly inappropriate, while those that did not use LIS rated these techniques as slightly appropriate.

Minnesota anglers' attitudes toward LIS management techniques

We asked anglers to rate their support or opposition to several techniques managers could use to reduce the potential negative impacts that LIS could have on fish populations and the fishing experience including: "creating designated lakes or stream segments where LIS or other advanced fishing technologies are not allowed," "establishing seasonal periods when LIS is not allowed," "limiting the species an angler can target using LIS," "limiting LIS use in shallow-water habitats or nearshore areas within waterbodies," "limiting LIS use in deep-water habitats within waterbodies." Anglers expressed significantly different attitudes towards these techniques depending on their past use of LIS. On average, those that did not use LIS while fishing in Minnesota in 2025 expressed slight support for LIS management techniques and expressed higher support than those that did use LIS. Most anglers expressed some level of support for creating designated lakes or stream segments where LIS and other technologies are not allowed (61%), establishing seasonal periods when LIS is not allowed (60%), and limiting the species anglers can target with LIS (53%).

Purpose

The Minnesota Department of Natural Resources (MNDNR) periodically conducts surveys of anglers to understand their values, beliefs, attitude and behaviors in support for fisheries management. This report details the results of one such survey of Minnesota fishing license holders following the 2025 license year. Of particular interest in this study was anglers' use of and attitudes toward Live Imaging Sonar (LIS). Live Imaging Sonar refers to a suite of sonar technologies that give an angler a real time view of their bait, the fish in the water column, and the habitat around their fishing location. LIS differs from traditional sonar in that the view is "live" rather than a snapshot with a time delay. Anglers using LIS can see how a fish is reacting to a presentation of a bait in real-time. LIS is an emerging issue of concern for fisheries managers (Cooke et al., 2025) as it has the potential to change patterns of angler behavior, and increase catch rates, with consequences for the catchability of fish, the size structure of fish populations, and anglers' satisfaction with the fishing experience. The acceptability of LIS is hotly debated among anglers in public discourse, but limited data exist on anglers' attitudes that generalize to management contexts like Minnesota. This study was motivated by this gap.

Topics examined in this investigation included:

1) Fishing participation by modality
2) Species or species groups targeted
1) Ice fishing
    a. Use of LIS for ice fishing
    b. Intention to purchase LIS for ice fishing
    c. Percent of time fishing with LIS through the ice
    d. Years of use of LIS for ice fishing
    e. Perception of skill using LIS through the ice
    f. Use of other technology while ice fishing
2) Fishing from a boat
    a. Use of LIS while fishing from a boat
    b. Intention to purchase LIS to fish from a boat
    c. Percent of time fishing with LIS from a boat
    d. Years of use of LIS fishing from a boat
    e. Perception of skill using LIS fishing from a boat
    f. Use of other technology while fishing from a boat
3) Days fished for species targeted and percent of time using LIS
4) Beliefs about LIS
5) Acceptability of using LIS by target species
6) Acceptability of hypothetical new LIS features
7) Perceptions of impact of LIS by species
8) Concerns about LIS
9) Perceptions of the appropriateness of general fisheries management techniques
10) Perceptions of management techniques to address LIS
11) Catch orientation
12) Identity as an angler
13) Angling skills and knowledge
14) Ecological dominance orientation

15) Trust in the MNDNR
16) Demographics

Methods

Sampling

We collected data in two separate samples. First, we drew a simple random sample of 7,000 individuals from all Minnesota resident fishing license holders (n = 784,979) aged 18 and over. We refer to this sample as the "push-to-web" sample. Second, we drew a sample of 10,000 individuals from the subset of all Minnesota resident license holders aged 18 and over that had an email on file within the Minnesota Electronic Licensing System (ELS) (n = 309,062). We refer to this as the "email" sample. We drew both samples in March 2026 at the close of the 2025 license year (March 1, 2025, to February 28th, 2026). Sampling was sequential such that individuals selected in the first sample were excluded from the population available for selection in the second. Prior to drawing any samples, we excluded a small number of individuals that were recently selected to participate in surveys of deer hunters, pheasant hunters, and turkey hunters in 2024 and 2025 to reduce survey burden across the population of hunters and anglers in Minnesota.

Data collection

Push-to-web

Selected participants received a customized letter in the mail inviting them to complete a questionnaire online. Non-respondents received up to two additional letters at roughly 3-week intervals, and mail lists were adjusted between rounds. Invitation letters contained both a QR code participants could scan on a mobile device to reach the questionnaire, and a web-address that could be typed into any browser. Upon reaching the questionnaire respondents were instructed to enter a numeric PIN used to ensure that only selected respondents completed the questionnaire and to adjust mailing lists between rounds.

Email

Selected participants received an email with a unique link that directed them to an online questionnaire. We distributed emails through the Qualtrics platform. Non-respondents received up to three emails soliciting their participation. We changed the day of week and time of day of emails to maximize response rates. Respondents were automatically removed from email lists between solicitations.

Response rate

Of the 7,000 push-to-web letters we initially sent, 439 were returned undeliverable as addressed and 1,500 participants completed at least some part of the questionnaire. After adjusting for undeliverable mail, this represents an adjusted response rate of 23%. Of the 10,000 emails we initially sent, 619 were returned undeliverable as addressed and 1,371 participants completed at least some portion of the questionnaire. After adjusting for undeliverable emails, this represents an adjusted response rate of 15%. The overall response rate was 18% (Table 1).

Table 1. Number of responses and response rate by strata.

Strata	Sample	Undeliverable	Adjusted sample	Completed	Response rate	Adjusted response rate
Push-to-web	7,000	439	6,561	1,500	0.21	0.23
Email	10,000	619	9,381	1,371	0.14	0.15
Total	**17,000**	**1,058**	**15,942**	**2,871**	**0.17**	**0.18**

Weighting and estimates

We designed weights to generalize estimates for the combined samples, and for the push-to-web and email samples respectively. All estimates in this report derive from the combined samples unless otherwise noted. For estimates of all anglers, we post stratified according to the distribution of 3 characteristics in the study population: possession of an email address on file (2 categories: yes/no), age (4 quartiles) and sex (2 categories: male/not male). Minnesota recognizes 3 genders within its licensing system (male, female, and other). Those that recorded their gender as other were collapsed into a category containing female and other and termed not male for the purpose of weighting. For push-to-web and email samples, we post stratified according to 2 characteristics with the respective populations: age (4 quartiles) and sex (2 categories male/not male).

Fishing participation by modality

We asked anglers if they went fishing in Minnesota during the 2025 license year (March 1, 2025 to February 28, 2026). Most respondents (97%) reported that they had (Table 2).

Among those that had fished in Minnesota in 2025, we asked if they fished on the ice, in open water from a boat, open water from a pier, shore or wading, dark house spearing, and with a bow, and if they had, how many days. Slightly more than half of respondents (56%) reported ice fishing in Minnesota in 2025, while 84% fished from a boat, 57% fished from a pier, shore, or while wading, 4% participated in spearing, and 2% fished with a bow (Table 2).

We created an estimate of total days fished by summing days fished across modes (boat, shore, ice, spear, and bow). Anglers fished an average of 28.6 days [Median = 19 days] in Minnesota in 2025 across all modes. Figure 1a contains a histogram of respondents reported days fished (unweighted). The data follow an over-dispersed count family distribution where the variance is greater than the mean, driven partly by a small number of very high but plausible responses (e.g., respondents that fished more than 100 days per year). It should also be noted that summing days across modes may double count some days as anglers may fish using different modes on the same day. Therefore, this should be considered an upper bounds estimate of total days fished. Ice anglers spent an average of 11.2 days ice fishing [Median = 7 days], boat anglers spent an average of 17.9 days fishing from a boat [Median = 10 days], anglers that fished from a pier, shore, or while wading fished an average of 13.6 days [Median = 7 days], dark house spearers fished an average of 4.3 days [Median = 3 days], and bow fishers fished an average of 7.1 days [Median = 3 days] (Table 2, Figure 1b). Estimates of effort by fishing mode are for those that fished at least one day using that mode in Minnesota in 2025.

Table 2. Percent of Minnesota anglers that fished in MN in 2025 and mean and median days fished by modality.

	Percent	Mean days[1]	Median days[1]	Standard deviation	Min	Max	n
Total[2]	97	28.6	19	31.4	1	255	2760
Ice	56	11.2	7	11.9	1	120	1463
Open water from a boat [boat]	84	17.9	10	20.8	1	214	2323
Open water from a pier, shore, or wading [shore]	57	13.6	7	23.5	1	365	1467
Dark house spearing [spear]	4	4.3	3	4.5	1	25	92
Bowfishing [bow]	2	7.1	3	11.6	1	87	27

1. Among those that fished at least one day
2. Sum of days fished by modality

Figure 1a. Histogram of the number of days fished by Minnesota anglers in 2025.

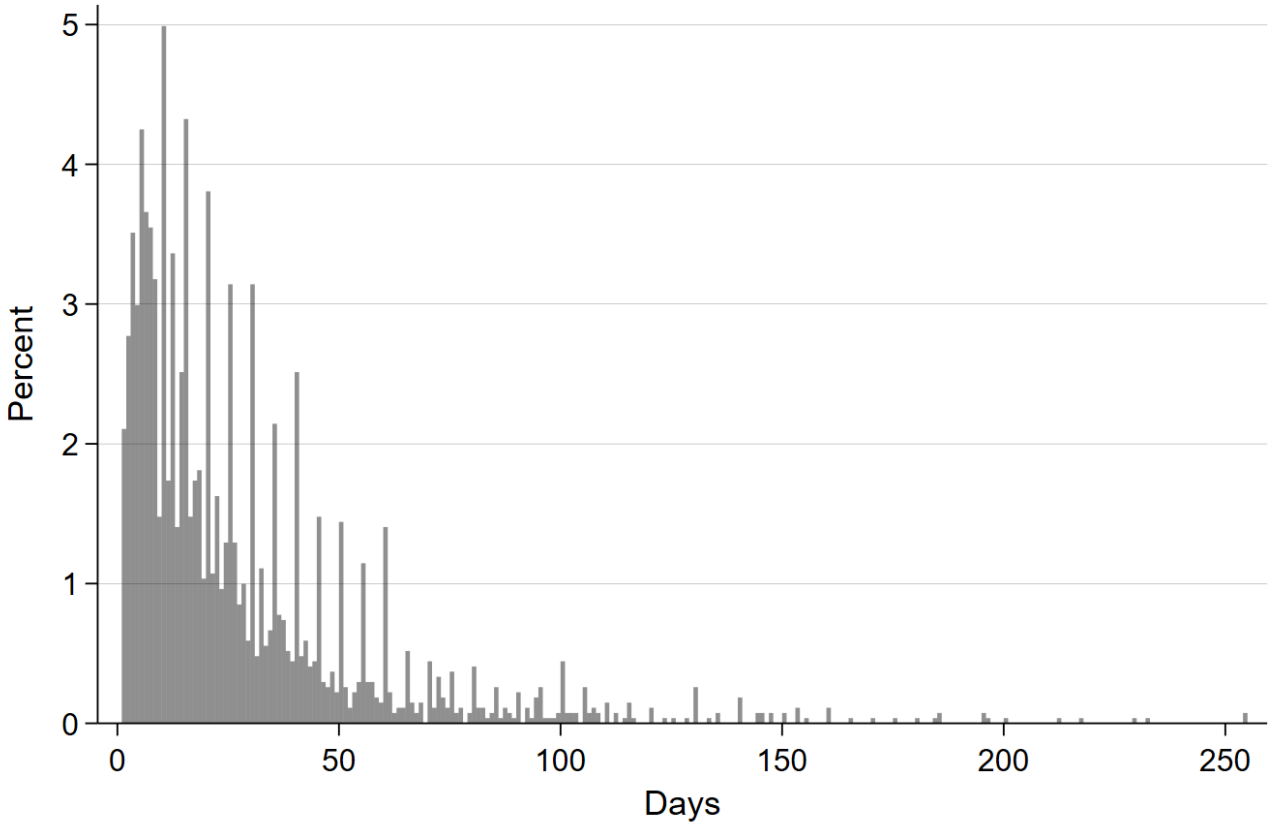
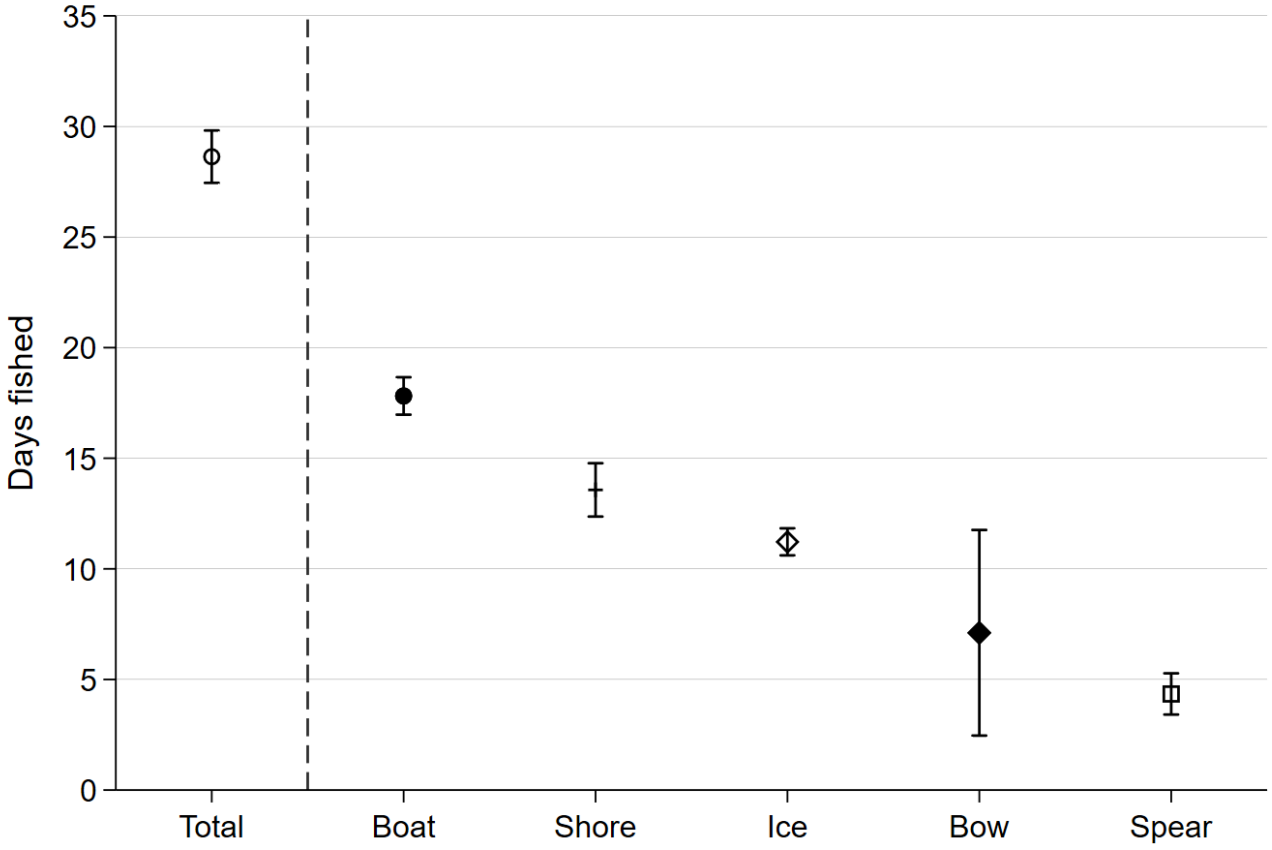


Figure 1b. Mean number of days fished (and 95% confidence intervals) by modality during the 2025 license year in Minnesota, among those that fished at least 1 day by that modality.



Species or species group targeted

Among those that fished in Minnesota in 2025, we asked if they had targeted a variety of fish species and species groups. Anglers that fished but did not target any species specifically were directed to report that they fished for “whatever was biting.” Walleye or sauger was the most targeted species or species group at 61% of anglers. This was followed by crappie (57%), sunfish (46%), “whatever was biting” (42%), large and smallmouth bass (40%), northern pike (36%), and yellow perch (19%). Ten percent or fewer of anglers reported targeting trout (rainbow, brook and brown, hereby referred to as “trout”) (10%), muskellunge (hereby referred to as “muskie”) (9%), catfish (7%), lake trout (6%), or “other” (4%) (Table 3, Figure 2.) Common “other” fish reported by Minnesota anglers included carp, salmon, sucker, burbot, sturgeon, bowfin, buffalo, and white bass among several others.

We asked anglers that targeted a species or species group to report the number of days they spent fishing for that species or species group in Minnesota in 2025. At an average of 20.1 days [Median = 10 days], anglers fished the most days for “whatever was biting,” followed by large and smallmouth bass (15.9 days) [Median = 10 days], walleye or sauger (14.5 days) [Median = 10 days], crappie (12.7 days) [Median = 7 days], sunfish (12.2 days) [Median = 7 days], northern pike (11.6 days) [Median = 6 days], muskie (10.4 days) [Median = 5 days], catfish (10.1 days) [Median = 5 days], yellow perch (9.3 days) [Median = 5 days], “other” (8.4 days) [Median = 6 days], trout (7.9 days) [Median = 5 days], and lake trout (6.1 days) [Median = 3 days] (Table 3. Figure 3.)

For those anglers that reported fishing for “whatever was biting,” we asked what species or species groups they caught most often. Sunfish, bass, northern pike, and crappie were the most caught species or species groups (Table 4, Figure 4).

Table 3. Percent of Minnesota anglers that targeted various species or species groups, and the mean and median number of days fished for that species or species group among those that fished at least one day.

	Percent targeted	Mean days	Median days	Standard deviation	Min	Max	n
Walleye or sauger	61	14.5	10	17.9	1	194	1274
Crappie	57	12.7	7	17.7	1	220	1111
Bluegill, pumpkinseed, or other sunfish [Sunfish]	46	12.2	7	14.6	1	130	839
Whatever was biting	42	20.1	10	32.8	1	365	588
Bass (largemouth or smallmouth)	40	15.9	10	21.6	1	160	683
Northern pike	36	11.6	6	15.3	1	151	646
Yellow perch	19	9.3	5	12.3	1	120	336
Trout (rainbow, brown, book)	10	7.9	5	9.8	1	80	188
Muskellunge [Muskie]	9	10.4	5	14.1	1	90	158
Catfish (channel or flathead)	7	10.1	5	13.2	1	60	81
Lake trout	6	6.1	3	7.8	1	40	119
Other	4	8.4	6	10.5	1	60	52

Figure 2. Proportion of adult license holders that targeted different species or species groups when fishing in Minnesota in 2025.

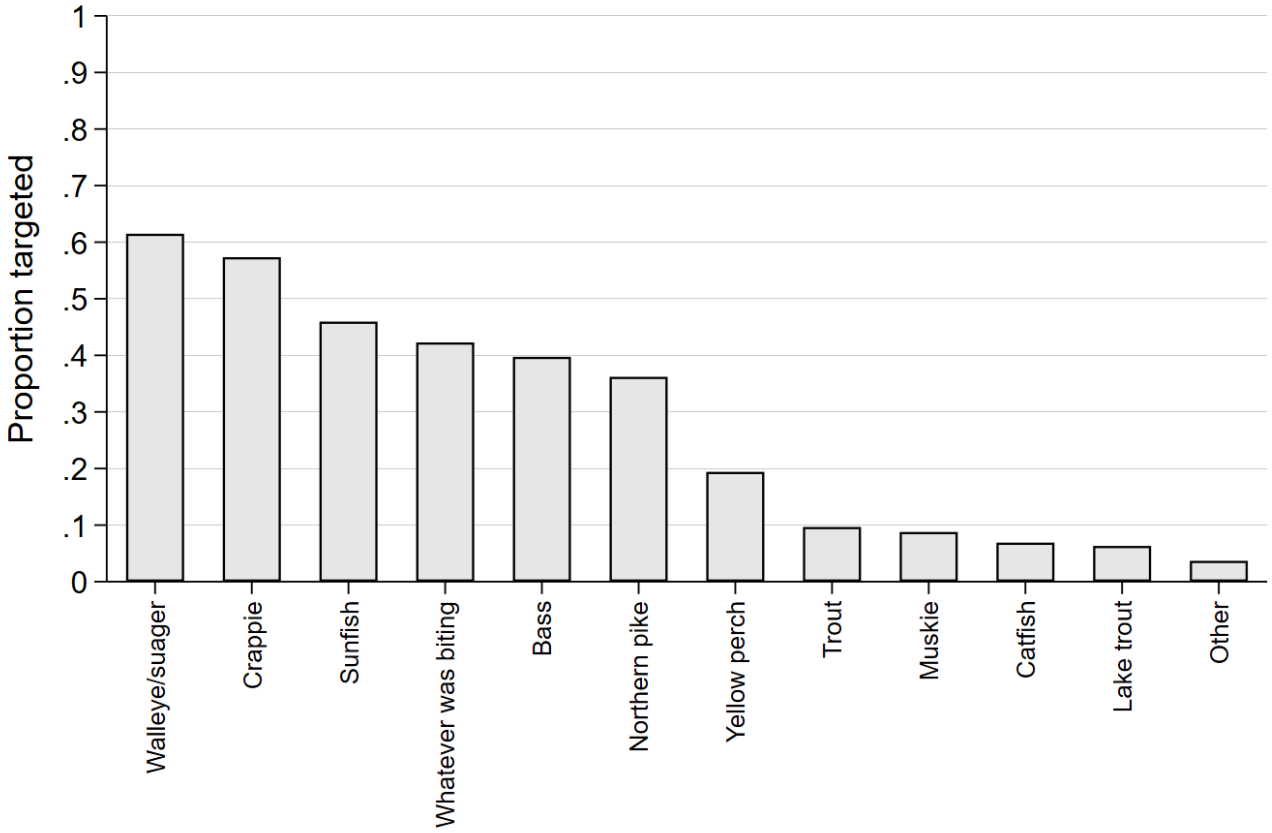


Figure 3. Estimated mean days fished while targeting different species or species groups by Minnesota anglers in 2025.

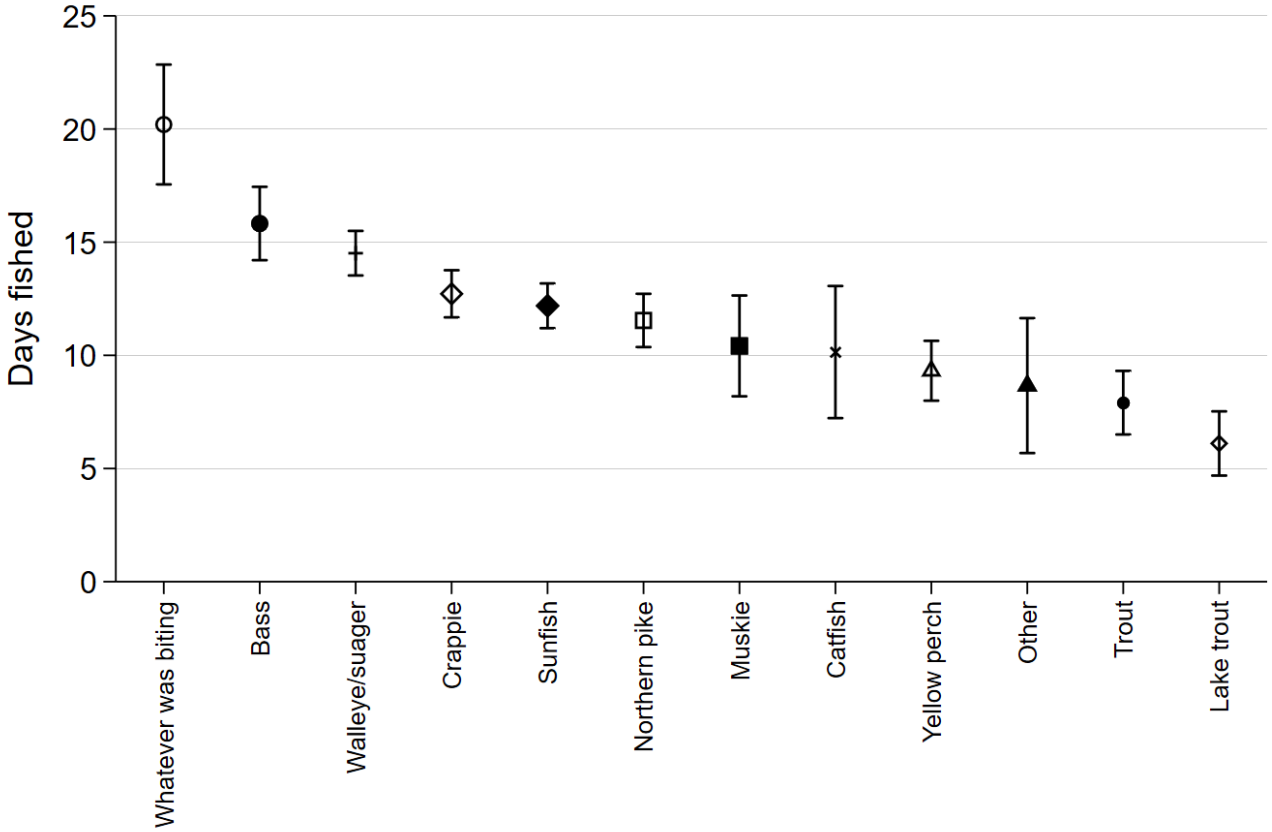
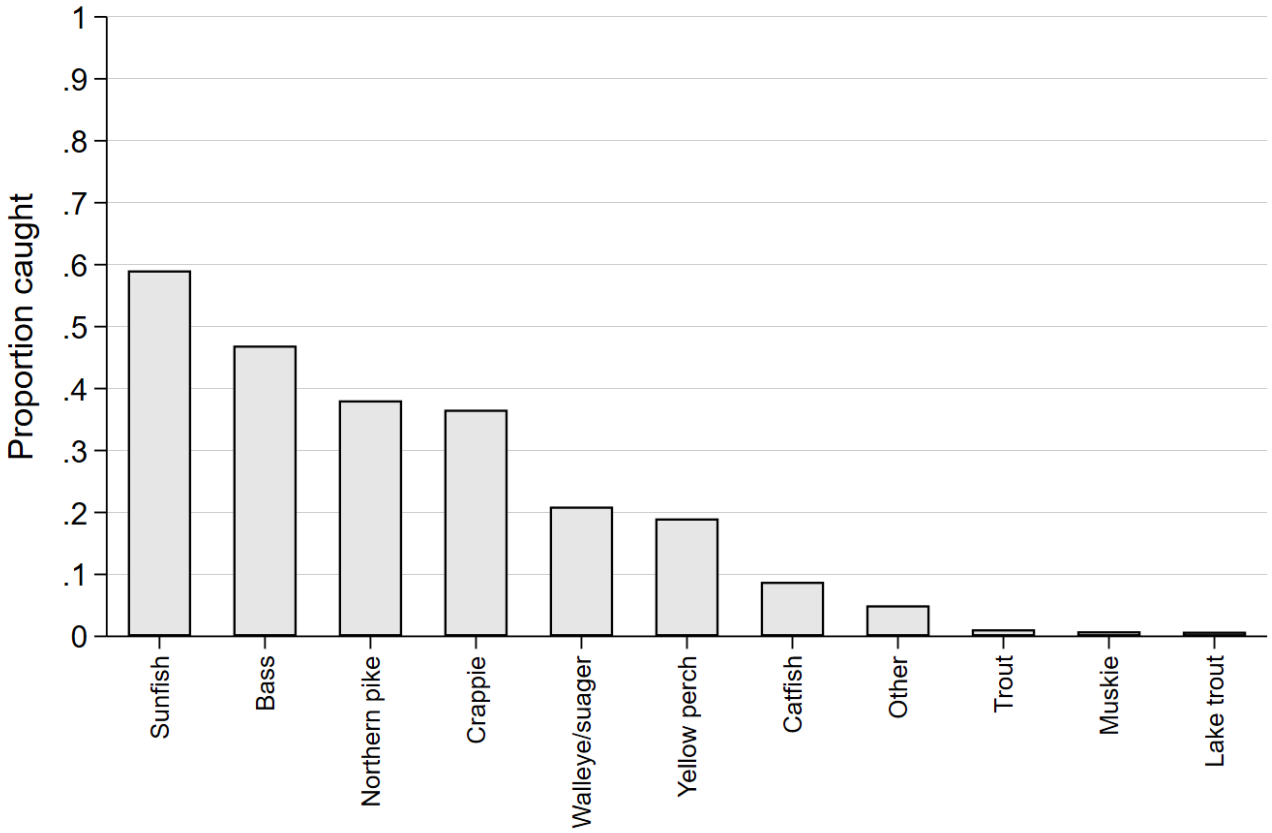


Table 4. Percentage of anglers who reported catching various species or species groups, among those that targeted "whatever was biting" in Minnesota in 2025.

	Percent caught	n
Bluegill, pumpkinseed, or other sunfish [Sunfish]	60	1048
Bass (largemouth or smallmouth)	48	1048
Northern pike	37	1048
Crappie	37	1048
Walleye or sauger	20	1048
Yellow perch	19	1048
Catfish (channel or flathead)	8	1048
Other	6	1048
Trout (rainbow, brown, book)	1	1048
Muskellunge [Muskie]	1	1048
Lake trout	1	1048

Figure 4. Proportion of anglers who caught various species or species groups among those who reported fishing for "whatever was biting" while fishing in Minnesota in 2025.



Use of LIS and other technology for ice fishing

We provided anglers with the following definition of Live Imaging Sonar (LIS) prior to the presentation of questions about their use of LIS while ice fishing. Only those that reported having fished on the ice in Minnesota in 2025 were presented with questions about ice fishing, and LIS while ice fishing.

> *Live Imaging Sonar (LIS), also known as "Forward Facing Sonar" and sold under brand names like "LiveScope", "MEGA Live", and "ActiveTarget," is a tool that generates a real-time image of the water column, the fish, your bait, and the habitat features around a boat or under the ice. It can be oriented to provide a forward, downward, or overhead view from the angler's location. It differs from other sonar like 2-dimensional sonar, side-imaging sonar, or 360-degree sonar, in that the image it generates is in real-time and accurate enough to allow an angler to pursue individual fish.*

Of the 56% of anglers that reported ice fishing during the 2025 license year, 37% reported using LIS for ice fishing (Table 5). It is important to note that this estimate is for those that used LIS, not those that may or may not have owned LIS. They may have fished with companions that had an LIS unit that they shared.

Among those that used LIS while ice fishing in Minnesota in 2025, we asked what percentage of the time they used LIS while ice fishing, how long they have been using LIS for ice fishing, and their self-assessed skill in using LIS for ice fishing. Around a third of anglers (32%) reported that they used LIS 90% of the time or more while ice fishing in Minnesota in 2025, while 15% reported using LIS 10% of the time or less. Less than half of anglers (41%) reported using LIS while ice fishing in Minnesota in 2025 50% of the time or less. Conversely, 59% of anglers reported using LIS while ice fishing in Minnesota in 2025 51% of the time or more (Table 6). Ice anglers, on average, have not been using LIS for very long, with 82% of anglers reporting that they have used LIS for ice fishing for 3 years or less (Table 7). Few anglers (4%) considered themselves an "expert" in using LIS for ice fishing. A plurality (35%) viewed themselves as "intermediate" in skill, while 27% assessed their skill as "beginner," 20% "novice," and 13% "advanced" (Table 8, Figure 5.)

We asked anglers that ice fished in Minnesota in 2025 but did not use LIS if they intended to purchase an LIS unit for ice fishing for the upcoming season. Only 9% of anglers reported that they intended to purchase an LIS unit for ice fishing (Table 9).

In addition to LIS, we asked anglers about their use of a variety of technologies for ice fishing including underwater cameras, non-LIS sonar units, auto hook-setting tip-ups, wheelhouse shelters and GPS maps. Most ice anglers (80%) reported that they used a non-LIS sonar unit while ice fishing in Minnesota in 2025. A near majority (48%) reported using GPS maps like Navionics, and close to one-third reported fishing from a wheel-house (31%) or with an underwater camera (27%). Relatively few anglers (7%) reported using an auto hook-setting tip-up (Table 10).

Table 5. Percent of Minnesota anglers who used LIS while ice fishing in 2025. Among those who participated in ice fishing.

	Percent	n
Used LIS while ice fishing in Minnesota in 2025	37	1463

Table 6. Percent of time Minnesota anglers used LIS while ice fishing in 2025 by decile. Among those who used LIS while ice fishing.

Percent of time	Percent	n
<10	15	79
11-20	6	31
21-30	6	34
31-40	2	10
41-50	12	57
51-60	1	7
61-70	3	122
71-80	13	53
81-90	10	53
+90	32	165

Table 7. Anglers' experience (percent using by number of years) using LIS while ice fishing, among those who used LIS while ice fishing in Minnesota in 2025.

Years	Percent	n
>1	23	77
1	14	45
2	25	95
3	20	61
4	7	29
5	5	17
6	2	3
7	>1	1
8	>1	4
9	-	-
10+	4	13

Table 8. Self-assessed skill using LIS for ice fishing, among those who reported using LIS for ice fishing while ice fishing in Minnesota in 2025.

	Percent	n
Beginner	27	139
Novice	20	109
Intermediate	35	174
Advanced	13	72
Expert	4	15

Figure 5. Self-assessed skill of anglers in using LIS while ice fishing, among those who used LIS while ice fishing in Minnesota in 2025.

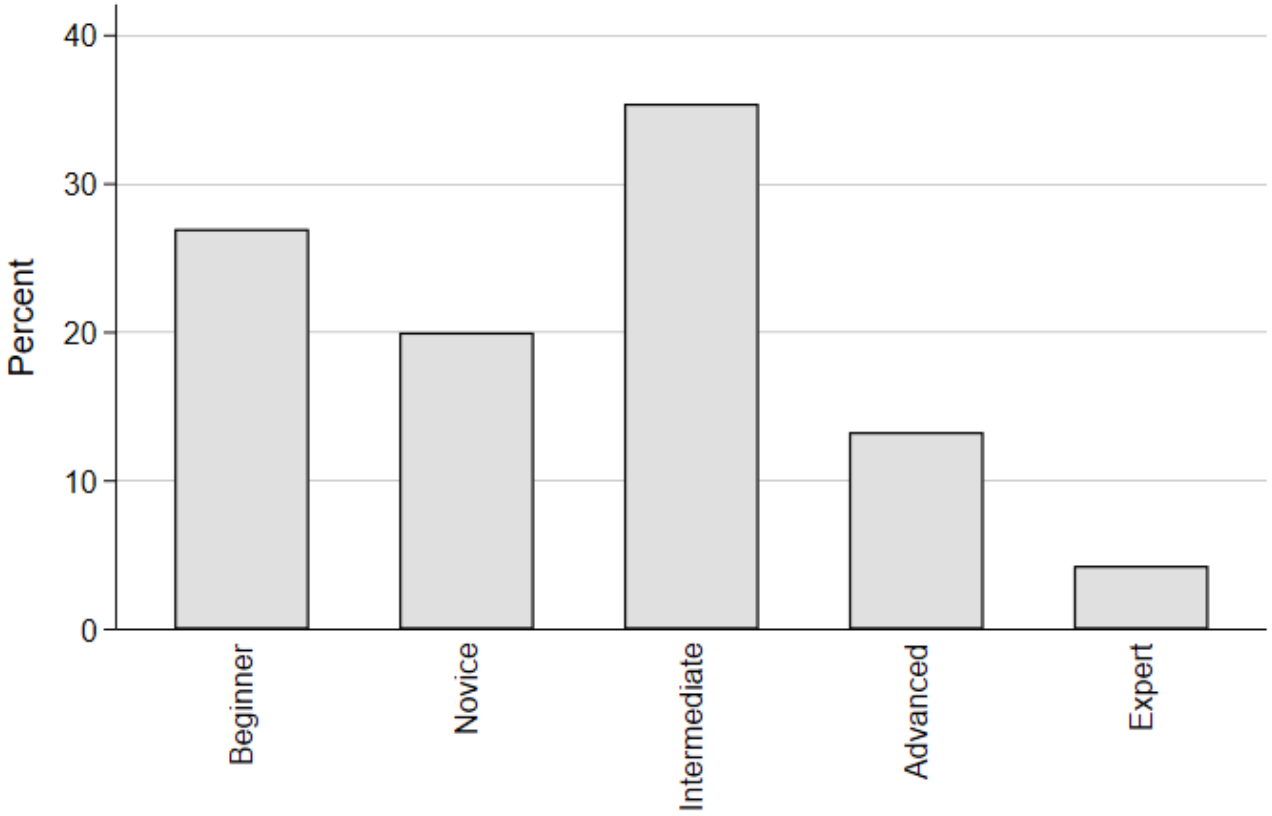


Table 9. Intent to purchase a LIS unit for use while ice fishing in Minnesota next season, among those who did not use LIS while ice fishing in 2025 but did participate in ice fishing.

	Percent	n
Angler intends to purchase a LIS unit for ice fishing next season	9	900

Table 10. Percent of anglers using various technologies while ice fishing, among those who participated in ice fishing in Minnesota in 2025.

	Percent	n
Underwater camera (e.g., Aqua-Vu)	27	1480
Portable flasher or sonar, that is not “live imaging sonar” (e.g., Vexilar)	80	1480
Auto hook-setting tip-up (e.g., Jaw Jacker)	7	1480
Wheelhouse (e.g., hard-sided towable ice shelter)	31	1480
GPS mapping (e.g., Navionics, onX)	48	1480

Use of LIS fishing from a boat

We provided anglers with the following definition of Live Imaging Sonar (LIS) prior to the presentation of questions about their use of LIS while fishing from a boat. Only those that reported having fished open water from a boat in Minnesota in 2025 were presented with questions about fishing from a boat, and LIS while fishing from a boat.

> *Live Imaging Sonar (LIS), also known as "Forward Facing Sonar" and sold under brand names like "LiveScope", "MEGA Live", and "ActiveTarget," is a tool that generates a real-time image of the water column, the fish, your bait, and the habitat features around a boat or under the ice. It can be oriented to provide a forward, downward, or overhead view from the angler's location. It differs from other sonar like 2-dimensional sonar, side-imaging sonar, or 360-degree sonar, in that the image it generates is in real-time and accurate enough to allow an angler to pursue individual fish.*

Of the 84% of anglers that reported fishing from a boat during the 2025 license year, 22% reported using LIS for boat fishing (Table 11). It is important to note that this estimate is for those that used LIS, not those that may or may not have owned LIS. They may have fished with companions that had an LIS unit that they shared.

Among those that used LIS while fishing from a boat in Minnesota in 2025, we asked what percentage of the time they used LIS while fishing from a boat, how long they have been using LIS while fishing from a boat, and their self-assessed skill in using LIS for fishing from a boat. Slightly less than a quarter of anglers (22%) reported that they used LIS 90% of the time or more while fishing from a boat in Minnesota in 2025, while 21% reported using LIS 10% of the time or less. A little more than half of anglers (54%) reported using LIS while fishing from a boat in Minnesota in 2025 50% of the time or less. Conversely, 46% of anglers reported using LIS while fishing from a boat in Minnesota in 2025 51% of the time or more (Table 12). Boat anglers, on average, have not been using LIS for very long, with 78% of anglers reporting that they have used LIS when fishing from a boat for 3 years or less (Table 13.) Few anglers (5%) considered themselves an "expert" in using LIS for fishing from a boat. A plurality (31%) viewed themselves as a "beginner", while 21% assessed their skill as "novice," 28% intermediate and 15% "advanced" (Table 14, Figure 6.)

We asked anglers that fished from a boat in Minnesota in 2025 but did not use LIS if they intended to purchase an LIS unit to fish from a boat for the upcoming season. Only 8% of anglers reported that they intended to purchase an LIS unit to fish from a boat next season (Table 15).

In addition to LIS, we asked anglers about their use of a variety of technologies for open water fishing from a boat including underwater cameras, non-LIS sonar units, spot-lock trolling motors, and GPS maps. Most boat anglers (55%) reported using some sort of GPS maps, and a non-LIS sonar (67%). A little more than a third (36%) reported using a spot lock trolling motor (Table 16.)

Table 11. Percent of Minnesota anglers who used LIS while fishing from a boat in 2025, among those who fished from a boat.

	Percent	n
Used LIS while fishing from a boat in Minnesota in 2025	22	2318

Table 12. Percent of time anglers used LIS while fishing from a boat in Minnesota in 2025 by decile, among those who used LIS while fishing from a boat.

Percent of time	Percent	n
<10	21	111
11-20	9	41
21-30	10	42
31-40	2	9
41-50	12	69
51-60	4	13
61-70	3	10
71-80	11	55
81-90	5	22
+90	22	89

Table 13. Anglers' experience (percent using by number of years) using LIS while fishing from a boat, among those who used LIS while fishing from a boat in Minnesota in 2025.

Years	Percent	n
>1	13	57
1	20	94
2	24	112
3	21	83
4	8	33
5	9	34
6	2	9
7	1	4
8	2	4
9	-	-
10+	-	-

Table 14. Self-assessed skill using LIS while fishing from a boat, among those who reported using LIS while fishing from a boat in Minnesota in 2025.

	Percent	n
Beginner	31	142
Novice	21	103
Intermediate	28	145
Advanced	15	65
Expert	5	17

Figure 6. Self-assessed skill of anglers in using LIS while fishing from a boat, among those who used LIS while fishing from a boat in Minnesota in 2025.

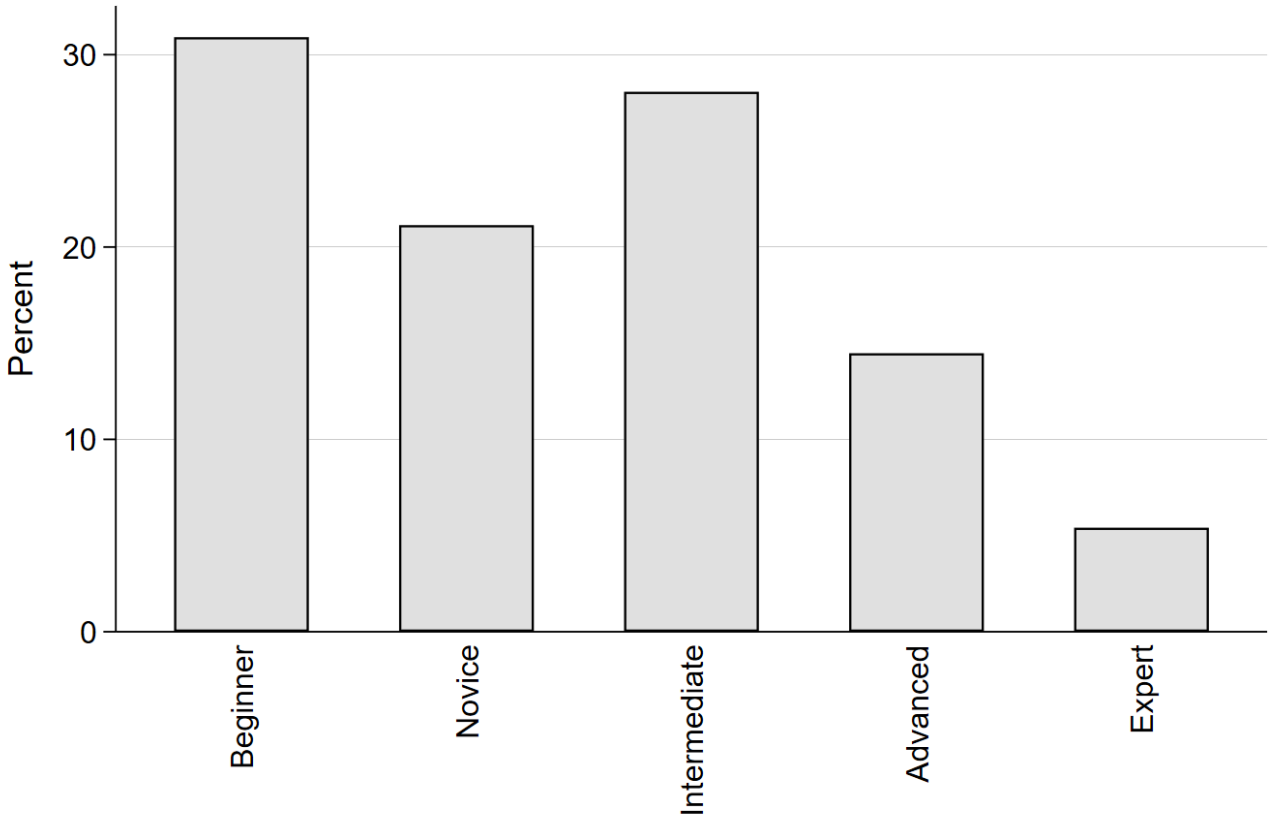


Table 15. Intent to purchase a LIS unit for use while fishing from a boat Minnesota next season, among those who did not use LIS while fishing from a boat in 2025 but did fish from a boat.

	Percent	n
Angler intends to purchase a LIS unit for fishing from a boat next season	8	1800

Table 16. Percent of anglers using various technologies while fishing form a boat, among those who fished from a boat in Minnesota in 2025.

	Percent	n
“Spot-lock” capable trolling motor	36	2358
GPS mapping (e.g., Navionics, onX, Head unit display)	55	2358
Non-LIS sonar	67	2358

Percent of time using LIS by species or species group

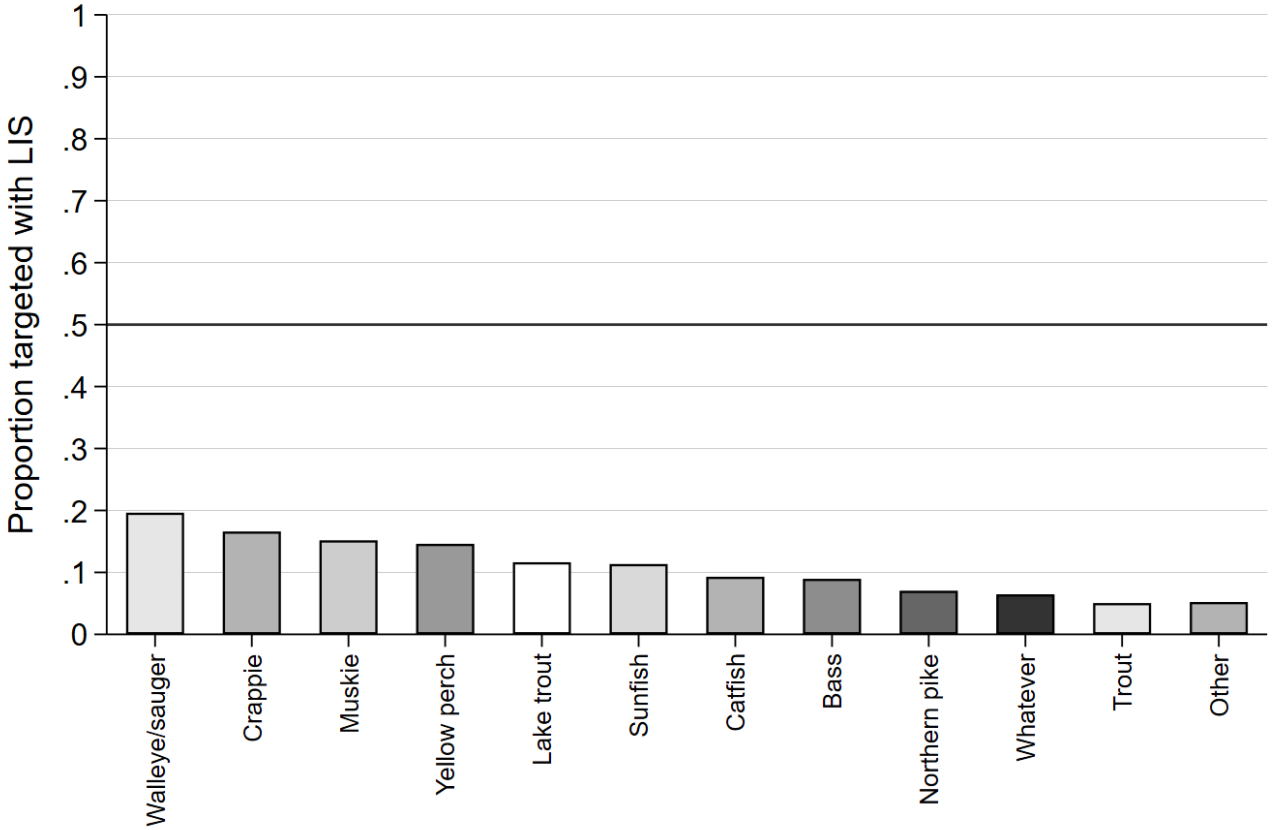
We asked anglers that used LIS to report what percentage of the time they used LIS to target various species or species groups while fishing in Minnesota in 2025. Responses were recorded using a drop-down menu with 1% increments. We re-coded these values to categories of 1%-50%, 51%-99% and 100%. Walleye or sauger and lake trout were tied for the species or species groups for which the highest percent (21%) of anglers used LIS 100% of the time to target. This was followed by crappie (18%), sunfish (14%), muskie (14%), yellow perch (13%), “other” (13%), bass (large and smallmouth) (9%), catfish (8%), “whatever was biting” (8%), northern pike (7%) and trout (5%) (Table 17).

We also calculated the proportion of all anglers that spent any time targeting a species or species group using LIS while fishing in Minnesota in 2025. Walleye or sauger were again the species or species group anglers most targeted using LIS, though this is confounded by the proportion of anglers targeting each species or species group respectively (Figure 7).

Table 17. Percent of time anglers spent using LIS to fish for various species or species groups in Minnesota in 2025, among those that used LIS.

	Did not use LIS	1%-50%	51%-99%	100%	n
Walleye or sauger	41	24	15	21	538
Lake trout	67	9	3	21	55
Crappie	49	23	11	18	469
Bluegill, pumpkinseed, or other sunfish [Sunfish]	61	17	9	14	334
Muskellunge [Muskie]	63	10	13	14	92
Yellow perch	59	22	6	13	166
Other	86	-	2	13	28
Bass (largemouth or smallmouth)	68	14	8	9	296
Catfish (channel or flathead)	71	10	12	8	47
Whatever was biting	68	19	5	8	220
Northern pike	75	14	4	7	255
Trout (rainbow, brown, book)	85	8	3	5	87

Figure 7. Proportion of anglers that targeted various species or species groups using LIS, among those that targeted various species or species groups while fishing in Minnesota in 2025.



Beliefs about LIS

Prior to conducting the survey, we completed semi-structured interviews with anglers and held conversations with fisheries managers and members of a Minnesota fisheries technology committee, with the goal of eliciting sets of beliefs about LIS. Following this work, we developed 18 statements reflecting the themes of the content we heard from interview participants, managers and committee members. These statements are presented in Table 18. Respondents recorded their agreement on a scale from 1 to 7 where 1 = strongly disagree, 7 = strongly agree, and 4 = neither. Analysis of these items is limited to the push-to-web sample only as there was a typographical error in the response scale for the email sample. While the sample used to make estimates to the population of Minnesota anglers differs from the sample used in the remainder of this report, it still far exceeds minimum sample size necessary to generalize to the population with 95% confidence at margin of +/-5%, and the push-to-web sample was designed to have standalone validity. Table 18 contains the percentage of anglers selecting nominal response categories (strongly disagree to strongly agree) for each item.

To reduce dimensionality, we subjected the data to exploratory factor analysis (EFA). This process elucidates patterns of covariance among responses to individual items and reveals latent factors that account for them. We used principal axis factoring, rotated loadings using the Oblimin method, and applied the Kaiser normalization. We retained factors that exceeded an eigenvalue of 1.0, and items that loaded onto a single factor with standardized value exceeding 0.32. Results suggest that two latent factors account for the pattern of covariance in items, we labeled these “challenges” and “opportunities,” and created scale variables that are the average of responses to items loading on these factors. We confirmed the empirical solution obtained from EFA using parallel analysis in the “paran” package (Dinno, 2010) in Stata 16 (StataCorp, 2020). A scree plot of the adjusted eigenvalues from the unrotated solution as compared to random also suggested the existence of two latent factors in the data. Higher scores on the challenges factor reflect agreement with a belief that LIS has negative impacts on fisheries and angling experience. Higher scores on the opportunities factor reflects agreement with a belief that LIS affords opportunities for angling R3 and enhanced fishing experience. We reverse coded two items that negatively loaded on the challenges factor; “LIS won’t impact fish populations if anglers release the fish they catch,” and “If anglers follow regulations, LIS won’t negatively impact fisheries.” The item “changing regulations to deal with LIS punishes everyone because of the actions of some” did not load on either factor and was not included in either scale. The EFA results are for a model that does not include this item. Table 19 contains EFA results.

Table 20 and Figure 8 contain mean estimates for responses to each item for those that did and did not use LIS while fishing in Minnesota in 2025. Table 21 contains mean estimates for the challenges and opportunities scales for those that did and did not use LIS while fishing in Minnesota in 2025. We observed a statistically significant difference in agreement with all items by LIS use. Those that used LIS in 2025 had lower agreement with items measuring challenges than those that did not, while the opposite held for items measuring opportunities where those that use LIS more strongly agreed.

We also asked anglers to report their perception about the impact of LIS on catch rates. The question was phrased “Anglers that use LIS catch ____ fish compared to anglers who do not use LIS.” Response options included “many fewer,” “fewer,” “about the same number of,” “more,” and “many more.” Table 22 contains the percentage of all anglers selecting each option, and for those that did and did not use LIS while fishing in Minnesota in 2025. Most anglers, regardless of LIS use, perceived that anglers that use LIS catch more fish. More

anglers that use LIS perceived that they catch “about the same number of” fish, while more anglers that did not use LIS perceived that anglers that did use LIS caught “many more” fish.

Table 18. Anglers' agreement or disagreement (percent selecting categories) with statements about LIS.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree	n
LIS won't impact fish populations if anglers release the fish they catch.	14	13	14	15	14	15	15	1385
LIS does not give fish a fair chance to escape.	17	9	10	19	15	14	15	1384
LIS takes the skill out of fishing.	13	9	8	14	17	18	20	1384
Catching a fish using LIS isn't the same as catching one without it.	8	6	6	20	14	16	29	1385
LIS gives anglers that use it an unfair advantage over other anglers.	8	5	5	14	19	20	29	1385
LIS use by some anglers reduces the quality of the fishing experience for anglers without it.	14	8	8	23	17	14	17	1388
The sound of LIS in the water can change fish behavior.	7	5	4	51	15	9	9	1383
Angling with LIS is changing how fish react to bait.	10	8	7	46	14	9	7	1385
Increasing catch and release angling because of LIS is reducing catch rates overall.	8	6	9	43	16	10	7	1377
If anglers follow regulations, LIS won't negatively impact fisheries.	11	11	14	19	1	14	15	1382

- Analysis conducted on the push-to-web sample only.

Table 18. Anglers' agreement or disagreement (percent selecting categories) with statements about LIS. Continued.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree	n
Changing regulations to deal with LIS punishes everyone because of the actions of some.	7	8	7	20	21	17	21	1382
Anglers that use LIS catch more fish.	5	4	5	23	23	20	21	1380
With LIS, anglers can catch the fish they want to catch.	7	6	10	20	30	18	10	1386
LIS gives anglers a chance to observe fish and their behavior in their natural habitat.	3	3	3	14	27	26	25	1382
LIS could help recruit anglers that might not have taken an interest in fishing otherwise.	6	10	7	23	31	13	10	1382
LIS could help reactivate anglers that have stopped fishing.	8	10	9	25	28	11	8	1381
LIS could help keep anglers fishing that might have stopped otherwise.	8	9	9	24	28	14	9	1381
LIS enhances the fishing experience for anglers that use it.	4	4	5	19	27	25	16	1383

- Analysis conducted on the push-to-web sample only.

Table 19. Results of exploratory factor analysis on LIS belief statements. Standardized factor loadings reported.

	Challenges	Opportunities
	λ	λ
LIS won't impact fish populations if anglers release the fish they catch. – r	-0.46	
LIS does not give fish a fair chance to escape.	0.78	
LIS takes the skill out of fishing.	0.81	
Catching a fish using LIS isn't the same as catching one without it.	0.71	
LIS gives anglers that use it an unfair advantage over other anglers.	0.82	
LIS use by some anglers reduces the quality of the fishing experience for anglers without it.	0.81	
The sound of LIS in the water can change fish behavior.	0.55	
Angling with LIS is changing how fish react to bait.	0.64	
Increasing catch and release angling because of LIS is reducing catch rates overall.	0.63	
If anglers follow regulations, LIS won't negatively impact fisheries. – r	-0.58	
Changing regulations to deal with LIS punishes everyone because of the actions of some.	-	-
Anglers that use LIS catch more fish.	0.68	
With LIS, anglers can catch the fish they want to catch.	0.53	
LIS gives anglers a chance to observe fish and their behavior in their natural habitat.		0.49
LIS could help recruit anglers that might not have taken an interest in fishing otherwise.		0.77
LIS could help reactivate anglers that have stopped fishing.		0.83
LIS could help keep anglers fishing that might have stopped otherwise.		0.80
LIS enhances the fishing experience for anglers that use it.		0.50
Mean (SD)	4.35 (1.3)	4.66 (0.95)
α	0.90	0.68

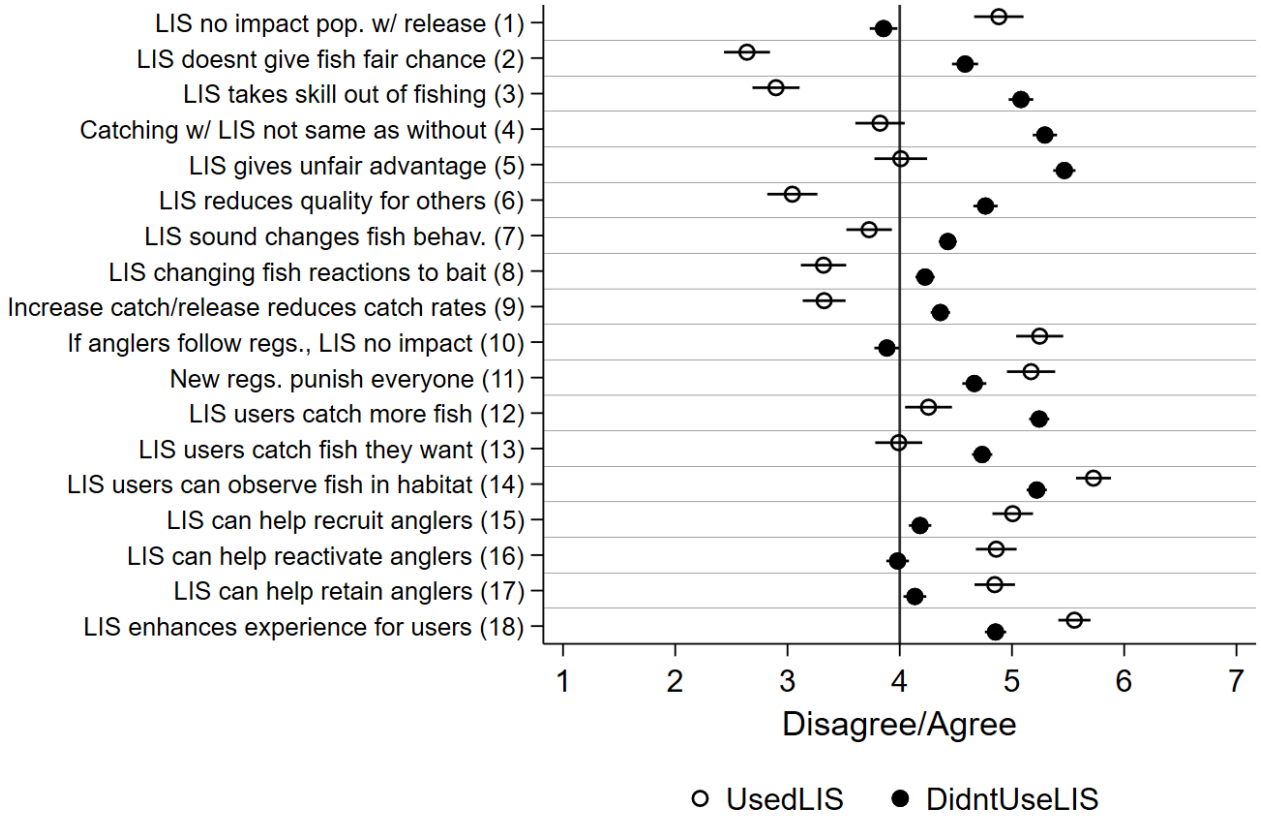
- Principle axis factoring
- Oblique rotation (Oblimin) with Kaiser normalization
- Analysis conducted on the push-to-web sample only

Table 20. Estimated marginal means following linear regression of beliefs about LIS for those that did and did not use LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate of use of LIS on belief.

	Mean					
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared	Fig. #
LIS won't impact fish populations if anglers release the fish they catch.	3.87	4.82	8.02	<0.001	0.05	1
LIS does not give fish a fair chance to escape.	4.59	2.71	-16.39	<0.001	0.13	2
LIS takes the skill out of fishing.	5.05	2.94	-19.16	<0.001	0.21	3
Catching a fish using LIS isn't the same as catching one without it.	5.27	3.85	-12.74	<0.001	0.11	4
LIS gives anglers that use it an unfair advantage over other anglers.	5.43	4.03	-13.27	<0.001	0.12	5
LIS use by some anglers reduces the quality of the fishing experience for anglers without it.	4.75	3.10	-14.75	<0.001	0.14	6
The sound of LIS in the water can change fish behavior.	4.44	3.77	-7.57	<0.001	0.04	7
Angling with LIS is changing how fish react to bait.	4.23	3.39	-9.12	<0.001	0.06	8
Increasing catch and release angling because of LIS is reducing catch rates overall.	4.38	3.37	-11.18	<0.001	0.09	9
If anglers follow regulations, LIS won't negatively impact fisheries.	3.87	5.21	12.04	<0.001	0.10	10
Changing regulations to deal with LIS punishes everyone because of the actions of some.	4.65	5.13	4.44	<0.001	0.01	11
Anglers that use LIS catch more fish.	5.25	4.30	-9.94	<0.001	0.07	12
With LIS, anglers can catch the fish they want to catch.	4.73	4.03	-7.40	<0.001	0.04	13
LIS gives anglers a chance to observe fish and their behavior in their natural habitat.	5.22	5.72	5.73	<0.001	0.02	14
LIS could help recruit anglers that might not have taken an interest in fishing otherwise.	4.21	5.01	8.26	<0.001	0.05	15
LIS could help reactivate anglers that have stopped fishing.	3.99	4.85	8.79	<0.001	0.05	16
LIS could help keep anglers fishing that might have stopped otherwise.	4.14	4.83	6.92	<0.001	0.03	17
LIS enhances the fishing experience for anglers that use it.	4.85	5.53	7.55	<0.001	0.04	18

- 1 = strongly disagree, 4 = neither, 7 = strongly agree
- Analysis conducted on the push-to-web sample only
- Fig. # corresponds to the abbreviated item wording in Figure 8

Figure 8. Mean agreement or disagreement with statements about LIS by use of LIS while fishing in Minnesota in 2025.



- Analysis conducted on the push-to-web sample only.
- Numbers "(1)" correspond to "Fig. #" in Table 20 for complete wording

Table 21. Estimated marginal means following linear regression of beliefs about LIS for those that did and did not use LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate of use of LIS on belief.

	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Challenges	4.7	3.4	-16.71	<0.001	0.18
Opportunities	4.6	4.9	4.61	<0.001	0.02

- Analysis conducted on push-to-web sample only.

Table 22. Anglers' perception (percent selecting categories) of the effect of LIS on catch rates by use of LIS while fishing in Minnesota in 2025.

Anglers that use LIS catch ____ fish compared to anglers who do not use LIS.	Much fewer	Fewer	About the same number of	More	Much more	n
All anglers	0	1	24	56	18	2537
Used LIS	1	2	38	51	8	623
Did not use LIS	0	1	19	58	22	1836

Acceptability of using LIS by species or species group

We asked anglers to report their perception of the acceptability of using LIS to fish for various species or species groups in open water from a boat and through the ice. Respondents recorded responses on a scale from very unacceptable to very acceptable with a neutral mid-point. Table 23 contains the percentage of anglers selecting response category for each species or species group for fishing from a boat, and Table 24 for through the ice.

We also compared mean levels of acceptability of using LIS to fish for each species or species group from a boat (Table 25 and Figure 9) and through the ice (Table 26 and Figure 10) by those anglers that used LIS while fishing in Minnesota in 2025 and those that did not.

For all species, and for both fishing from a boat and through the ice, anglers that did not use LIS, on average, rated using LIS as slightly unacceptable, and significantly lower than those that did. Muskellunge was a point of interest as those that did use LIS rated the acceptability of using LIS lower than for other species.

We also asked anglers about the acceptability of using LIS for dark house spearing northern pike. A plurality of anglers (37%) reported that using LIS for dark house spearing was neither acceptable or unacceptable, while 19% responded that the practice was very unaccepted, and 12% stated very acceptable (Table 27). On average, those that did not use LIS rated using LIS for dark house spearing for northern pike as less acceptable than those that did use LIS while fishing in Minnesota in 2025 (Table 28).

Table 23. Anglers' perceptions (percent selecting categories) of the acceptability of using LIS to fish for various species or species groups from a boat.

	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable	n
Bass (largemouth or smallmouth)	12	9	10	26	14	12	17	2466
Muskellunge	20	12	10	26	10	8	14	2449
Walleye or sauger	18	11	10	22	12	11	16	2461
Northern pike	15	10	11	27	12	10	16	2445
Bluegill, pumpkinseed, or other sunfish [Sunfish]	14	9	10	28	11	10	17	2451
Crappie	17	10	11	25	12	10	16	2451
Yellow perch	12	9	10	30	11	10	17	2441
Lake trout	17	10	8	31	11	9	15	2425
Trout (rainbow, brook, brown)	18	10	8	34	9	7	13	2425
Catfish (channel or flathead)	11	7	8	36	10	10	18	2423
All fish	13	12	11	25	14	10	14	2439

Table 24. Anglers' perceptions (percent selecting categories) of the acceptability of using LIS to fish for various species or species groups through the ice.

	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable	n
Bass (largemouth or smallmouth)	12	9	8	29	13	10	18	2382
Muskellunge OMITTED FOR ICE	-	-	-	-	-	-	-	-
Walleye or sauger	16	10	9	23	14	11	18	2365
Northern pike	13	9	9	26	13	10	19	2362
Bluegill, pumpkinseed, or other sunfish [Sunfish]	14	9	8	26	13	11	19	2360
Crappie	16	9	8	25	13	11	18	2362
Yellow perch	13	8	8	28	14	11	18	2350
Lake trout	16	8	8	30	12	9	17	2348
Trout (rainbow, brook, brown)	17	7	8	32	11	9	16	2341
Catfish (channel or flathead)	12	6	7	36	12	9	18	2344
All fish	14	9	9	25	15	11	17	2372

Table 25. Estimated marginal means following linear regression of perceptions of the acceptability of using LIS to fish for various species or species groups from a boat on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Bass (largemouth or smallmouth)	3.77	5.52	21.85	<0.001	0.17
Muskellunge	3.36	4.85	17.11	<0.001	0.11
Walleye or sauger	3.38	5.49	25.63	<0.001	0.22
Northern pike	3.59	5.33	21.28	<0.001	0.16
Bluegill, pumpkinseed, or other sunfish [Sunfish]	3.63	5.41	21.80	<0.001	0.17
Crappie	3.54	5.34	21.32	<0.001	0.16
Yellow perch	3.68	5.47	22.80	<0.001	0.18
Lake trout	3.45	5.23	21.80	<0.001	0.17
Trout (rainbow, brook, brown)	3.32	5.11	22.36	<0.001	0.18
Catfish (channel or flathead)	3.87	5.33	18.38	<0.001	0.13
All fish	3.50	5.43	24.77	<0.001	0.21

Table 26. Estimated marginal means following linear regression of perceptions of the acceptability of using LIS to fish for various species or species groups through the ice on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Bass (largemouth or smallmouth)	3.78	5.46	20.45	<0.001	0.15
Muskellunge OMITTED FOR ICE	-	-	-	-	-
Walleye or sauger	3.59	5.58	23.31	<0.001	0.19
Northern pike	3.73	5.56	22.02	<0.001	0.17
Bluegill, pumpkinseed, or other sunfish [Sunfish]	3.71	5.58	22.36	<0.001	0.18
Crappie	3.68	5.52	21.39	<0.001	0.17
Yellow perch	3.75	5.57	22.22	<0.001	0.18
Lake trout	3.61	5.38	21.16	<0.001	0.16
Trout (rainbow, brook, trout)	3.57	5.32	20.95	<0.001	0.16
Catfish (channel or flathead)	3.89	5.39	18.68	<0.001	0.13
All fish	3.66	5.55	23.33	<0.001	0.19

Figure 9. Mean acceptability of using LIS to fish for various species or species groups from a boat by use of LIS while fishing in Minnesota in 2025.

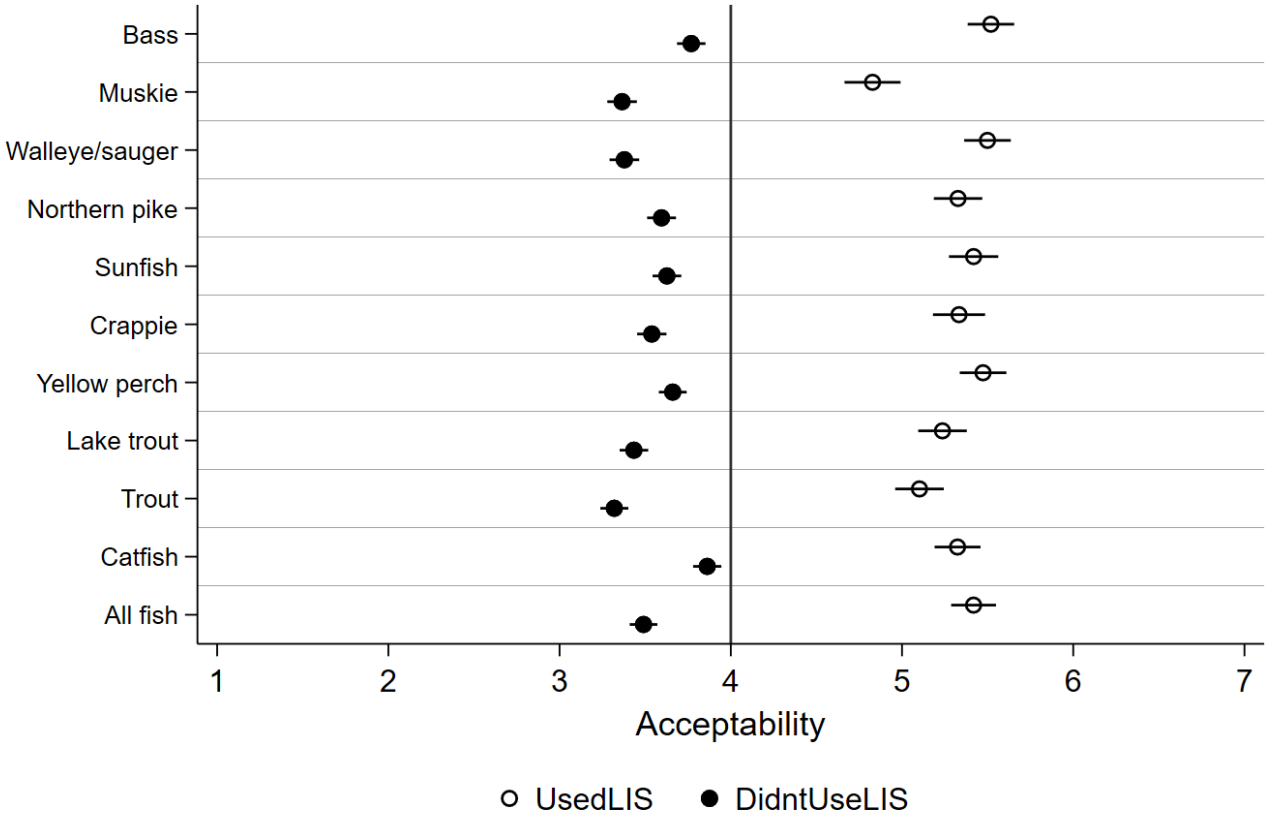


Figure 10. Mean acceptability of using LIS to fish for various species or species groups while ice fishing by use of LIS while fishing in Minnesota in 2025.

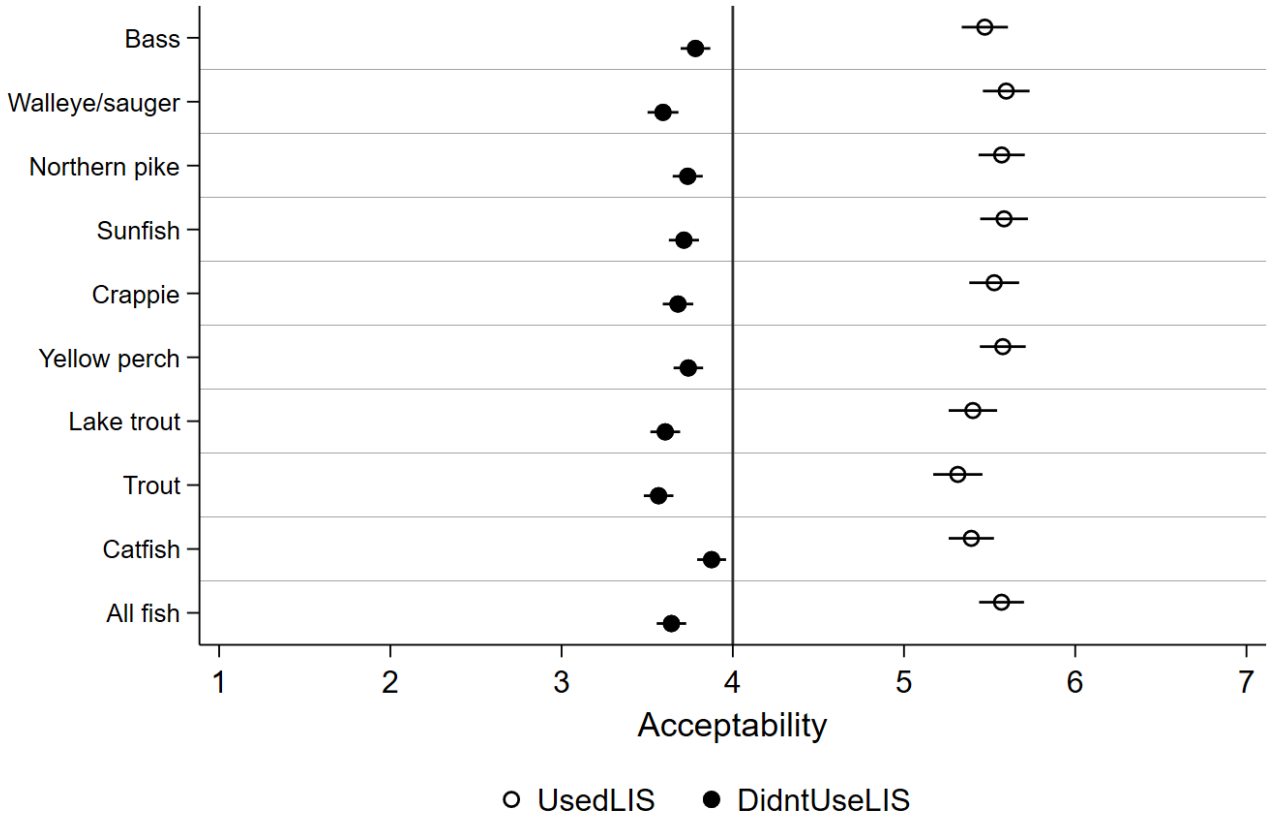


Table 27. Acceptability (percent selecting categories) of using LIS for dark house spearing for northern pike by use of LIS while fishing in Minnesota in 2025.

	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable	n
All anglers	19	10	9	37	6	6	12	2409
Used LIS	10	5	4	40	6	9	27	595
Did not use LIS	23	12	10	37	6	5	7	1741

Table 28. Estimated marginal means following linear regression of perceptions of the acceptability of using LIS for dark house spearing for northern pike on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
How acceptable or unacceptable do you find the use of Live Imaging Sonar (LIS) in dark house spearing for northern pike?	3.34	4.62	15.39	<0.001	0.09

Acceptability of hypothetical new LIS features

We presented anglers with scenarios regarding potential future applications of LIS and asked them to rate their acceptability. These scenarios included A LIS system that "…uses artificial intelligence to interpret images for the angler making it easier to identify fish species and size," "…that links to the boat's trolling motor and locks on to and automatically follows an individual fish as it moves through a waterbody," "…can provide an angler with a real-time 360-degree view of the area underwater around their boat," "…can provide an angler with real-time images at much greater distances than is possible with current models," "…can provide an angler with real-time images at a much higher resolution than is possible with current models," "…can provide an angler with enhanced visualizations like virtual reality or 3-D images of fish habitat or bait." Respondents recorded their response on a scale where 1 = very unacceptable 4 = neither, and 7 = very acceptable. Table 29 contains the percentage of anglers selecting each response category for each scenario.

A notable finding pertains to the scenario describing an LIS system that would link to a boat trolling motor and automatically follow a fish. A plurality of anglers (42%) found this scenario very unacceptable, and regardless of whether they used LIS in 2025, mean estimates fell below a value of 4 (Table 30, Figure 11), indicating that on average anglers find this an unacceptable use of LIS.

A similar pattern played out for the remaining scenarios where anglers that used LIS in 2025, on average, found future applications of LIS acceptable and those that did not use found them unacceptable. These findings suggest that a chance for escape is a belief common to most anglers' construction of fair chase.

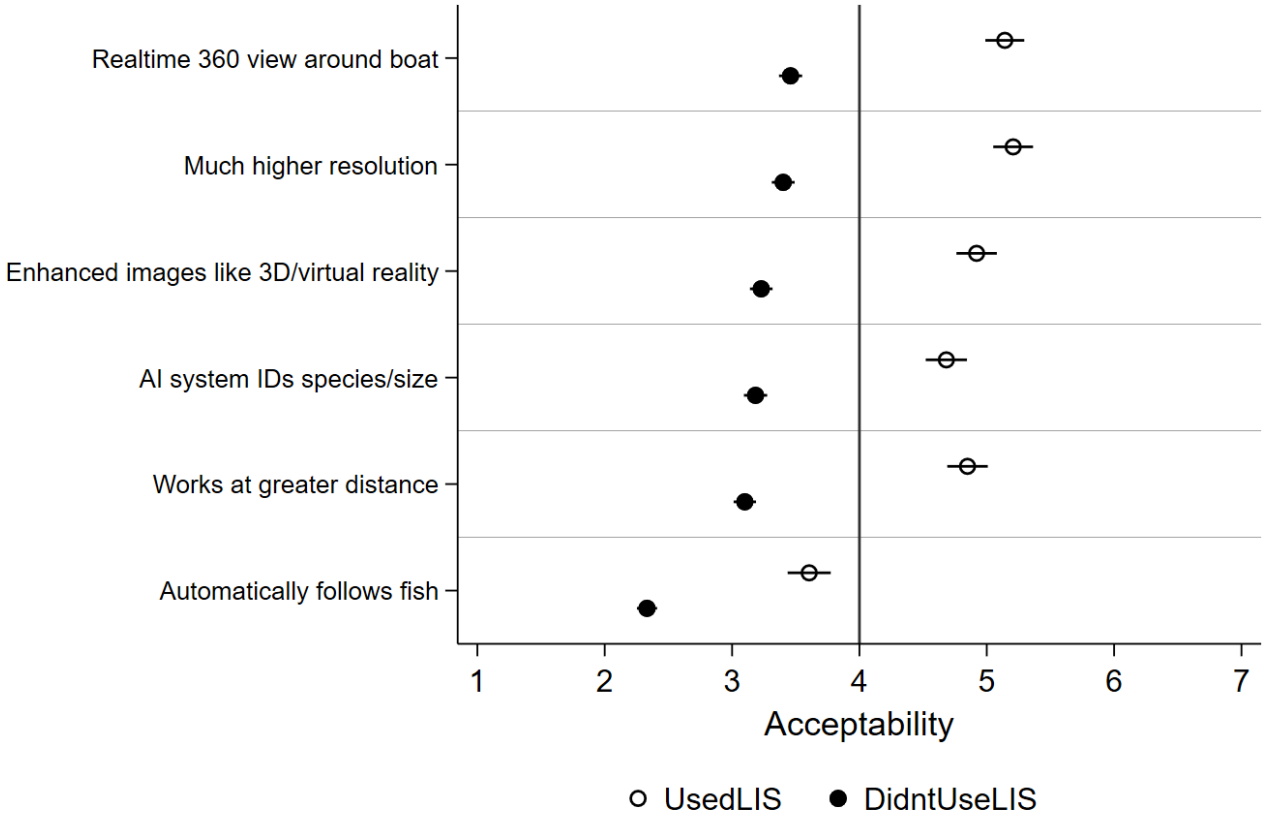
Table 29. Perceptions of the acceptability (percent selecting categories) of scenarios of hypothetical future applications of LIS.

A LIS system that…	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable	n
…uses artificial intelligence to interpret images for the angler making it easier to identify fish species and size	24	13	9	18	15	8	12	2387
…that links to the boat's trolling motor and locks on to and automatically follows an individual fish as it moves through a waterbody	42	13	13	14	7	4	7	2383
…can provide an angler with a real-time 360-degree view of the area underwater around their boat	19	11	10	18	17	9	15	2382
…can provide an angler with real-time images at much greater distances than is possible with current models	24	12	10	20	14	7	13	2379
…can provide an angler with real-time images at a much higher resolution than is possible with current models	21	10	9	21	15	9	16	2377
…can provide an angler with enhanced visualizations like virtual reality or 3-D images of fish habitat or bait	22	11	11	20	13	8	14	2382

Table 30. Estimated marginal means following linear regression of perceptions of the acceptability of hypothetical future applications of LIS on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

A LIS system that…	Mean		t-value	p-value	Eta-squared
	Did not use LIS	Used LIS			
…uses artificial intelligence to interpret images for the angler making it easier to identify fish species and size	3.19	4.68	16.54	<0.001	0.11
…that links to the boat's trolling motor and locks on to and automatically follows an individual fish as it moves through a waterbody	2.33	3.61	15.25	<0.001	0.09
…can provide an angler with a real-time 360-degree view of the area underwater around their boat	3.46	5.14	18.94	<0.001	0.13
…can provide an angler with real-time images at much greater distances than is possible with current models	3.10	4.85	19.88	<0.001	0.15
…can provide an angler with real-time images at a much higher resolution than is possible with current models	3.40	5.21	20.23	<0.001	0.15
…can provide an angler with enhanced visualizations like virtual reality or 3-D images of fish habitat or bait	3.23	4.92	19.13	<0.001	0.14

Figure 11. Estimated mean acceptability of scenarios of hypothetical future applications of LIS by use of LIS while fishing in Minnesota in 2025.



Perceptions of impacts of LIS by species or species group

We asked anglers to report their perception of the impacts that LIS could have on populations of various fish species or species groups over the next 5 years. They recorded responses on a scale where 1 = none, 2 = some impact, 3 = moderate impact, 4 = a fair amount of impact, and 5 = a great deal of impact. Table 31 contains the percent of all anglers selecting each response category by species or species group. In the case of each species or species group, and for all fish overall, those that did not use LIS in 2025 perceived that LIS will have a greater impact in the next 5 years than those did not use LIS (Table 32, Figure 12).

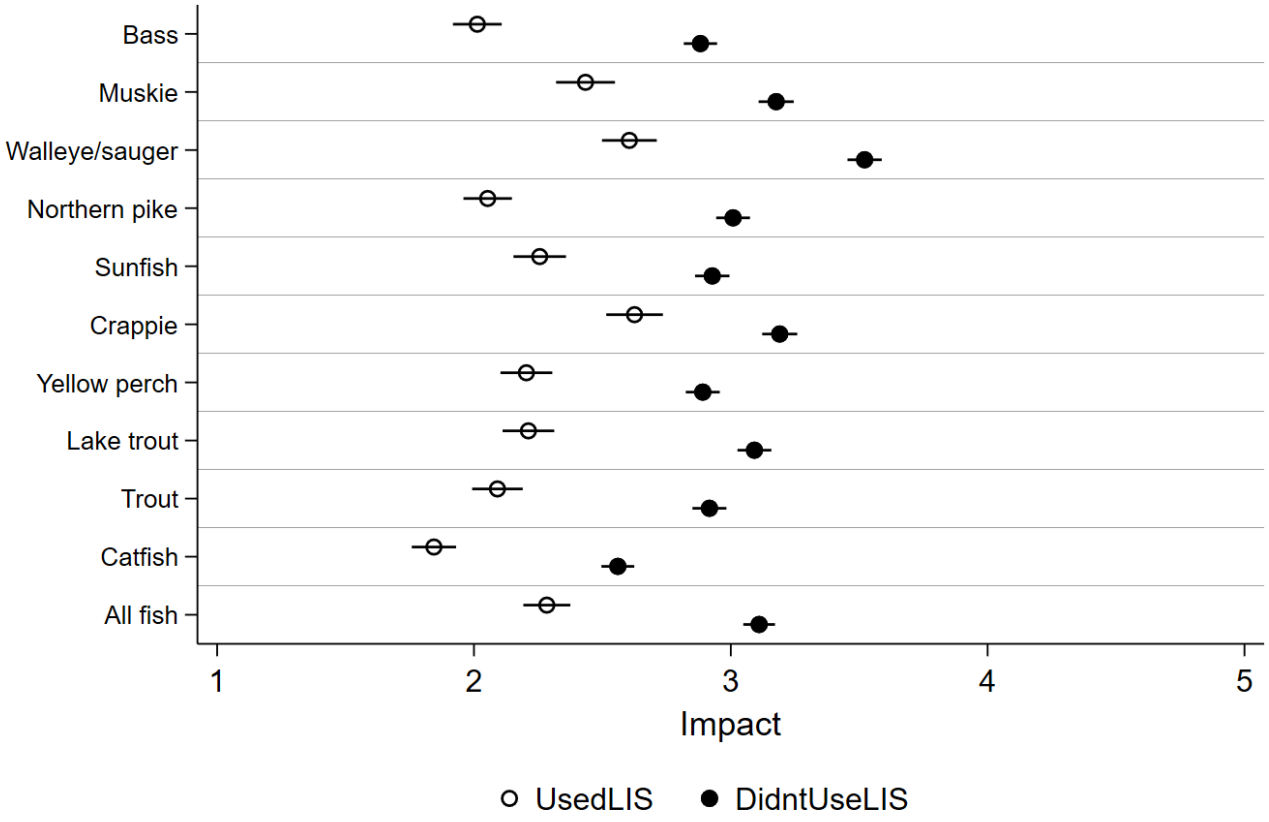
Table 31. Anglers' perception of (percent selecting categories) the degree of impact LIS could have on populations of various species or species groups in the next 5 years.

	None	Some impact	Moderate impact	A fair amount of impact	A great deal of impact	n
Bass (largemouth or smallmouth)	23	31	18	15	13	2303
Muskellunge	19	26	17	16	22	2297
Walleye or sauger	13	23	17	20	27	2303
Northern pike	21	29	18	17	15	2299
Bluegill, pumpkinseed, or other sunfish [Sunfish]	21	30	19	15	16	2291
Crappie	16	27	19	15	23	2300
Yellow perch	21	31	18	14	15	2283
Lake trout	19	29	18	17	17	2276
Trout (rainbow, brook, brown)	23	30	18	16	14	2270
Catfish (channel or flathead)	30	33	16	11	10	2272
All fish	14	33	21	19	14	2290

Table 32. Estimated marginal means following linear regression of perceptions of the impact of LIS on populations of various species or species groups in the next 5 years on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Bass (largemouth or smallmouth)	2.89	2.02	-14.30	<0.001	0.08
Muskellunge	3.17	2.44	-11.00	<0.001	0.08
Walleye or sauger	3.51	2.61	-14.22	<0.001	0.08
Northern pike	3.00	2.07	-15.39	<0.001	0.10
Bluegill, pumpkinseed, or other sunfish [Sunfish]	2.92	2.26	-10.46	<0.001	0.05
Crappie	3.17	2.63	-8.49	<0.001	0.03
Yellow perch	2.88	2.20	-10.90	<0.001	0.05
Lake trout	3.08	2.21	-14.10	<0.001	0.08
Trout (rainbow, brook, brown)	2.91	2.10	-13.11	<0.001	0.07
Catfish (channel or flathead)	2.55	1.85	-12.03	<0.001	0.06
All fish	3.10	2.29	-14.28	<0.001	0.08

Figure 12. Estimated mean degree of impact of LIS on populations of various species or species groups in the next 5 years, by use of LIS while fishing in Minnesota in 2025.



Concern about LIS impacts on fishing experience

We asked anglers to report their concern about the potential for LIS to have negative impacts on various aspects of fishing including “your fishing experience,” “fishing heritage or tradition,” “numbers of fish,” “size of fish,” how easy fish are to catch,” “the number of fish you’ll catch in the future,” and “mortality after fish are caught and released.” Respondents recorded responses on a scale where 1 = none, 2 = some concern, 3 = moderate concern, 4 = a fair amount of concern, and 5 = a great deal of concern. Table 33 contains percents of all angler selecting response categories by concern. Between and 23% and 29% of anglers selected “none” when asked about their level of concern with issues presented, except in the case of “your fishing experience” where a greater proportion of anglers (41%) expressed this level of concern.

On average, those that used LIS in 2025 expressed less concern about the potential negative impacts of LIS on fishing than those that did not use LIS (Table 34, Figure 13).

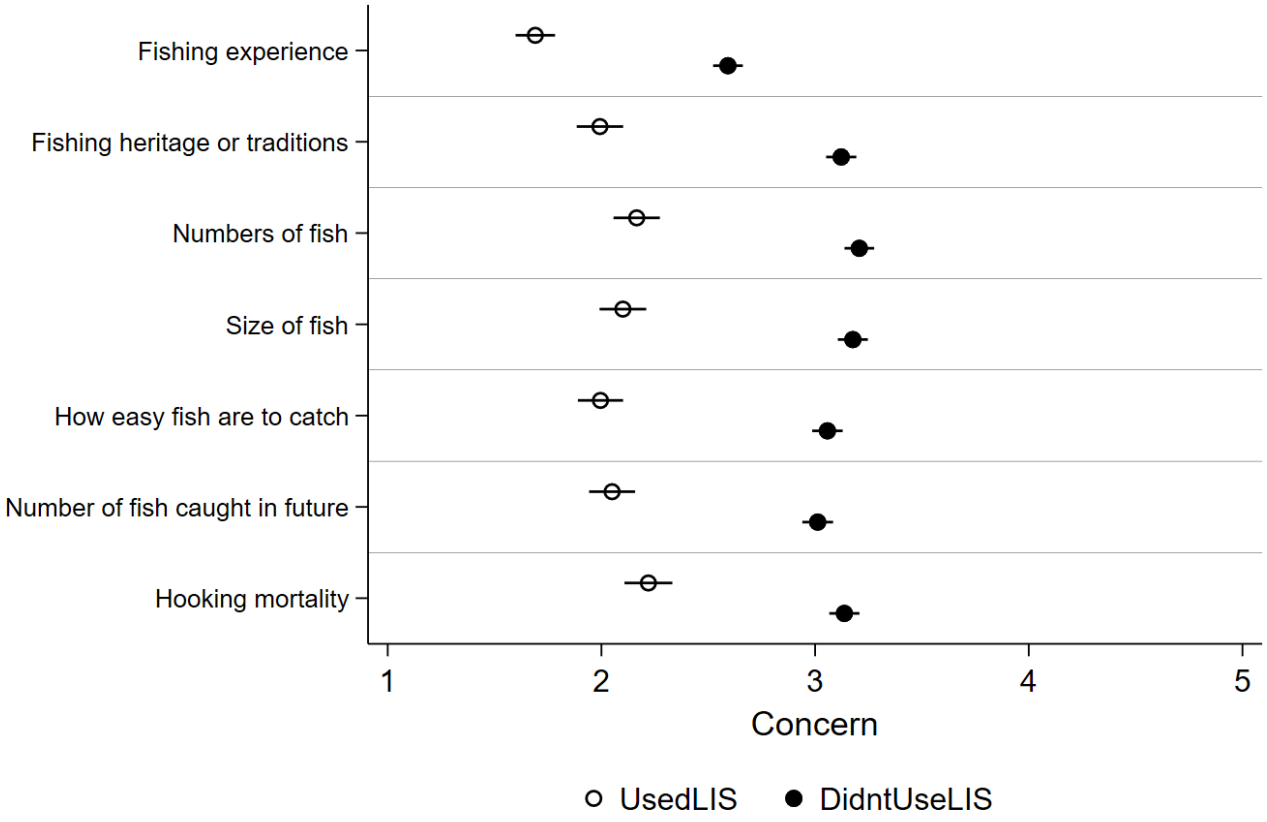
Table 33. Anglers' concern (percent selecting categories) about potential negative effects of LIS on elements of the fishing experience.

	None	Some concern	Moderate concern	A fair amount of concern	A great deal of concern	n
Your fishing experience.	41	21	14	11	13	2340
Fishing heritage or tradition.	29	21	14	12	22	2335
Numbers of fish.	23	23	15	16	23	2336
Size of fish.	26	20	16	15	23	2336
How easy fish are to catch.	29	21	15	15	21	2331
The number of fish you'll catch in the future.	29	22	15	13	21	2333
Mortality after fish are caught and released.	25	22	16	14	23	2336

Table 34. Estimated marginal means following linear regression of concerns regarding the impacts LIS on elements of the fishing experience on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Your fishing experience.	2.58	1.69	-13.93	<0.001	0.08
Fishing heritage or tradition.	3.11	1.99	-16.71	<0.001	0.11
Numbers of fish.	3.20	2.16	-15.54	<0.001	0.10
Size of fish.	3.16	2.10	-15.88	<0.001	0.10
How easy fish are to catch.	3.06	1.99	-15.70	<0.001	0.10
The number of fish you'll catch in the future.	3.00	2.05	-13.96	<0.001	0.08
Mortality after fish are caught and released.	3.14	2.22	-13.58	<0.001	0.08

Figure 13. Estimated mean degree of concern about LIS impacts on elements of the fishing experience, by use of LIS while fishing in Minnesota in 2025.



Perceptions of the appropriateness of general fisheries management techniques

Fisheries managers possess a limited set of tools they can be deployed to address concerns about the quality or sustainability of a given fishery. These tools manipulate aspects of the fishery including: a) total effort by limiting the season length, b) the total catch by limiting the number of fish an angler may retain, c) characteristics of the size structure by limiting the size of fish anglers may retain (minimum length, slot, and maximum length limits), d) access by limiting where anglers can fish, e) impacts by limiting catch and release activity, and f) efficacy by limiting the gear anglers can use to catch fish. Little data exist on anglers' preferences for the use of these tools. We asked anglers to rate the appropriateness of different tools for fisheries management after reviewing the following prompt:

> *Fisheries managers work to ensure the long-term sustainability of fish populations, conserve fish habitats, and provide enjoyable fishing experiences. Fishing regulations including season dates, bag limits, and limits on fishing methods and gear, exist in part to help achieve these goals. In instances where fisheries managers are concerned about the long-term sustainability of fish stocks, how appropriate are each of the following responses in general?*

Respondents recorded their responses on a scale where 1 = very inappropriate, 4 = neither, and 7 = very appropriate. Respondents rated the following statements: "limiting the use of certain fishing gears and technologies," "reducing the number of fish that can be kept," "modifying the fishing season," "limiting the size of fish that can be kept," "limiting the number of fish that could be caught and released alive," and "restricting where fishing can occur within a waterbody." Table 35 contains the percent of all anglers selecting response categories for each statement. Most anglers viewed limiting the size of fish that can be caught (72%), reducing bag limits (67%), and limiting the use of certain gears and technology (60%) as appropriate response. While restricting where fishing can occur within a waterbody was rated as inappropriate by the greatest percentage (41%) of anglers. It appears that anglers prefer management tools that limit fish retention over those that limit opportunity.

We observed mean differences in ratings of appropriateness of 4 of 6 management responses between those that did and did not use LIS in 2025. However, effect sizes were small (Table 36 and Figure 14), except in the case of limiting the use of certain gears and technology. We did not observe differences rating of appropriateness between those that did and did not use LIS in 2025 for reducing the bag limit or limiting the size of fish that can be kept. Those that did not use LIS rated the remaining management tools as more appropriate than did those that used LIS in 2025.

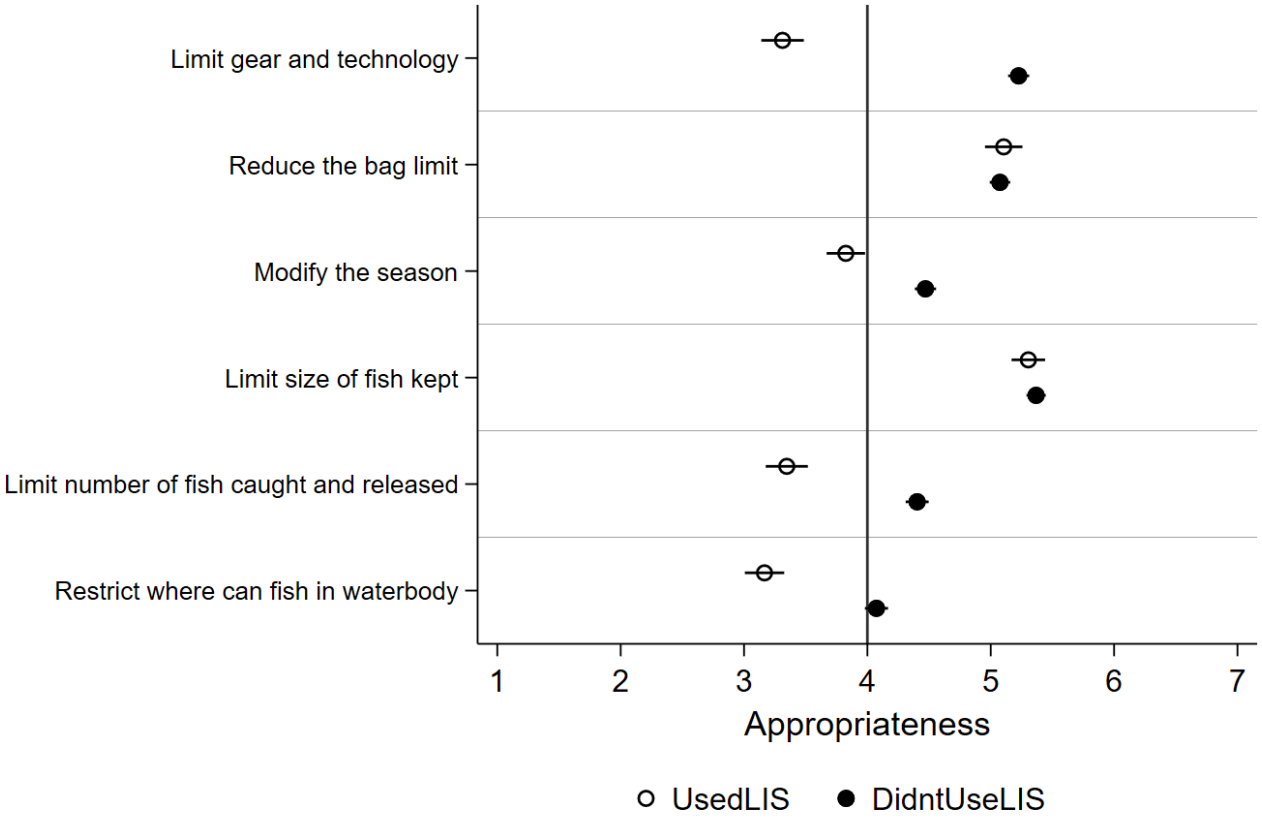
Table 35. Anglers' perception (percent selecting categories) of the appropriateness of various fisheries management techniques.

	Very inappropriate	Moderately inappropriate	Slightly inappropriate	Neither	Slightly appropriate	Moderately appropriate	Very appropriate	n
Limiting the use of certain fishing gears and technologies.	14	6	7	14	17	17	26	2327
Reducing the number of fish that can be kept.	6	5	8	15	20	19	28	2323
Modifying the fishing season.	11	7	12	23	18	15	14	2323
Limiting the size of fish that can be kept.	4	3	7	13	19	21	32	2328
Limiting the number of fish that could be caught and released alive.	17	9	10	18	16	14	16	2325
Restricting where fishing can occur within a waterbody.	19	10	12	19	15	12	12	2326

Table 36. Estimated marginal means following linear regression of perceptions of the appropriateness of various fisheries management techniques on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Limiting the use of certain fishing gears and technologies.	5.23	3.29	-22.01	<0.001	0.18
Reducing the number of fish that can be kept.	5.07	5.10	0.40	0.691	0.00
Modifying the fishing season.	4.46	3.84	-7.16	<0.001	0.02
Limiting the size of fish that can be kept.	5.35	5.31	-0.61	0.542	0.00
Limiting the number of fish that could be caught and released alive.	4.40	3.33	-11.49	<0.001	0.05
Restricting where fishing can occur within a waterbody.	4.06	3.16	-9.86	<0.001	0.04

Figure 14. Estimated mean appropriateness of general fisheries management techniques by use of LIS while fishing in Minnesota in 2025.



Perceptions of management techniques to address LIS

We asked anglers to report their level of support or opposition to 5 management techniques managers could employ to help manage the potential negative impacts of LIS including: “creating designated lakes or stream segments where LIS or other advanced fishing technologies are not allowed,” “establishing seasonal periods when LIS is not allowed,” “limiting the species an angler can target using LIS,” “limiting LIS use in shallow-water habitats or nearshore areas within waterbodies,” and “limiting LIS use in deep-water habitats within waterbodies.” Respondents recorded responses on a scale where 1 = strongly oppose, 4 = neither, and 7 = strongly support.

Table 37 contains the percentage of anglers selecting each category for each of the management techniques. Between 21% and 31% of anglers strongly supported the proposed management techniques, while 15% – 18% strongly opposed. As one might expect, the use of LIS in 2025 exerted a significant effect on support for techniques to manage LIS impacts (Table 38, Figure 15). Those that did not use LIS in 2025 were in greater support of the use of each technique that those that did use LIS, with effect sizes ranging from 0.18-0.22.

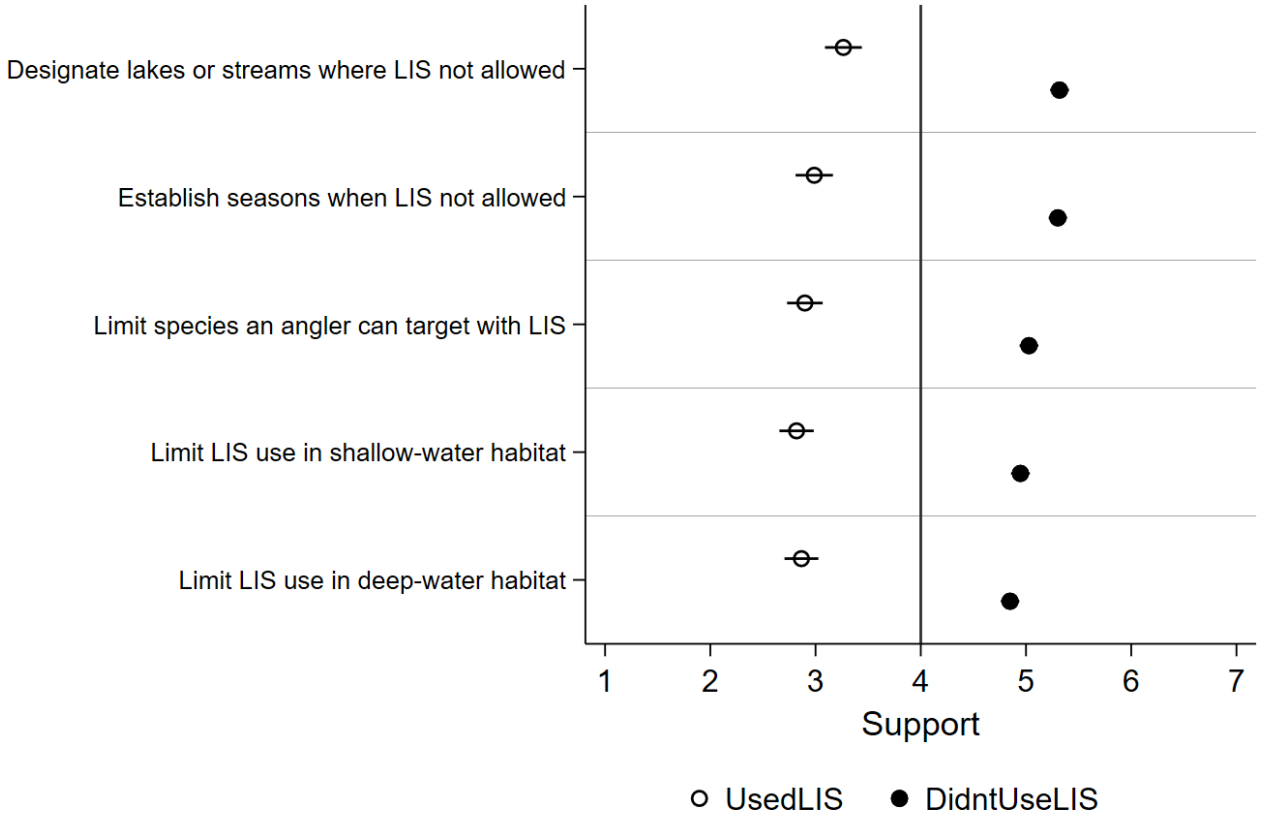
Table 37. Anglers' agreement or disagreement (percent selecting categories) with statements about strategies to manage the impacts from LIS.

	Strongly oppose	Moderately oppose	Slightly oppose	Neither	Slightly support	Moderately support	Strongly support	n
Creating designated lakes or stream segments where LIS or other advanced fishing technologies are not allowed.	15	5	5	14	15	15	31	2315
Establishing seasonal periods when LIS is not allowed.	17	5	4	15	15	15	30	2316
Limiting the species an angler can target using LIS.	18	6	5	19	13	15	25	2313
Limiting LIS use in shallow-water habitats or nearshore areas within waterbodies.	18	5	5	23	12	13	24	2316
Limiting LIS use in deep-water habitats within waterbodies.	17	6	7	23	13	13	21	2316

Table 38. Estimated marginal means following linear regression of support for various management techniques to limit the impacts of LIS on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Creating designated lakes or stream segments where LIS or other advanced fishing technologies are not allowed.	5.31	3.26	-22.19	<0.001	0.18
Establishing seasonal periods when LIS is not allowed.	5.30	2.98	-25.38	<0.001	0.22
Limiting the species an angler can target using LIS.	5.03	2.89	-23.45	<0.001	0.20
Limiting LIS use in shallow-water habitats or nearshore areas within waterbodies.	4.95	2.82	-23.75	<0.001	0.20
Limiting LIS use in deep-water habitats within waterbodies.	4.85	2.86	-22.41	<0.001	0.18

Figure 15. Estimated mean support for various management techniques to limit the impacts of LIS by use of LIS while fishing in Minnesota in 2025.



Catch orientation

We employed a standardized scale often referred to as “catch orientation” to measure Minnesota anglers’ attitudes toward the fishing related elements of the angling experience (Anderson et al., 2007). The scale is comprised of 4 dimensions: something, many, big, and keep. Something refers to anglers’ tendency to positively evaluate catching at least something while angling as an important part of the activity. Big refers to an anglers’ tendency to positively evaluate catching large fish as an important part of the activity. Many refers to anglers’ tendency to positively evaluate catching lots of fish as an important part of the activity. Finally, keep refers to an anglers’ tendency to positively evaluate keeping fish to consume as an important part of the activity. Each dimension is operationalized with 4 statements, and responses recorded on a scale where 1 = strongly disagree, 4 = neither, and 7 = strongly agree. Table 39 contains the percentage of all anglers selecting response categories for each statement.

Given that the consumptive orientation scale represents a hypothesis about the structure of the relationships among the statements, and the latent factors they reflect, we subjected the data to confirmatory factor analysis (CFA). We estimated the CFA on the un-weighted sample using the maximum likelihood method. Table 40 contains CFA results including item means and standard deviations, standardized factor loadings, z-values and p-values. The table also contains reliability estimates (Cronbach’s alpha) for the latent factors. Fit statistics suggest acceptable congruence of the model implied and population covariance matrices, confirming the hypothesized factor structure.

We compared mean values (Table 41, Figure 16) on the 4 dimensions across use of LIS. We observed a statistically significant difference for two of the dimensions, where those that used LIS in 2025 had a slightly more positive attitude toward catching big fish, while the opposite was true of keeping fish. In both cases the effect size was very small.

Table 39. Anglers' agreement or disagreement (percent selecting categories) with statements about their attitudes toward angling.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree	n
Something								
A fishing trip can be successful even if no fish are caught.	5	6	9	6	21	20	33	2321
When I go fishing, I'm just as happy if I don't catch fish.	7	11	24	9	19	17	14	2320
If I thought I wouldn't catch any fish, I wouldn't go fishing.	23	13	16	9	14	12	12	2317
When I go fishing, I'm not satisfied unless I catch at least something.	13	9	13	13	24	16	12	2318
Many								
The more fish I catch, the happier I am.	8	7	9	13	30	18	14	2316
A successful fishing trip is one in which many fish are caught.	13	9	12	14	27	16	11	2317
A full stringer is the best indicator of a good fishing trip.	26	16	15	17	15	7	3	2315
I'm happiest with a fishing trip if I catch at least the limit.	17	14	15	21	18	8	6	2315

Table 39. Anglers' agreement or disagreement (percent selecting categories) with statements about their attitudes toward angling. Continued.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree	n
Big								
I would rather catch 1 or 2 big fish than 10 smaller fish.	9	11	17	20	16	14	12	2316
The bigger the fish I catch, the better the fishing trip.	12	10	11	21	23	12	11	2317
I'm happiest with the fishing trip if I catch a challenging game fish.	6	6	8	21	26	19	14	2318
I like to fish where I know I have a chance to catch a "trophy" fish.	12	8	10	24	19	13	13	2318
Keep								
I usually eat the fish I catch.	11	9	7	11	19	15	29	2318
I'm just as happy if I don't keep the fish I catch.	4	5	10	11	17	20	35	2321
I want to keep all the fish I catch.	46	19	12	11	6	4	2	2320
I'm just as happy if I release the fish I catch.	3	4	7	9	16	20	43	2320

Table 40. Confirmatory factor analysis of catch orientation scale.

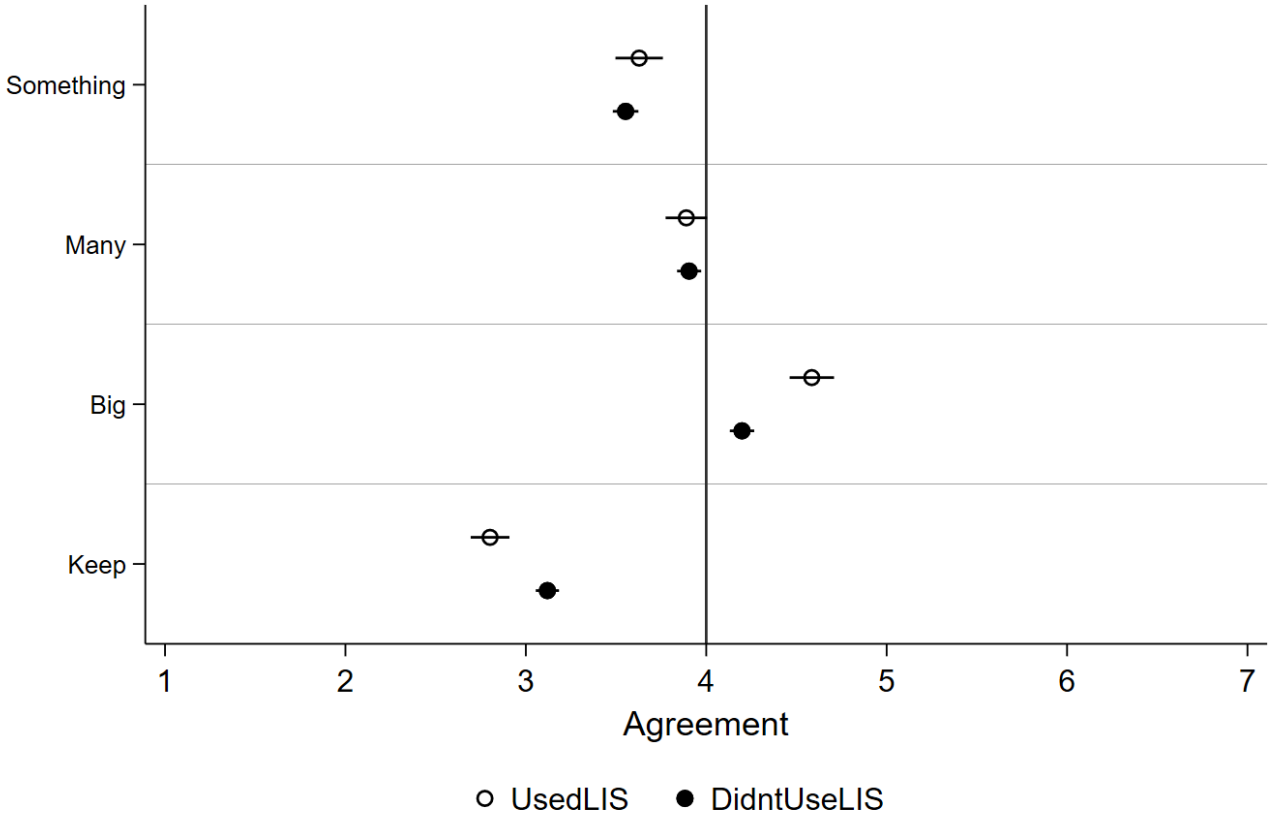
	M	SD	λ	*z*-value	*p*-value
Something (α = 0.80)					
A fishing trip can be successful even if no fish are caught. - r	5.2	1.8	0.64	38.92	<0.001
When I go fishing, I'm just as happy if I don't catch fish. - r	4.3	1.8	0.69	45.09	<0.001
If I thought I wouldn't catch any fish, I wouldn't go fishing.	3.6	2.1	-0.66	-42.89	<0.001
When I go fishing, I'm not satisfied unless I catch at least something.	4.2	1.9	-0.78	-58.74	<0.001
Many (α = 0.79)					
The more fish I catch, the happier I am.	4.6	1.7	0.74	60.33	<0.001
A successful fishing trip is one in which many fish are caught.	4.3	1.8	0.87	81.95	<0.001
A full stringer is the best indicator of a good fishing trip.	3.1	1.8	0.54	31.88	<0.001
I'm happiest with a fishing trip if I catch at least the limit.	3.6	1.8	0.53	30.38	<0.001
Big (α = 0.82)					
I would rather catch 1 or 2 big fish than 10 smaller fish.	4.1	1.8	0.66	47.05	<0.001
The bigger the fish I catch, the better the fishing trip.	4.1	1.8	0.91	82.13	<0.001
I'm happiest with the fishing trip if I catch a challenging game fish.	4.7	1.6	0.61	38.51	<0.001
I like to fish where I know I have a chance to catch a "trophy" fish.	4.2	1.8	0.63	40.32	<0.001
Keep (α = 0. 76)					
I usually eat the fish I catch.	4.8	2.0	0.51	28.68	<0.001
I'm just as happy if I don't keep the fish I catch. - r	5.3	1.7	-0.82	-72.38	<0.001
I want to keep all the fish I catch.	2.3	1.6	0.53	31.03	<0.001
I'm just as happy if I release the fish I catch. – r	5.6	1.6	-0.83	-74.48	<0.001

- χ^2 = 1193.04, df = 95, p < 0.001; RMSEA 90% CI = 0.068, 0.075; CFI = 0.92; NNFI = 0.90; SRMR = 0.07
- *λ = standardized factor loading*
- *Model estimated with the unweighted sample using the maximum likelihood method.*
- *Mean and standard deviation (SD) estimated from the weighted sample*

Table 41. Estimated marginal means following linear regression of dimensions of catch orientation on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Something	3.56	3.65	1.25	0.211	0.00
Many	3.91	3.89	-0.24	0.813	0.00
Big	4.19	4.59	5.74	<0.001	0.01
Keep	3.12	2.81	-4.89	<0.001	0.01

Figure 16. Estimated mean agreement with dimensions of catch orientation by use of LIS while fishing in Minnesota in 2025.



Identity as an angler

We asked respondents to report their agreement with 5 statements measuring their degree of identification as angler. The statements stem from a standardized scale developed by Callero (1985) and adapted for use in recreational fisheries research (Landon et al., 2018). Statements included: “being an angler is an important part of who I am,” “fishing is something that I rarely think about,” “I would be at a loss if I were forced to give up fishing,” “for me, being an angler is about more than just fishing,” “I really don’t have any clear feelings about being an angler.” Statements marked “– r” in the table were reverse coded prior to further analysis. Respondents recorded responses on a scale where 1 = strongly disagree, 4 = neither, and 7 = strongly agree.

Table 42 contains the percentage of all anglers selecting each response category for each statement. Respondents reported relatively high levels of identification with being an angler, with between 28% and 37% selecting the “strongly agree” category.

Given that identity scale represents a hypothesis about the relationships among statements and the latent factor that accounts for them, we subjected the data to confirmatory factor analysis (CFA). Table 43 contains mean, standard deviation, standardized factor loading, z-value, and p-value for each statement, as well as the scale reliability. Model fit statistics suggest that the hypothesized factor structure is a fit for the data.

Following establishment of construct validity, we created a scale variable that was an average of the 5 statements measuring identity, and compared identity across those that did and did not use LIS in 2025. Those that used LIS in 2025 (M = 5.7) more strongly identified as an angler than those that did not (M = 5.2), though the effect size was small (Table 44, Figure 17).

Table 42. Anglers' agreement or disagreement (percent selecting categories) with statements about their identity as an angler.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree	n
Being an angler is an important part of who I am.	6	5	6	16	19	20	28	2312
Fishing is something that I rarely think about. – r	33	21	22	9	7	5	3	2309
I would be at a loss if I were forced to give up fishing.	7	7	9	10	14	17	37	2311
For me, being an angler is about more than just fishing.	2	2	4	10	22	26	34	2311
I really don't have any clear feelings about being an angler. – r	30	21	17	17	9	4	3	2312

Table 43. Confirmatory factor analysis of identity scale.

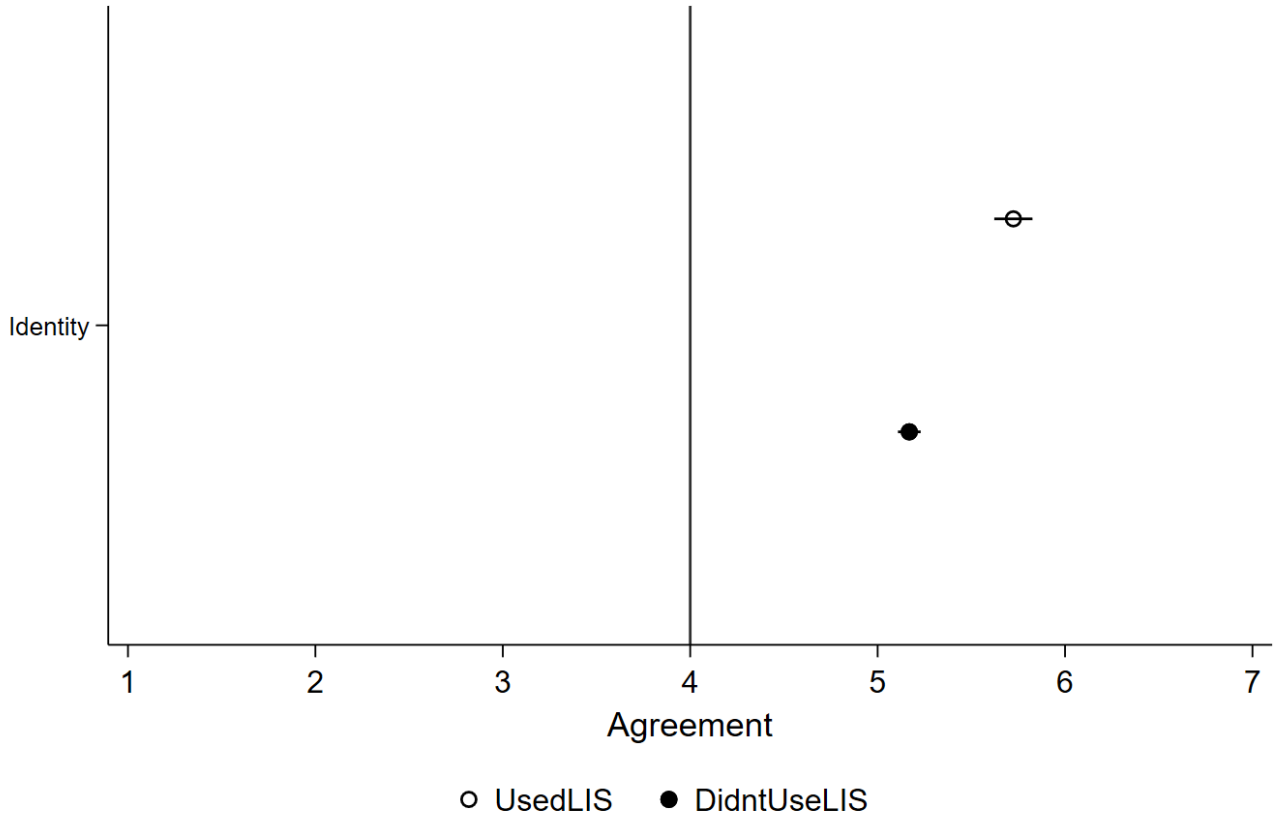
α = 0.82	M	SD	λ	*z*-value	*p*-value
Being an angler is an important part of who I am.	5.1	1.8	0.84	87.14	<0.001
Fishing is something that I rarely think about. – r	2.6	1.6	-0.76	-66.23	<0.001
I would be at a loss if I were forced to give up fishing.	5.2	1.9	0.76	67.23	<0.001
For me, being an angler is about more than just fishing.	5.7	1.4	0.42	22.68	<0.001
I really don't have any clear feelings about being an angler. – r	2.8	1.6	-0.66	-47.73	<0.001

- χ^2 = 95.58, df = 5, p < 0.001; RMSEA 90% CI = 0.073, 0.104; CFI = 0.98; NNFI = 0.96; SRMR = 0.03
- *λ = standardized factor loading*
- *Model estimated with the unweighted sample using the maximum likelihood method.*
- *Mean and standard deviation (SD) estimated from the weighted sample*

Table 44. Estimated marginal means following linear regression of identity scale on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Identity	5.2	5.7	9.27	<0.001	0.04

Figure 17. Estimated mean agreement with identity scale by use of LIS while fishing in Minnesota in 2025.



Angling skill and knowledge

We asked anglers to respond to a single question regarding their self-assessed skill and knowledge as an angler respectively. Respondents recorded responses on a scale where 1 = much less skilled/much less knowledgeable, 2 = less skilled/less knowledgeable, 3 = about average, 4 = more skilled/more knowledgeable, and 5 = much more skilled/much more knowledgeable, in reference to the average angler.

Table 45 contains the percentage of anglers that selected each response category for skill, while Table 46 contains results for knowledge. A plurality of respondents reported that they were about average with respect to skill (48%) and knowledge (45%).

We created a scale variable comprised as the average of the two statements about skill and knowledge and compared this skill and knowledge variable across those that did and did not use LIS in 2025. We found that those that used LIS in 2025 rated themselves as higher in skill and knowledge as compared to the average angler than did those that did not use LIS (Table 47 and Figure 18).

Table 45. Anglers' self-assessed (percent selecting categories) skill as an angler.

Much less skilled	Less skilled	About average	More skilled	Much more skilled	n
7	15	48	25	6	2320

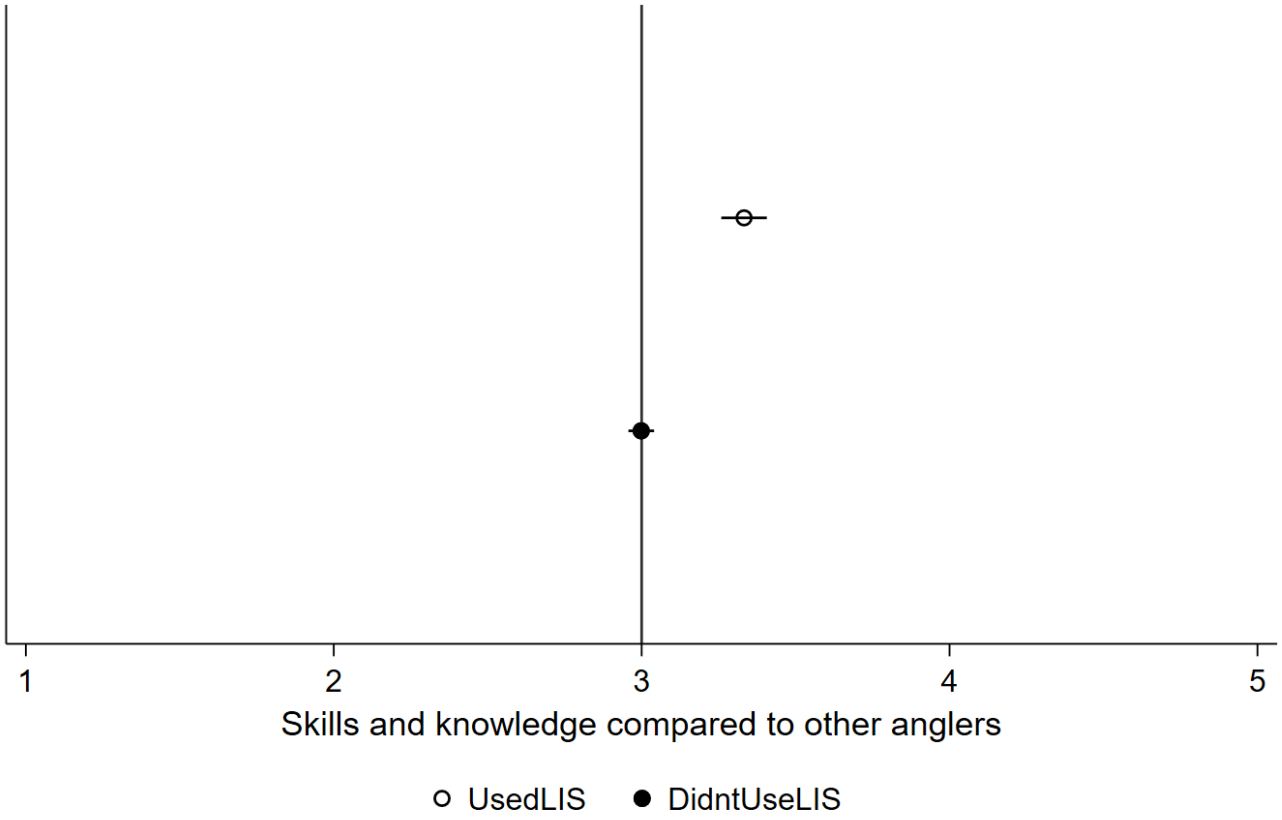
Table 46. Anglers' self-assessed (percent selecting categories) knowledge as an angler.

Much less knowledgeable	Less knowledgeable	About average	More knowledgeable	Much more knowledgeable	n
7	17	45	25	6	2321

Table 47. Estimated marginal means following linear regression of skill and knowledge scale on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Skill and knowledge	3.0	3.3	8.04	<0.001	0.03

Figure 18. Estimated mean skill and knowledge as compared to other anglers by use of LIS while fishing in Minnesota in 2025.



Ecological dominance orientation

We asked anglers to report their perception of the hierarchical nature of the natural world using a single iconographic measure developed by Uenal et al. (2022) and known as one's ecological dominance orientation (EDO). The scale (see Appendix A for its presentation) contains two images that depict differing versions of the relationship between humans and nature. One where humans are positioned as part of an interconnected web of life and anchored at the low end of the scale, and another where humans are depicted as sitting atop of pyramid of life and anchored at the high end of the scale. Respondents select their belief about these relationships by selecting a value along a 7-point scale where 1 = less hierarchical (web of life) and 7 = more hierarchical (humans atop a pyramid).

Table 48 contains the percentage of anglers selecting each response category along the scale. The distribution is close to normal with 21% selecting the mid-point, and roughly equal proportions of anglers (12%-14%) selecting all other response options.

We compared anglers' EDO by those that did and did not use LIS in 2025. Those that used LIS had a slightly more hierarchical EDO than those that did not (Table 49, Figure 19).

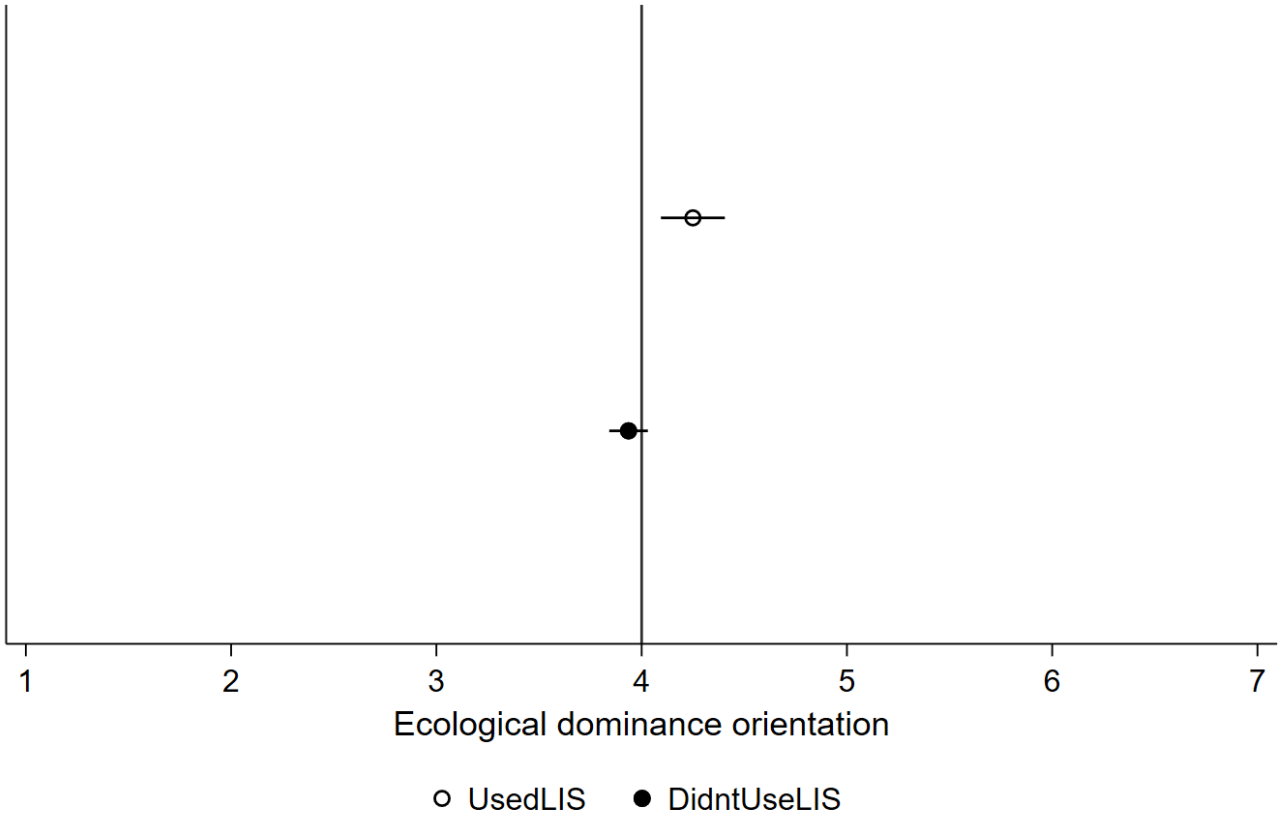
Table 48. Anglers' ecological dominance orientation (percent selecting categories).

Less hierarchical	2	3	4	5	6	More hierarchical	n
13	13	12	21	14	13	13	2320

Table 49. Estimated marginal means following linear regression of ecological dominance orientation on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Ecological dominance orientation	3.9	4.3	3.48	0.001	0.01

Figure 19. Estimated mean ecological dominance orientation (EDO) by use of LIS while fishing in Minnesota in 2025.



Trust in the MNDNR

We asked anglers to respond to 5 statements regarding their trust in the Minnesota Department of Natural Resources, as it related to fisheries management. Statements included: “The MNDNR does a good job of managing fisheries in Minnesota,” “The MNDNR is open and honest about things they do and say related to fisheries management,” “The MNDNR can be trusted to make decisions about fisheries management that are good for the resource,” “The MNDNR will make decisions about fisheries management in a way that is fair,” “The MNDNR has fisheries managers and biologists who are well-trained for their jobs,” “The MNDNR listens to anglers’ concerns.” Respondents recorded responses on a scale where 1 = strongly disagree, 4 = neither, and 7 = strongly agree.

Table 50 contains the percentage of anglers selecting response categories by statement. More anglers agreed with the statements presented than disagreed, reflecting relatively high levels of trust in the MNDNR among anglers.

We subjected the data to confirmatory factor analysis to test the validity of the trust scale. Table 51 contains CFA results including item mean and standard deviation, standardized factor loading and z-value and p-value, along with the scale reliability. Model fit statistics suggest the data are a close fit to the hypothesized factor structure.

Following establishment of construct validity, we compared trust across those that did and did not use LIS in 2025. Those that did not use LIS had slightly higher trust in the MNDNR than those that did (Table 52, Figure 20).

Table 50. Anglers' agreement or disagreement (percent selecting categories) with statements about their trust in the Minnesota Department of Natural Resources (MNDNR).

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree	n
The MNDNR does a good job of managing fisheries in Minnesota.	5	7	10	15	20	30	14	2289
The MNDNR is open and honest about things they do and say related to fisheries management.	6	7	11	21	18	24	14	2285
The MNDNR can be trusted to make decisions about fisheries management that are good for the resource.	5	6	10	16	22	27	15	2290
The MNDNR will make decisions about fisheries management in a way that is fair.	5	6	11	20	21	25	13	2293
The MNDNR has fisheries managers and biologists who are well-trained for their jobs.	3	3	4	21	18	29	22	2290
The MNDNR listens to anglers' concerns.	6	7	12	20	23	22	10	2290

Table 51. Confirmatory factor analysis of trust scale.

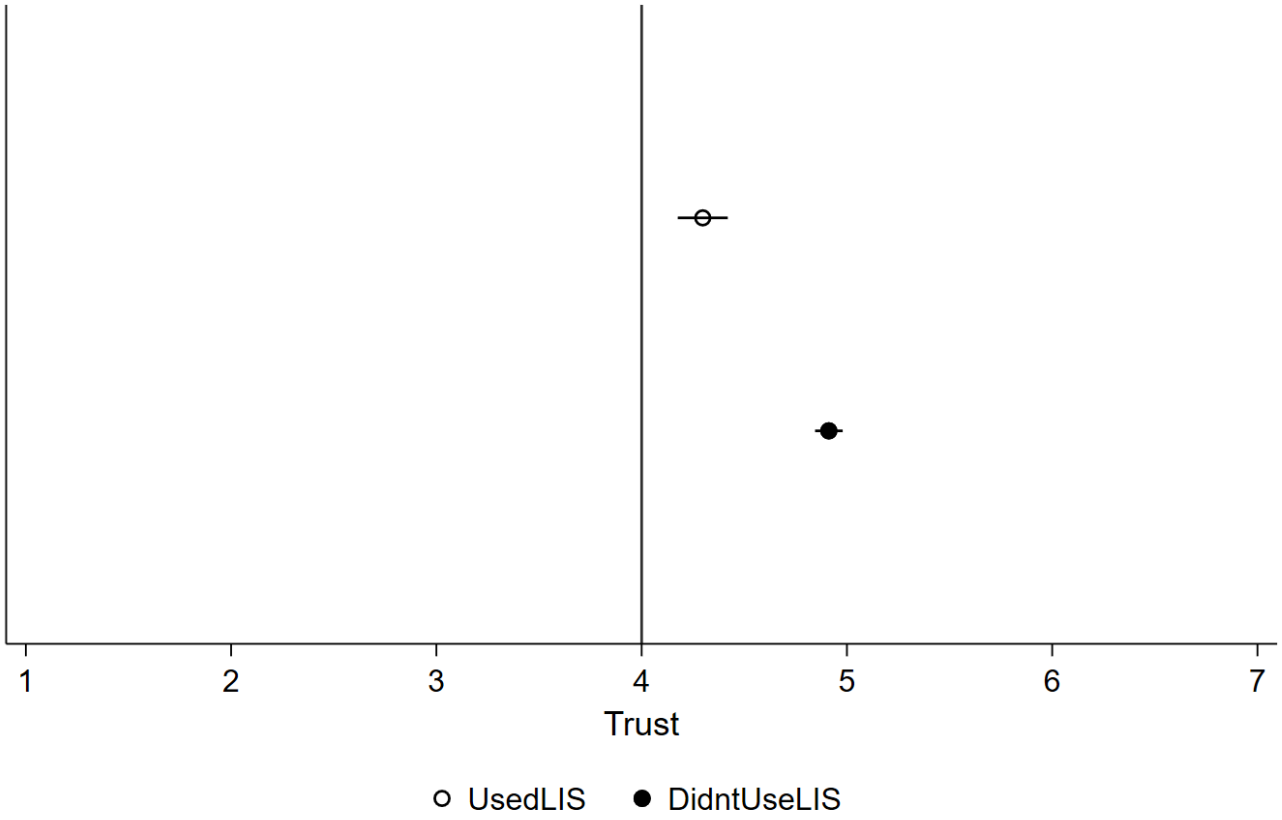
α = 0.95	M	SD	λ	*z*-value	*p*-value
The MNDNR does a good job of managing fisheries in Minnesota.	4.8	1.6	0.87	148.27	<0.001
The MNDNR is open and honest about things they do and say related to fisheries management.	4.7	1.7	0.88	159.37	<0.001
The MNDNR can be trusted to make decisions about fisheries management that are good for the resource.	4.8	1.7	0.93	262.68	<0.001
The MNDNR will make decisions about fisheries management in a way that is fair.	4.7	1.6	0.91	215.27	<0.001
The MNDNR has fisheries managers and biologists who are well-trained for their jobs.	5.2	1.5	0.76	81.35	<0.001
The MNDNR listens to anglers' concerns.	4.5	1.6	0.82	108.82	<0.001

- χ^2 = 103.10, df = 9, p < 0.001; RMSEA 90% CI = 0.056, 0.080; CFI = 0.99; NNFI = 0.99; SRMR = 0.01
- *λ = standardized factor loading*
- *Model estimated with the unweighted sample using the maximum likelihood method.*
- *Mean and standard deviation (SD) estimated from the weighted sample*

Table 52. Estimated marginal means following linear regression of trust scale on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean				
	Did not use LIS	Used LIS	t-value	p-value	Eta-squared
Trust	4.3	4.8	-9.05	<0.001	0.04

Figure 20. Estimated mean trust by use of LIS while fishing in Minnesota in 2025.



Demographics

We asked anglers to report on their race and ethnicity, income, and education. Values for age and sex derive from electronic license records matched at the time of sample.

The vast majority (90%) of respondents identified their race or ethnicity as white (Table 53). Given the limited variance in the racial composition of the sample, we did not compare race across use of LIS.

The percentage of anglers selecting each category of income is presented in Table 54. The category, $100,000 to $124,999, was the category selected most often by anglers. Table 54 also contains the percentage of angler selected income categories by use of LIS. We subjected the data to the non-parametric Wilcoxon rank sum test to estimate differences in income by use of LIS. Results suggest that those that used LIS in 2025 had higher incomes than those that did not.

We estimated that 40% of anglers attained at least a bachelor's degree as their highest level of educational attainment, and this did not differ by use of LIS (Table 55).

We estimated the mean age of anglers at 46.4 years and did observe a statistically significant difference in age between those that used LIS in 2025 (M = 41.7) and those that did not (M = 48.1). This suggests that younger anglers use LIS at a higher rate than older anglers (Table 56, Figure 21).

Weighted estimates of respondent sex matched the population proportion in three categories (male/female/other), and we did not observe a statistically significant difference in the distribution of respondents by use of LIS in 2025 (Table 57).

Table 53. Percent of respondents reporting race and ethnicity by category (unweighted).

	Percent	n
Asian or Asian American	2	41
Black or African American	1	13
Hispanic or Latino	1	22
Middle Eastern or North African	<1	6
Native Hawaiian or Pacific Islander	<1	6
White	90	2056
Prefer not to answer	7	159
Prefer to self-identify	2	34

- Unweighted values
- Themes of self-identification: Native American (including Ojibwe); Various versions of “None of Your Business/Don’t ask people about race”; Offensive comments and insults; American; Human.

Table 54. Percent of respondents reporting income by category.

	Percent (all)	Percent (UsedLIS)	Percent (DidntUseLIS)
Less than $10,000	3	2	3
$10,000 to $19,999	1	1	1
$20,000 to $29,999	3	3	3
$30,000 to $39,999	3	4	3
$40,000 to $49,999	6	5	6
$50,000 to $59,999	4	4	4
$60,000 to $69,999	7	5	7
$70,000 to $79,999	6	5	6
$80,000 to $89,999	7	6	7
$90,000 to $99,999	6	7	6
$100,000 to $124,999	16	14	17
$125,000 to $149,999	9	12	8
$150,000 to $174,999	8	10	8
$175,000 to $199,999	6	6	6
$200,000 to $224,999	4	5	4
$225,000 to $249,999	2	3	2
$250,000 or more	8	9	8

- n = 2157
- Wilcoxon rank-sum (Mann Whitney) test of equivalence of groups: $z = -2.71$, $p = 0.007$
    - Non-parametric test on the unweighted sample

Table 55. Percent of respondents reporting on education by category.

	Percent (all)	Percent (UsedLIS)	Percent (DidntUseLIS)
Grade school	0	0	0
Some high school	2	2	2
High school diploma or GED	16	17	15
Some vocational or technical school	9	6	9
Vocational/technical (associate's) degree	19	19	19
Some college	14	16	13
Four-year college (bachelor's) degree	26	26	27
Some graduate school	2	2	3
Graduate (master's or doctoral) degree	12	11	13

- n = 2273
- Wilcoxon rank-sum (Mann Whitney) test of equivalence of groups: $z = 1.84$, $p = 0.07$
    - Non-parametric test on the unweighted sample

Table 56. Mean age of all anglers and estimated marginal means following linear regression of age on use of LIS while fishing in Minnesota in 2025. T-value, p-value, and effect size are from regression estimate.

	Mean (All anglers)	Standard deviation	Mean		t-value	p-value	Eta-squared
			Did not use LIS	Used LIS			
Age	46.4	17.6	48.1	41.7	-8.76	<0.001	0.03

- Population Age = 46.1 (17.8)

Figure 21. Estimated mean age of anglers by use of LIS in 2025.

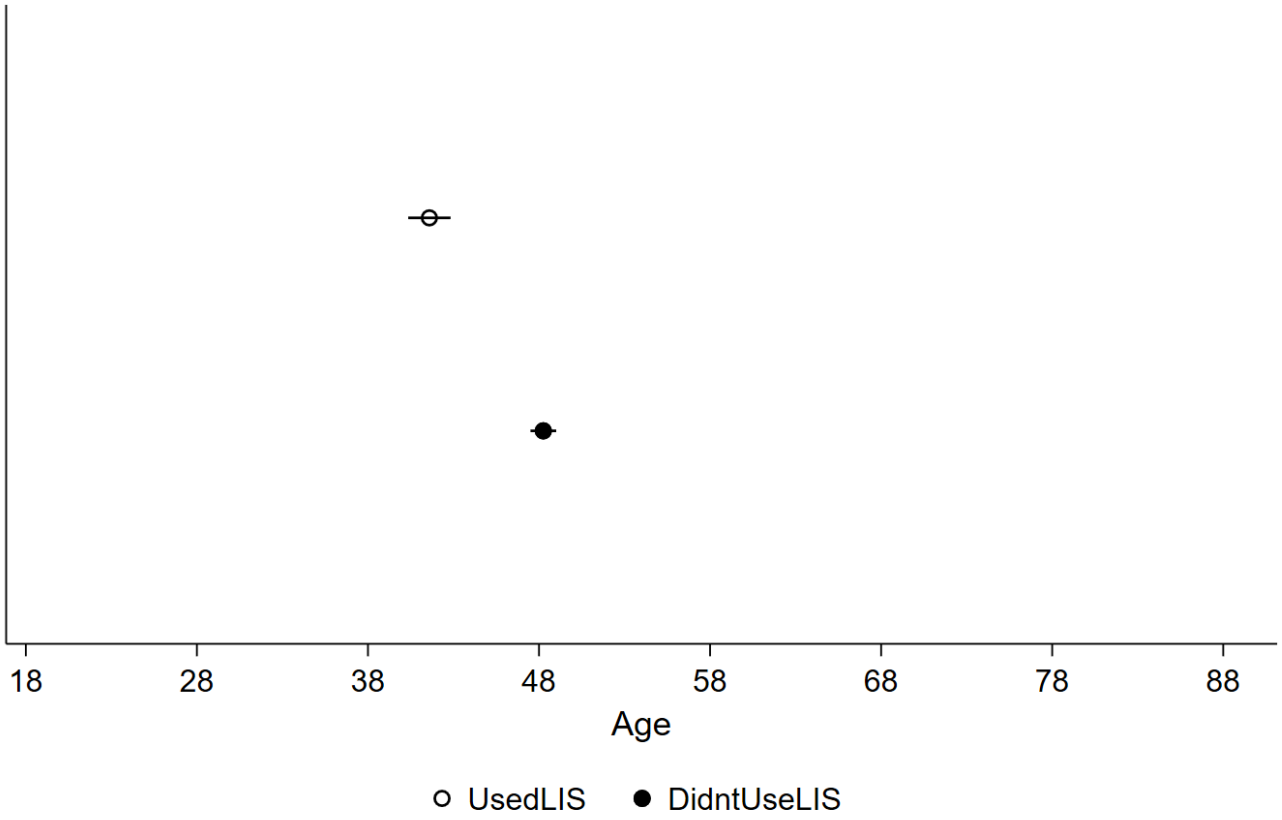


Table 57. Anglers sex (percent male, female, other)

	Percent (all)	Percent (DidntUseLIS)	Percent (UsedLIS)
Male (M)	80	79	83
Female (F)	20	21	17
Other (X)	<1	<1	<1

- n = 2869
- χ^2 = 3.99, df = 2, p-value = 0.136, Cramer's V = 0.04 [test of equality of distribution by use of LIS]
- Population percentage M = 80, F = 20, X <1
- Estimates for all anglers are weighted, estimates by use of LIS are unweighted

References

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Appendix A – Questionnaire

Section 1. Participation in Fishing in Minnesota in 2025

Q1. Did you fish in Minnesota during the 2025 license year (March 1, 2025, to February 28, 2026)?

_____Yes _____No (Please skip to Section 3.)

Q2. Did you fish in any of the following ways in Minnesota during the 2025 license year (March 1, 2025, to February 28, 2026)? (Please choose all that apply.)

_____Ice fishing

_____Open water fishing from a boat

_____Open water fishing from a pier, shore, or wading

_____Dark house spearing

_____Bowfishing

Q2a. Approximately how many days did you spend fishing in the following ways in Minnesota during the 2025 license year (March 1, 2025, to February 28, 2026)? Please write a number between 1 and 365 for each of the ways you fished. Write 0 if you did not fish with a given method.

_____Days: Ice fishing

_____Days: Open water fishing from a boat

_____Days: Open water fishing from a pier, shore, or wading

_____Days: Dark house spearing

_____Days: Bowfishing

Q3. Did you specifically target any of the following species or species groups while fishing in Minnesota during the 2025 license year (March 1, 2025, to February 28, 2026)? If you fished without targeting a particular species, select "whatever was biting." (Please choose all that apply.)

_____ Whatever was biting

_____Bass (largemouth or smallmouth)

_____Muskellunge

_____Walleye or sauger

_____Northern pike

_____Bluegill, pumpkinseed, or other sunfish

_____Crappie

_____Yellow perch

_____Lake trout

_____Trout (rainbow, brook, brown)

_____Catfish (channel or flathead)

_____Other: please specify: _____

Section 2. Possession and use of Live Imaging Sonar (LIS) and other technologies

Live Imaging Sonar (LIS), also known as "Forward Facing Sonar" and sold under brand names like "LiveScope", "MEGA Live", and "ActiveTarget," is a tool that generates a real-time image of the water column, the fish, your bait, and the habitat features around a boat or under the ice. It can be oriented to provide a forward, downward, or overhead view from the angler's location. It differs from other sonar like 2-dimensional sonar, side-imaging sonar, or 360-degree sonar, in that the image it generates is in real-time and accurate enough to allow an angler to pursue individual fish.

Please answer questions 4, 4a, 4b, 4c, 4d, and 4e only if you went ice fishing during the 2025 license year. Skip to Question 5 if you did not ice fish during the 2025 license year.

Q4. Did you use any type of Live Imaging Sonar (LIS) **while ice fishing** in Minnesota during the 2025 license year (March 1, 2025, to February 28, 2026)?

____Yes (Please answer questions 4b-4e.) _____No (Please answer questions 4a and 4e.)

Q4a. Do you intend to purchase a LIS unit to use **while ice fishing** in Minnesota next season? (Please choose one.)

____Yes _____No

Q4b. Approximately what percent of time did you use LIS **while ice fishing** in Minnesota in 2025? Please write a whole number between 1% and 100%.

_____Percent

Q4c. For approximately how many years have you used LIS **while ice fishing**?

_____Years

Q4d. How would you rate your skill using LIS **while ice fishing**? (Please choose one.)

_____Beginner

_____Novice

_____Intermediate

_____Advanced

_____Expert

Q4e. Did you use any of the following technology or equipment **while ice fishing** in Minnesota during the 2025 license year? (Choose all that apply.)

_____Underwater camera (e.g., Aqua-Vu)

_____Portable flasher or sonar, that is not "live imaging sonar" (e.g., Vexilar)

_____Auto hook-setting tip-up (e.g., Jaw Jacker)

_____Wheelhouse (e.g., hard-sided towable ice shelter)

_____GPS mapping (e.g., Navionics, onX)

Please answer questions 5, 5a, 5b, 5c, 5d, and 5e only if you went open water fishing from a boat during the 2025 license year. Skip to Section 3 if you did not open water fish from a boat during the 2025 license year.

Q5. Did you use any type of Live Imaging Sonar **while open water fishing from a boat** in Minnesota during the 2025 license year (March 1, 2025, to February 28, 2026)?

____Yes (Please answer questions 5b-5e.) _____No (Please answer questions 5a and 5e.)

Q5a. Do you intend to purchase a LIS unit to use **while open water fishing from a boat** in Minnesota next season? (please choose one)

_____Yes _____No

Q5b. Approximately what percent of time did you use LIS **while open water fishing from a boat** in Minnesota in 2025? Please write a whole number between 1% and 100%.

_____Percent

Q5c. For approximately how many years have you used LIS **while open water fishing from a boat**?

_____Years

Q5d. How would you rate your skill using LIS **while open water fishing from a boat**? (Please choose one.)

_____Beginner

_____Novice

_____Intermediate

_____Advanced

_____Expert

Q5e. Did you use any of the following other types of technology or equipment **while open water fishing from a boat** in Minnesota during the 2025 license year? (Choose all that apply.)

_____"Spot-lock" capable trolling motor

_____GPS mapping (e.g., Navionics, onX, Head unit display)

_____Traditional 2d sonar or flasher

_____Non-live 360-degree sonar (e.g., Hummingbird 360)

Please fill out the table for question 6 only if you used LIS (live imaging sonar) while fishing during the 2025 license year. If you did not use LIS while fishing, skip to the table in question 7.

Q6. For each of the species or groups of species you reported targeting in Minnesota during the 2025 license year, approximately how many days did you spend fishing for that species or group and what percent of the time did you use Live Imaging Sonar (LIS) while targeting that species or group? Record days where you were not fishing for any specific species or group under "whatever was biting." If you were targeting several species or groups at once, record those days for each of those species or groups separately. If you did not target a species with LIS, select the box "I did not fish for this species using LIS" in replace of writing a percent of time using LIS.

	Days fished (all methods) *Write a number between 1-365*	Percent of time using LIS *Write a number between 1-100*	I did not fish for this species using LIS
Bass (largemouth or smallmouth)			❑
Muskellunge			❑
Walleye or sauger			❑
Northen pike			❑
Bluegill, pumpkinseed or other sunfish			❑
Crappie			❑
Yellow perch			❑
Lake trout			❑
Catfish (channel or flathead)			❑
Trout (rainbow, brook, brown)			❑
Other			❑
Whatever was biting			❑

Q6a. *Only answer this question if you selected you fished for "whatever was biting" and filled out the table in question 6.* You said that you fished for whatever was biting. Which of the following species did you most catch while fishing for whatever was biting in Minnesota in 2025? (Choose all that apply.)

_____Bass (largemouth or smallmouth)

_____Muskellunge

_____Walleye or sauger

_____Northern pike

_____Bluegill, pumpkinseed, or other sunfish

_____Crappie

_____Yellow perch

_____Lake trout

_____Trout (rainbow, brook, brown)

_____Catfish (channel or flathead)

_____Other: _____

Only fill out the table in question 7 if you did not use LIS (live imaging sonar) while fishing during the 2025 license year. If you did use LIS to fish, please fill out the table in question 6.

Q7. For each of the species or groups of species you reported targeting in Minnesota during the 2025 license year, approximately how many days did you spend fishing for that species or group? Record days where you were not fishing for any specific species or group under "whatever was biting." If you were targeting several species or groups at once, record those days for each of those species or groups separately. Please write 0 if you did not target that species.

	Days fished (all methods) *Write a number between 1-365*
Bass (largemouth or smallmouth)	
Muskellunge	
Walleye or sauger	
Northen pike	
Bluegill, pumpkinseed or other sunfish	
Crappie	
Yellow perch	
Lake trout	
Catfish (channel or flathead)	

	Days fished (all methods) *Write a number between 1-365*
Trout (rainbow, brook, brown)	
Other	
Whatever was biting	

Q7a. *Only answer this question if you selected you fished for "whatever was biting" and filled out the table in question 7.* You said that you fished for whatever was biting. Which of the following species did you most catch while fishing for whatever was biting in Minnesota in 2025? (Choose all that apply.)

_____Bass (largemouth or smallmouth)

_____Muskellunge

_____Walleye or sauger

_____Northern pike

_____Bluegill, pumpkinseed, or other sunfish

_____Crappie

_____Yellow perch

_____Lake trout

_____Trout (rainbow, brook, brown)

_____Catfish (channel or flathead)

_____Other: _____

Section 3. Beliefs about LIS

Live Imaging Sonar (LIS), also known as "Forward Facing Sonar" and sold under brand names like "LiveScope", "MEGA Live", and "ActiveTarget," is a tool that generates a real-time image of the water column, the fish, your bait, and the habitat features around a boat or under the ice. It can be oriented to provide a forward, downward, or overhead view from the angler's location. It differs from other sonar like 2-dimensional sonar, side-imaging sonar, or 360-degree sonar, in that the image it generates is in real-time and accurate enough to allow an angler to pursue individual fish.

Q8. How much do you agree or disagree with the following statements about Live Imaging Sonar (LIS)? (Please choose one for each.)

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree
LIS won't impact fish populations if anglers release the fish they catch.	1	2	3	4	5	6	7
LIS does not give fish a fair chance to escape.	1	2	3	4	5	6	7
LIS takes the skill out of fishing.	1	2	3	4	5	6	7
Catching a fish using LIS isn't the same as catching one without it.	1	2	3	4	5	6	7
LIS gives anglers that use it an unfair advantage over other anglers.	1	2	3	4	5	6	7
LIS use by some anglers reduces the quality of the fishing experience for anglers without it.	1	2	3	4	5	6	7
The sound of LIS in the water can change fish behavior.	1	2	3	4	5	6	7
Angling with LIS is changing how fish react to bait.	1	2	3	4	5	6	7
Increasing catch and release angling because of LIS is reducing catch rates overall.	1	2	3	4	5	6	7
If anglers follow regulations, LIS won't negatively impact fisheries.	1	2	3	4	5	6	7
Changing regulations to deal with LIS punishes everyone because of the actions of some.	1	2	3	4	5	6	7

CONTINUED

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree
Anglers that use LIS catch more fish.	1	2	3	4	5	6	7
With LIS, anglers can catch the fish they want to catch.	1	2	3	4	5	6	7
LIS gives anglers a chance to observe fish and their behavior in their natural habitat.	1	2	3	4	5	6	7
LIS could help recruit anglers that might not have taken an interest in fishing otherwise.	1	2	3	4	5	6	7
LIS could help reactivate anglers that have stopped fishing.	1	2	3	4	5	6	7
LIS could help keep anglers fishing that might have stopped otherwise.	1	2	3	4	5	6	7
LIS enhances the fishing experience for anglers that use it.	1	2	3	4	5	6	7

Q9. Please fill in the blank with the option you best think represents your thoughts. Anglers that use LIS catch ____ fish compared to anglers who do not use LIS.

___ Much fewer

___ Fewer

___ About the same number of

___ More

___ Much more

Q10. In your opinion, how acceptable or unacceptable is it for an angler to use Live Imaging Sonar (LIS) to target fish of the following species or species groups **while open water fishing (from a boat)**? (Please choose one for each.)

	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
Bass (largemouth or smallmouth)	1	2	3	4	5	6	7
Muskellunge	1	2	3	4	5	6	7
Walleye and sauger	1	2	3	4	5	6	7
Northern pike	1	2	3	4	5	6	7

	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
Bluegill, pumpkinseed, and other sunfish	1	2	3	4	5	6	7
Crappie	1	2	3	4	5	6	7
Yellow perch	1	2	3	4	5	6	7
Lake trout	1	2	3	4	5	6	7
Trout (rainbow, brook, brown)	1	2	3	4	5	6	7
Catfish (channel or flathead)	1	2	3	4	5	6	7
All species in general	1	2	3	4	5	6	7

Q11. In your opinion, how acceptable or unacceptable is it for an angler to use Live Imaging Sonar (LIS) to target fish of the following species or species groups **while ice fishing**? (Please choose one for each.)

	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
Bass (largemouth or smallmouth)	1	2	3	4	5	6	7
Walleye and sauger	1	2	3	4	5	6	7
Northern pike	1	2	3	4	5	6	7
Bluegill, pumpkinseed, and other sunfish	1	2	3	4	5	6	7
Crappie	1	2	3	4	5	6	7
Yellow perch	1	2	3	4	5	6	7
Lake trout	1	2	3	4	5	6	7
Trout (rainbow, brook, brown)	1	2	3	4	5	6	7
Catfish (channel or flathead)	1	2	3	4	5	6	7

	Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
All species in general	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Q12. How acceptable or unacceptable do you find the use of Live Imaging Sonar (LIS) in dark house spearing for northern pike? Dark house spearing involves attracting northern pike to an opening in the ice, usually in shallow water. The angler then throws a spear into the hole to harvest the fish. (Please choose one.)

Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
1	2	3	4	5	6	7

Section 4. Scenarios involving new technology

As Live Imaging Sonar (LIS) technology evolves it may gain new features. How acceptable or unacceptable do you find the use of LIS in the following hypothetical scenarios involving new systems used on boats.

Q13. A LIS system that uses artificial intelligence to interpret images for the angler making it easier to identify fish species and size. (Please choose one.)

Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
1	2	3	4	5	6	7

Q14. A LIS system that links to the boat's trolling motor and locks on to and automatically follows an individual fish as it moves through a waterbody. (Please choose one.)

Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
1	2	3	4	5	6	7

Q15. A LIS system that can provide an angler with a real-time 360-degree view of the area underwater around their boat (Please choose one.)

Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
1	2	3	4	5	6	7

Q16. A LIS system that can provide an angler with real-time images at much greater distances than is possible with current models. (Please choose one.)

Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
1	2	3	4	5	6	7

Q17. A LIS system that can provide an angler with real-time images at a much higher resolution than is possible with current models. (Please choose one.)

Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
1	2	3	4	5	6	7

Q18. A LIS system that can provide an angler with enhanced visualizations like virtual reality or 3-D images of fish habitat or bait. (Please choose one.)

Very unacceptable	Moderately unacceptable	Slightly unacceptable	Neither	Slightly acceptable	Moderately acceptable	Very acceptable
1	2	3	4	5	6	7

Q19. People have different opinions about the appropriateness of different technologies in fishing. Can you picture a point where fishing technology has gone too far and is no longer ethical?

_____Yes _____No (Please skip to question 20.)

Q19a. In your own words, please describe what makes this hypothetical fishing technology unethical? Use the space below to answer.

Q20. Keeping with current management, how much of an impact do you believe Live Imaging Sonar (LIS) will have on populations of the following species or groups of species in Minnesota in the next 5 years? (please choose one for each).

	None	Some impact	Moderate impact	A fair amount of impact	A great deal of impact
Bass (largemouth or smallmouth)	1	2	3	4	5
Muskellunge	1	2	3	4	5
Walleye	1	2	3	4	5
Northern pike	1	2	3	4	5
Bluegill, pumpkinseed, and other sunfish	1	2	3	4	5
Crappie	1	2	3	4	5
Yellow perch	1	2	3	4	5
Lake trout	1	2	3	4	5
Trout (rainbow, brook, brown)	1	2	3	4	5
Catfish (channel or flathead)	1	2	3	4	5
All species in general	1	2	3	4	5

Q21. How much concern do you have about Live Imaging Sonar (LIS) negatively impacting each of the following? (please choose one for each).

	None	Some concern	Moderate concern	A fair amount of concern	A great deal of concern
Your fishing experience.	1	2	3	4	5
Fishing heritage or tradition.	1	2	3	4	5
Numbers of fish.	1	2	3	4	5
Size of fish.	1	2	3	4	5
How easy fish are to catch.	1	2	3	4	5
The number of fish you'll catch in the future.	1	2	3	4	5
Mortality after fish are caught and released.	1	2	3	4	5

Section 5. Preferences for responses to changing fisheries conditions.

Q22. Fisheries managers work to ensure the long-term sustainability of fish populations, conserve fish habitats, and provide enjoyable fishing experiences. Fishing regulations including season dates, bag limits, and limits on fishing methods and gear, exist in part to help achieve these goals. In instances where fisheries managers are concerned about the long-term sustainability of fish stocks, how appropriate are each of the following responses in general? (please choose one for each).

	Very inappropriate	Moderately inappropriate	Slightly inappropriate	Neither	Slightly appropriate	Moderately appropriate	Very appropriate
Limiting the use of certain fishing gears and technologies.	1	2	3	4	5	6	7
Reducing the number of fish that can be kept.	1	2	3	4	5	6	7
Modifying the fishing season.	1	2	3	4	5	6	7
Limiting the size of fish that can be kept.	1	2	3	4	5	6	7
Limiting the number of fish that could be caught and released alive.	1	2	3	4	5	6	7
Restricting where fishing can occur within a waterbody.	1	2	3	4	5	6	7

Q23. How much do you support or oppose the following hypothetical tools that could be used to manage the impacts of Live Imaging Sonar (LIS) on fish populations and the fishing experience. (please choose one for each).

	Strongly oppose	Moderately oppose	Slightly oppose	Neither	Slightly support	Moderately support	Strongly support
Creating designated lakes or stream segments where LIS or other advanced fishing technologies are not allowed.	1	2	3	4	5	6	7
Establishing seasonal periods when LIS is not allowed.	1	2	3	4	5	6	7
Limiting the species an angler can target using LIS.	1	2	3	4	5	6	7
Limiting LIS use in shallow-water habitats or nearshore areas within waterbodies.	1	2	3	4	5	6	7
Limiting LIS use in deep-water habitats within waterbodies.	1	2	3	4	5	6	7

Section 6. Catch Orientation

Q24. How much do you agree or disagree with the following statements about fishing? (please choose one for each).

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree
A fishing trip can be successful even if no fish are caught.	1	2	3	4	5	6	7
When I go fishing, I'm just as happy if I don't catch fish.	1	2	3	4	5	6	7
If I thought I wouldn't catch any fish, I wouldn't go fishing.	1	2	3	4	5	6	7
When I go fishing, I'm not satisfied unless I catch at least something.	1	2	3	4	5	6	7
The more fish I catch, the happier I am.	1	2	3	4	5	6	7
A successful fishing trip is one in which many fish are caught.	1	2	3	4	5	6	7
A full stringer is the best indicator of a good fishing trip.	1	2	3	4	5	6	7
I'm happiest with a fishing trip if I catch at least the limit.	1	2	3	4	5	6	7
I would rather catch 1 or 2 big fish than 10 smaller fish.	1	2	3	4	5	6	7
The bigger the fish I catch, the better the fishing trip.	1	2	3	4	5	6	7
I'm happiest with the fishing trip if I catch a challenging game fish.	1	2	3	4	5	6	7
I like to fish where I know I have a chance to catch a "trophy" fish.	1	2	3	4	5	6	7
I usually eat the fish I catch.	1	2	3	4	5	6	7
I'm just as happy if I don't keep the fish I catch.	1	2	3	4	5	6	7
I want to keep all the fish I catch.	1	2	3	4	5	6	7
I'm just as happy if I release the fish I catch.	1	2	3	4	5	6	7

Section 7. Identification as an angler.

Q25. How much do you agree or disagree with the following statements about your involvement in fishing? (please choose one for each.)

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree
Being an angler is an important part of who I am.	1	2	3	4	5	6	7
Fishing is something that I rarely think about.	1	2	3	4	5	6	7
I would be at a loss if I were forced to give up fishing.	1	2	3	4	5	6	7
For me, being an angler is about more than just fishing.	1	2	3	4	5	6	7
I really don't have any clear feelings about being an angler.	1	2	3	4	5	6	7

Section 8. Perceived Angling Skills and Knowledge

Q26. How would you compare your fishing SKILLS to the fishing skills of other anglers?

Much less skilled	Less skilled	About average	More skilled	Much more skilled
1	2	3	4	5

Q27. How would you compare your fishing KNOWLEDGE to the fishing knowledge of other anglers?

Much less knowledgeable	Less knowledgeable	About average	More knowledgeable	Much more knowledgeable
1	2	3	4	5

Section 9. Beliefs about human nature relationships.

Q28. Ideas on how humans, animals, and the natural environment should relate to one another can differ for every person. Some people prefer to think about humans as sitting atop a hierarchy with animals and the natural environment underneath. Other people prefer to think of humans as existing as part of nature. Using the images below as a guide, indicate which arrangement you personally think represents your preference. There are no right or wrong answers here: we are simply interested in your personal preference.

The image at the far right represents a more hierarchical relationship between humans, animals, and the natural environment, with humans at the top. The image at the far left represents a less hierarchical relationship where humans are a part of nature. ***Please choose one number that best represents your preference. A higher value reflects a more hierarchical relationship and lower value a less hierarchical relationship.***





Less hierarchical						More hierarchical
1	2	3	4	5	6	7

Section 10. Beliefs about the Minnesota Department of Natural Resources

Q29. The Minnesota Department of Natural Resources (MNDNR) is the state agency charged with the conservation and management of fisheries on behalf of Minnesotans. How much do you agree or disagree with the following statements about the MNDNR? (please choose one for each).

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree
The MNDNR does a good job of managing fisheries in Minnesota.	1	2	3	4	5	6	7
The MNDNR is open and honest about things they do and say related to fisheries management.	1	2	3	4	5	6	7
The MNDNR can be trusted to make decisions about fisheries management that are good for the resource.	1	2	3	4	5	6	7
The MNDNR will make decisions about fisheries management in a way that is fair.	1	2	3	4	5	6	7

	Strongly disagree	Moderately disagree	Slightly disagree	Neither	Slightly agree	Moderately agree	Strongly agree
The MNDNR has fisheries managers and biologists who are well-trained for their jobs.	1	2	3	4	5	6	7
The MNDNR listens to anglers' concerns.	1	2	3	4	5	6	7

Section 11. Demographics

Q30. How would you describe your race/ethnicity? Please choose all that apply.

_____Asian or Asian American

_____Black or African American

_____Hispanic or Latinp

_____Middle Eastern or North African

_____Native Hawaiian or Pacific Islander

_____White

_____Prefer not to answer

_____Prefer to self-identify: _____

Q31. What was your annual household income from all sources before taxes in 2025? (please choose one)

- ❑ Less than $10,000
- ❑ $10,000 to $19,999
- ❑ $20,000 to $29,999
- ❑ $30,000 to $39,999
- ❑ $40,000 to $49,999
- ❑ $50,000 to $59,999
- ❑ $60,000 to $69,999
- ❑ $70,000 to $79,999
- ❑ $80,000 to $89,999
- ❑ $90,000 to $99,999
- ❑ $100,000 to $124,999
- ❑ $125,000 to $149,999
- ❑ $150,000 to $174,999
- ❑ $175,000 to $199,999
- ❑ $200,000 to $224,999
- ❑ $225,000 to $249,999
- ❑ $250,000 or more

Q32. What is the highest level of education you have completed? (please choose one)

- ❑ Grade school
- ❑ Some high school
- ❑ High school diploma or GED
- ❑ Some vocational or technical school
- ❑ Vocational/technical school (associate's) degree
- ❑ Some college
- ❑ Four-year college (bachelor's) degree
- ❑ Some graduate school
- ❑ Graduate (master's or doctoral) degree

Thank you for your time and participation!

Appendix B – A comparison of characteristics of respondents from push-to-web and email samples

Table B1. Select comparisons of the characteristics of email and push-to-web samples (unweighted). Mean differences estimated using linear regression for continuous measures, and differences in percents between categories tested using chi-squared test.

	Email		Push-to-web				
	Mean	SD	Mean	SD	t-value	p-value	Eta-squared
Age	51.2	17.2	52.8	16.9	2.51	0.012	<0.01
Identity	5.4	1.2	5.3	1.3	-1.93	0.053	<0.01
Skills and knowledge	3.1	0.9	3.1	0.9	-1.72	0.086	<0.01
Days fished[1]	27.7	29.7	26.6	29.1	-0.94	0.348	<0.01
Trust	4.0	1.2	4.1	1.2	1.54	0.123	<0.01
	Percent		Percent		χ^2	p-value	Cramer's V
Gender							
Male	85		83		1.50	0.221	0.02
Non-male	15		17				

1. Data are of a Poisson family distribution and over dispersed (variance greater than the mean). Consequently, we also estimated the effect of the collection method on days fished (expected count) following negative binomial regression. Again, we did not observe a statistically significant difference between collection methods in days fished.

Appendix C – Population level extrapolation for LIS use while ice fishing and fishing from a boat, and by species or species group targeted

Table C-1. Estimated numbers of anglers using LIS for ice fishing in Minnesota in 2025.

All license holders[1]	Proportion that fished	Proportion that ice fished	Proportion used LIS to ice fish	Estimated number of individuals that used LIS to ice fish in Minnesota in 2025
1,292,507	.97	.56	.37	259,773

1. U.S. Fish and Wildlife Service certified number of individual license holders in Minnesota for 2025

Table C-2. Estimated numbers of anglers using LIS while fishing from a boat in Minnesota in 2025.

All license holders[1]	Proportion that fished	Proportion that fished from a boat	Proportion used LIS to fish from a boat	Estimated number of individuals that used LIS to fish from a boat in Minnesota in 2025
1,292,507	.97	.84	.22	231,689

1. U.S. Fish and Wildlife Service certified number of individual license holders in Minnesota for 2025

Table C-3. Estimated number of Minnesota anglers that targeted species or species groups using LIS in 2025.

Species or group	All license holders[1]	Proportion that fished	Proportion targeted species or species group	Proportion targeted with LIS, among those that fished for that species or group	Estimated number of anglers that targeted species or group using LIS in Minnesota in 2025
Walleye or sauger	1,292,507	.97	0.61	0.20	152,955
Crappie	1,292,507	.97	0.57	0.17	121,487
Muskellunge [Muskie]	1,292,507	.97	0.09	0.15	16,925
Perch	1,292,507	.97	0.19	0.15	35,731
Lake trout	1,292,507	.97	0.06	0.12	9,027
Bluegill, pumpkinseed, or other sunfish [Sunfish]	1,292,507	.97	0.46	0.11	63,439
Catfish (channel or flathead)	1,292,507	.97	0.07	0.09	7,899
Bass (largemouth or smallmouth)	1,292,507	.97	0.4	0.09	45,134
Northern pike	1,292,507	.97	0.36	0.07	31,594
Whatever is biting	1,292,507	.97	0.42	0.06	31,594
Other	1,292,507	.97	0.04	0.05	2,507
Trout (rainbow, brown, brook)	1,292,507	.97	0.1	0.05	6,269

1. U.S. Fish and Wildlife Service certified number of individual license holders in Minnesota for 2025