Evaluation of Personal Floatation Device (PFD) and Personal Locator Beacon (PLB) Use Among Newfoundland and Labrador Fish Harvesters

A Final Report Submitted to the

Canadian Center for Fisheries Innovation



Submitted by

Kerri Ann Ennis, Fisheries and Marine Institute
Robert Brown, Fisheries and Marine Institute
Kimberley Cullen, Memorial University of Newfoundland and SafetyNet







2026-05-01

Version Draft 1.0

Acknowledgements

This research was conceptualized and conducted by Kerri Ann Ennis and Dr. Rob Brown at the Fisheries and Marine Institute of Memorial University of Newfoundland, and Dr. Kim Cullen at Memorial University of Newfoundland. As well, Dr. John Cullen contributed to data cleaning as a research collaborator.

We gratefully acknowledge our industry partners—the Newfoundland and Labrador Fish Harvesting Safety Association, the Professional Fish Harvesters Certification Board, the Fish, Food and Allied Workers Union, and the Fish Harvesters' Resource Centre—for their support and contributions to the project. Their industry knowledge, input into questionnaire development, and assistance with recruitment and sharing findings helped ensure the research reflected the experiences and priorities of fish harvesters.

We also extend a big thank you to the fish harvesters who participated in the surveys and focus groups for sharing their time, experiences, and perspectives. As well, we thank WorkplaceNL for funding the project, and the Canadian Centre for Fisheries Innovation (CCFI) for funding administration and project management.

Table of Contents

Acknowledgements ..... *i*

List of Tables ..... *iv*

List of Figures ..... *v*

1 Introduction *1*

2 Methodology *3*

2.1 Study Design **3**

2.2 Intervention **3**

2.3 Systematic Literature Review **4**

2.4 Survey Data Collection **6**

2.5 Focus Groups **8**

2.6 PLB Registration Data **9**

2.7 Ethics Approval **9**

3 Results *10*

3.1 Systematic Review **10**

3.2 Survey Participants **12**

3.3 Intervention Awareness **13**

3.4 PLB Usage Rate and Intention **15**

3.5 PLB Knowledge and Perceived Effectiveness **17**

3.6 Perceived Barriers 18

3.7 PLB Registrations 20

3.8 Focus Group Findings 21

4 Discussion 23

5 Conclusion and Recommendations 28

6 Acknowledgements 30

7 References 30

List of Tables

Table 1 Participant demographics by survey 12

List of Figures

Figure 1 Boolean logic for literature search. 5

Figure 2 PRISMA flowchart. 11

Figure 3 Percentage of fish harvesters reporting awareness of the PLB campaign, stratified by survey 14

Figure 4 Percentage of fish harvesters reporting PLB point of acquisition, stratified by survey 15

Figure 5 Percentage of fish harvesters reporting frequency of PLB use, stratified by survey 16

Figure 6 Percentage of fish harvesters by stage of behaviour change for PLB use, stratified by survey 16

Figure 7 Percentage of fish harvesters correctly identifying the steps for activating a PLB, stratified by survey 18

Figure 8 Percentage of fish harvesters reporting perceived effectiveness of PLBs, stratified by survey 18

Figure 9 Percentage of fish harvester reporting PLB are affordable, stratified by survey 19

Figure 10 Percentage of fish harvesters reporting PLB can be easily found in stores for purchase, stratified by survey 20

Figure 11 Annual number of PLBs registered in Newfoundland and Labrador from inception to the end of 2024. Registrations prior to 2022 were aggregated to illustrate uptake before the intervention. 21

1 Introduction

Being surrounded by the North Atlantic Ocean, many Newfoundlanders and Labradorians depend on the fishing industry for their livelihoods. However, this work is carried out in an inherently hazardous environment characterized by harsh weather conditions, cold water temperatures, and physically demanding tasks.

Commercial fishing continues to be one of the most dangerous occupations worldwide, with higher fatality and injury rates compared to national averages for all other occupations (International Labour Organization [ILO], 2023; Petursdottir et al., 2001). In 1999, the average annual number of fishing deaths worldwide was estimated to be 24,000 people (ILO, 2000), which had increased to 32,000 by 2019 (Food and Agriculture Organization, 2024). However, recent research conducted by the FISH Safety Foundation has demonstrated that these estimates are conservative and fishing-related death estimates are well in excess of 100,000 per year (Willis et al., 2023). In Canada, there were 97 fatalities reported in the fishing industry from 2008 to 2017, and in 2018 alone there were 19 fatalities, which was nearly double the 10-year annual average of 9.7 (Transportation Safety Board [TSB], 2019). More recent data indicates that there were an additional 35 fishing-related fatalities reported in Canadian waters in the three-year span from 2019 to 2021 (TSB, 2022).

Drowning as the result of vessel disasters and falls overboard make up a larger portion of the fatalities (Jensen et al, 2014; TSB, 2022). To mitigate drowning related fatalities, a

personal floatation device (PFD) or lifejacket is the most critically important piece of personal protective equipment (PPE) for ensuring a person stays afloat when they are in the water. However, if the individual is lacking sufficient thermal protection, it also becomes critically important that they be rescued as quickly as possible to reduce their exposure time. One of the most versatile and reliable methods for alerting rescuers is an emergency radio beacon, such as a personal locator beacon (PLB). PLBs are commercially available electronic radio frequency devices that have helped save thousands of people in distress worldwide each year.

Despite the demonstrated benefits, failure to use PFDs and emergency signaling devices, such as PLBs, has been identified as a factor leading to fatalities in fishing vessel accidents (TSB, 2012). When the TSB examined 63 fishing vessel-related fatalities between 2011 and 2017, they found that the use of a PFD could not be ascertained for 80 percent of cases. Similarly, accident investigation reports have often concluded that boating accidents, especially those involving smaller vessels, did not send any emergency distress signal and went undetected until the boat was reported overdue (TSB, 2022). Not wearing a PFD or PLB has been identified as factors leading to fatalities in fishing vessel accidents (TSB, 2022; Lincoln & Lucas, 2010).

Because PFDs have been widely available for decades, several interventions have been implemented to increase their use by fish harvesters over the years (Sorensen et al., 2019). However, as PLBs are a relatively newer technology, awareness of the device and its benefits appears to be lower. To address this gap, the Newfoundland and

Labrador Fish Harvesting Safety Association (NL-FHSA), Professional Fish Harvesters Certification Board, Fish Food and Allied Workers Union, and Fish Harvesters' Resource Centre introduced a personal locator beacon (PLB) campaign on February 14, 2022**.** The intervention aimed to reduce barriers to PLB adoption, such as cost and accessibility, by subsidizing the cost and providing fish harvesters in Newfoundland and Labrador (NL) with direct access to in-stock PLBs ready for purchase.

This report builds on the PLB campaign by (1) evaluating the current use of PFDs and PLBs by fish harvesters in NL, (2) identifying the factors that influence their use, and (3) determine the impact of the PLB campaign over time.

2 Methodology

2.1 Study Design

This study used a mixed-methods approach, combining a systematic literature review on factors associated with PFD and PLB use, repeated cross-sectional surveys, analysis of objective PLB registration data, and qualitative focus group discussions with fish harvesters to provide a comprehensive understanding of PFD and PLB awareness, use, and intervention impact.

2.2 Intervention

The intervention was a PLB campaign that was introduced province wide on February 14, 2022 by the NL-FHSA in collaboration with industry partners. The campaign used a cost-share model to improve access to PLBs and provided direct access to in-stock

devices through a designated distribution channel. During the beginning of the campaign, 2500 PLBs were made available at 40% of the regular cost and open to one PLB per enterprise. The offer was later extended to all owners, operators, and crewmembers. In addition to the 60% subsidized rate, the campaign emphasized the role and effectiveness of a PLB in an emergency, including an informational video on how to properly test and activate the PLB.

2.3 Systematic Literature Review

A systematic review of the literature was conducted to identify factors associated with PFD and PLB use among fish harvesters. Five major electronic databases (Scopus, Web of Science, Medline, Excerpta Media database (EMBASE), and PsycINFO) were searched for articles published in the English language up until 29 February 2024 using a comprehensive search strategy with Boolean logic. The search strategy included three groups of terms, each represented by a circle in the Venn diagram in Figure 1 below, with terms within a group combined using ‘OR’ logic. The first group included PFD and lifejacket terms, the second group included PLB and emergency signaling device terms, and the third group included boating related terms. The studies included in this review were those from the intersection of all three groups, which were found using the “AND” strategy.

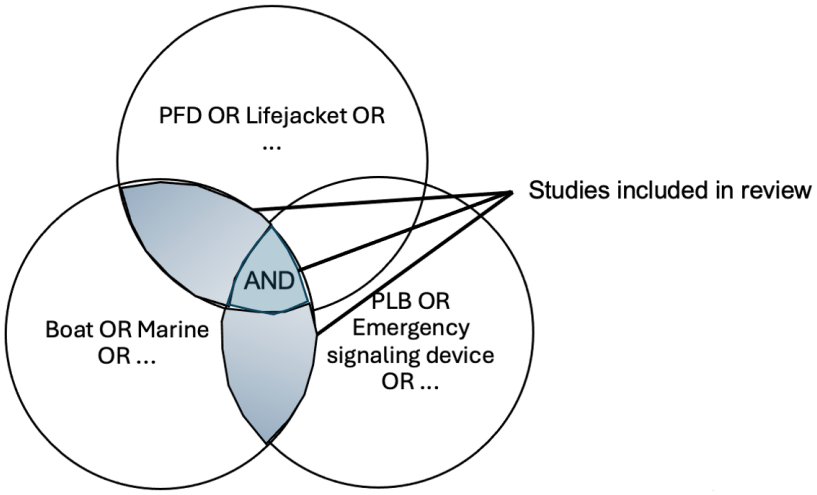


Figure 1 Boolean logic for literature search.

We included all journal publications that provided qualitative or quantitative data on factors associated with PFD or PLB use by professional fish harvesters. Studies on PFD or PLB use by recreational boaters or swimmers were excluded, as were studies that included PFD use data for fatalities only. Grey literature was also excluded.

The title and abstracts of the retrieved articles were each screened by two of the four reviewers (KE and RB or KC or DH) who independently applied the inclusion criteria to select articles for full-text review. Identified conflicts for full-text review were resolved by the first reviewer (KE). Full-text review was then carried out for each article independently by pairs of the three reviewers (KE and RB or KC) who then came to a consensus.

Again, pairs of reviewers (KE and RB or KC) used the Mixed Methods Appraisal Tool (MMAT) version 2018 to independently appraise the methodological quality of each study (Hong et al., 2018). Conflicts of appraisals were resolved by consensus between

each pair of reviewers. Since it is discouraged to exclude studies with low methodological quality, we did not remove any articles from the review.

2.4 Survey Data Collection

A cross-sectional survey design was used to evaluate the use of PFDs and PLBs, as well as the effectiveness of the PLB campaign among fish harvesters in NL. Data were collected from three online survey administered at different times following the implementation of the intervention, which was introduced on February 14, 2022. Survey 1 was launched on January 9, 2024 and closed on February 6, 2024. Survey 2 ran from June 18, 2025 to August 18, 2025, and Survey 3 ran from January 8, 2026 to March 27, 2026.

Participants included professional fish harvesters in NL aged 15 years and older. The research team worked with the industry partners, using their communication channels (e.g., email distribution lists), to recruit professional fish harvesters in NL to participate in the study. Participants were also recruited through local fish harvester's communities on social media (e.g., Newfoundland Fisherman's Forum) and the Marine Institute's Community Based Education Delivery program.

The online questionnaires were developed using the Qualtrics survey software (Qualtrics, 2024). The questionnaires included questions about participant demographics, fishing experience and activities, behaviour around use of PFDs and PLBs, and factors associated with the use of PFDs and PLBs. Measures of rate of use and intention to use were used to determine the fish harvesters' stage of change for

PLB use. Stages of change for PLB use were assessed using the Transtheoretical Model, which categorizes individuals based on their readiness to adopt a behaviour (precontemplation, contemplation, preparation, action, and maintenance) (Prochaska & Velicer, 1997).

Small modifications were made between Survey 1 and 2, with no changes between Survey 2 and 3. For Surveys 2 and 3, participants who indicated they completed a previous survey did not have to repeat questions related to demographics or fishing experience and activities. Features of the Qualtrics survey software, such as skip logic and branching, were used to improve the flow of the questionnaire by only showing the most relevant questions to each participant.

Fish harvesters who decided to participate in the study, followed the link or QR code provided in the recruitment communications and were asked to complete a consent form followed by an anonymous online questionnaire. For each survey, they were asked to provide a unique code that was easy for them to remember but could not be used to identify them. In an attempt to help the fish harvesters remember their unique code in the event they returned to complete another survey; we suggested that they use their initials and last four digits of their phone number. If they returned for Survey 2 or 3, they were reminded that we suggested their initials and last four digits of their phone number. When the data were cleaned and screened for repeats in unique codes, only six codes could be matched across all the surveys, which was insufficient for meaningful within-subject analyses.

Therefore, the survey data were analyzed as three repeated cross-sectional samples and comparisons were made between surveys to examine changes over time. Because most respondents could not be reliably matched across all surveys, responses were analyzed as independent observations. A sensitivity analysis compared respondents who provided a unique identification code with those who did not to assess whether the groups differed across key variables. Fisher's Exact Test indicated no statistically significant differences (all $p > 0.05$), suggesting the distribution of responses were similar across the two groups.

When participants reached the end of the questionnaire, participants were given the option to enter a prize draw for a chance to win a new PLB or an inflatable PFD that was donated by the Professional Fish Harvesters Certification Board and NL-FHSA.

2.5 Focus Groups

Focus groups were conducted to gather qualitative data on fish harvesters' perceptions and behaviours related to PFD and PLB use. Focus groups were scheduled during industry organized events. Four focus groups were held with participants representing experienced fish harvesters, women fish harvesters, and younger harvesters. All participants were professional fish harvesters in NL aged 15 years and older.

The focus groups were semi-structured and facilitated using a discussion guide that explored PFD and PLB use, perceived barriers and facilitators, and suggestions for improvement. Participants were encouraged to share their thoughts and experiences

openly. A researcher reassured the participants that all data would be anonymized. Discussions were audio-recorded and transcribed. The transcripts were analyzed for recurring themes.

2.6 PLB Registration Data

Registration data for all PLBs registered in NL were obtained from the Canadian Beacon Registry on April 10, 2025. The data included the date of registration with all other identifiers removed. There was no information provided on the type of activity associated with the PLB, therefore this data should be interpreted as PLB registration by all of Newfoundlanders and Labradorians and not just fish harvesters.

Data were aggregated by calendar year with all data prior to 2022 grouped together to represent registrations pre-implementation of the PLB campaign, while registrations from 2022, 2023, and 2024 represented the post-implementation period.

2.7 Ethics Approval

Ethics was sought and approval granted prior to Survey 1 data collection from Memorial University's Interdisciplinary Committee on Ethics in Human Research (ICEHR) on October 10, 2023. Additional amendments were submitted and approved prior to data collection for Surveys 2 and 3, and the focus groups. The amendments included minor changes to the questionnaire, consent form, and recruitment material.

3 Results

3.1 Systematic Review

After removing duplicate studies, 689 studies were screened for title and abstract and 168 studies for full text. Sixteen studies met our inclusion criteria. The remaining 673 studies were not relevant to our review objectives (Figure 2). Of the 16 studies that met our inclusion criteria, all were related to factors associated with PFD use by fish harvesters. No studies were found related to factors associated with PLB use by fish harvesters. Ten of the 16 studies were quantitative, four were qualitative, and two were mixed methods.

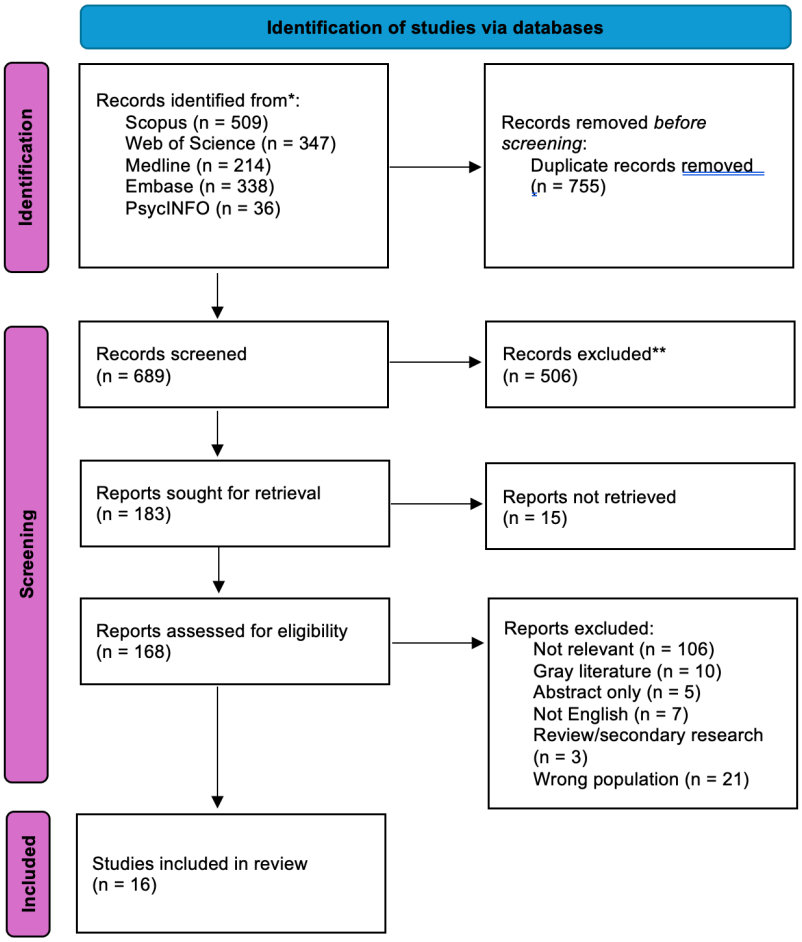


Figure 2 PRISMA flowchart.

Several studies identified multiple factors inversely associated with PFD use by fish harvesters. These barriers included lack of comfort, cost, work interference, social norms, risk diffusion, and confidence in PFD effectiveness (Ahmad et al., 2017; Fay Cyr et al., 2024; Lucas et al., 2013; Oporia et al., 2022a; Sorensen et al., 2019; Weil et al., 2016). Conversely, other studies highlighted factors associated with increased use of PFDs, such as exposure to previous incidents and participation in PFD education (Oporia et al., 2022a; Oporia et al., 2022b). Few studies evaluated interventions aimed

to increase adoption of PFDs by professional fish harvesters (Oporia et al., 2023a; Sorensen et al., 2021; Teske et al., 2022).

3.2 Survey Participants

A total of 392, 340, and 358 fish harvesters completed Surveys 1, 2, and 3, respectively. Table 1 shows that the demographics of fish harvesters were similar across the surveys, with comparable distributions for age, gender, years of fishing experience, swim ability, and vessel characteristics. The majority fish harvesters that participated in each survey were 35-64 years of age, males, and reported having more than 10 years of fishing experience. In addition, the majority reported that they fished from a decked longliner, followed by an open speed boat. Similar distributions of participant demographics across surveys indicate that observed differences in the data likely reflect changes over time rather than differences between groups.

Table 1 Participant demographics by survey

Participant demographics by survey (N, (%))[1]			
	Survey 1	**Survey 2**	**Survey 3**
Characteristic	N = 392	N = 340	N = 358
Age group			
15-24	10 (2.6%)	22 (7.2%)	12 (4.1%)
25-34	48 (12%)	46 (15%)	34 (12%)
35-44	67 (17%)	62 (20%)	66 (23%)
45-54	130 (33%)	81 (26%)	85 (29%)
55-64	94 (24%)	72 (24%)	66 (23%)
65 or more	43 (11%)	23 (7.5%)	29 (9.9%)
Unknown	0	34	66
Gender			
Female	65 (17%)	75 (25%)	56 (19%)
Male	326 (83%)	230 (75%)	236 (81%)
Unknown	1	35	66
Years of fishing experience			
less than 5 years	44 (11%)	72 (25%)	55 (19%)

Participant demographics by survey (N, (%))[1]			
	Survey 1	**Survey 2**	**Survey 3**
Characteristic	N = 392	N = 340	N = 358
6-10 years	50 (13%)	45 (15%)	44 (15%)
11-20 years	72 (19%)	65 (22%)	61 (21%)
21-30 years	78 (20%)	52 (18%)	46 (16%)
more than 30 years	143 (37%)	59 (20%)	83 (29%)
Unknown	5	47	69
Swim ability			
Cannot swim	82 (21%)	63 (21%)	60 (21%)
Beginner / weak swimmer	119 (31%)	85 (29%)	85 (29%)
Good swimmer	186 (48%)	146 (50%)	147 (50%)
Unknown	5	46	66
Vessel type			
Open speed boat	132 (34%)	110 (37%)	109 (37%)
Decked longliner	226 (59%)	179 (60%)	173 (59%)
Factory freezer trawler	27 (7.0%)	8 (2.7%)	12 (4.1%)
Unknown	7	43	64
Vessel length			
under 30'	124 (32%)	99 (33%)	106 (36%)
30' - 39'11"	108 (28%)	93 (31%)	93 (32%)
40' - 64'11"	114 (30%)	78 (26%)	66 (22%)
65' or more	37 (9.7%)	27 (9.1%)	29 (9.9%)
Unknown	9	43	64

[1] Percentages are based on valid responses. Unknown categories represent missing responses and are not included in percentage calculations.

3.3 Intervention Awareness

Across all three surveys, the majority of fish harvesters reported that they had heard about the PLB campaign. There was a slight increase in the number of fish harvesters that reported hearing about the PLB campaign from Survey 1 (89%) to Survey 2 (92%), with a small decrease back down to 89% for Survey 3. The PLB campaign reached more than 89% of respondents across all three surveys (Figure 3). The percentage reporting they received a PLB from the NL-FHSA, FRC, FFAW, or PFHCB (also known

as the PLB campaign) increased from Survey 1 (27%) to Survey 2 (50%) and Survey 3 (52%) (Figure 4).

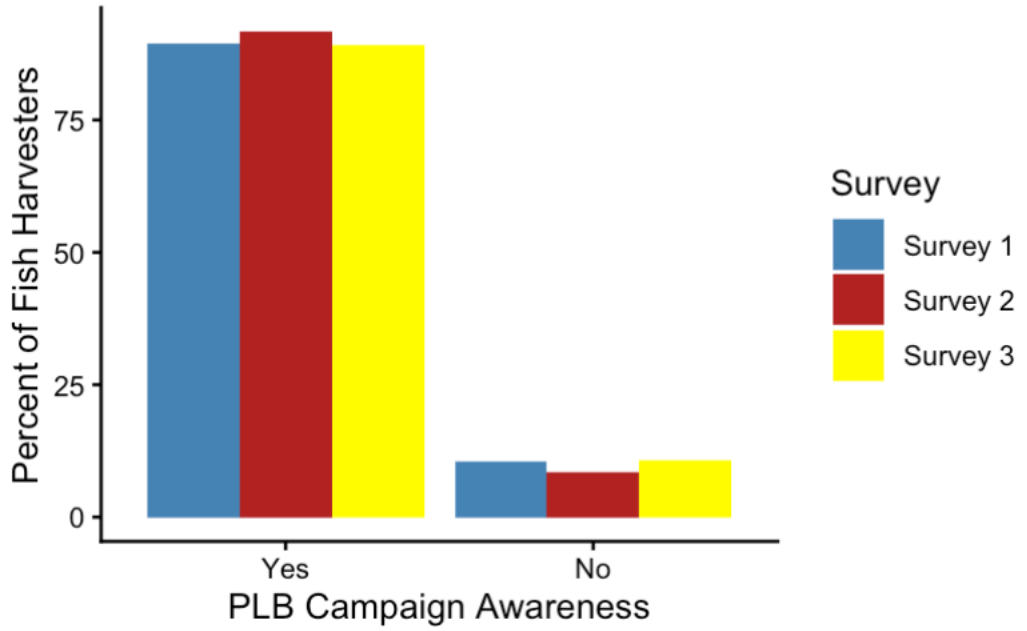


Figure 3 Percentage of fish harvesters reporting awareness of the PLB campaign, stratified by survey

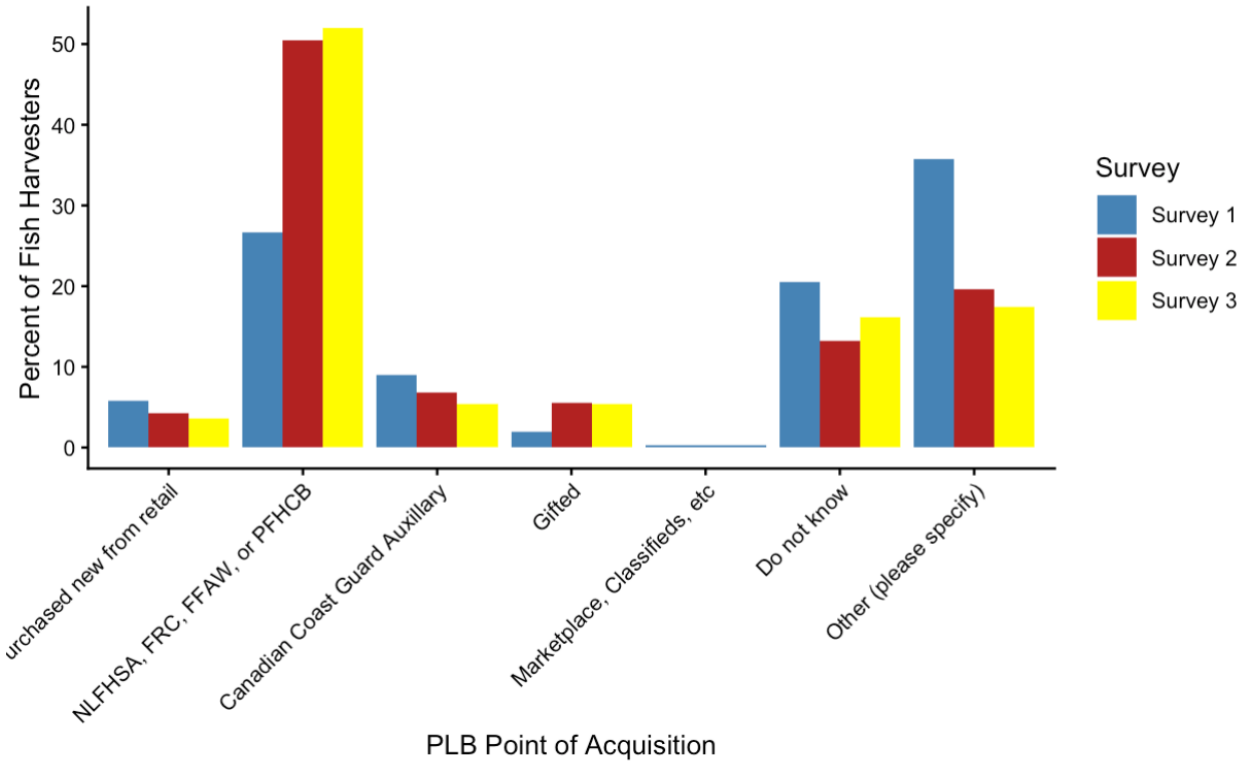


Figure 4 Percentage of fish harvesters reporting PLB point of acquisition, stratified by survey

3.4 PLB Usage Rate and Intention

Figure 6 shows that the number of fish harvesters reporting use of PLB increased across the surveys. The proportion reporting always using a PLB increased from 12% in Survey 1 to 26% in Survey 2 and 28% in Survey 3. Similarly, the proportion reporting often and rarely using a PLB increased across the surveys. Concurrently, the number of fish harvesters reporting never using a PLB decreased across the surveys, with 76% for Survey 1 to 46% in Survey 2 and 40% in Survey 3.

Aligning with the shift in usage, fish harvesters showed a shift toward the later stages of behaviour change for PLB use across the surveys. The proportion of fish harvesters in the precontemplation, contemplation, and preparation stages decreased across the surveys, while the proportion of fish harvesters in the action and maintenance stages increased. The largest proportion of fish harvesters were in the preparation stage during Survey 1 and maintenance stage during Survey 2 (Figure 6). This shift indicates a positive move from planning to sustained behaviour, suggesting that more fish harvesters are not only adopting PLBs but continuing to use them.

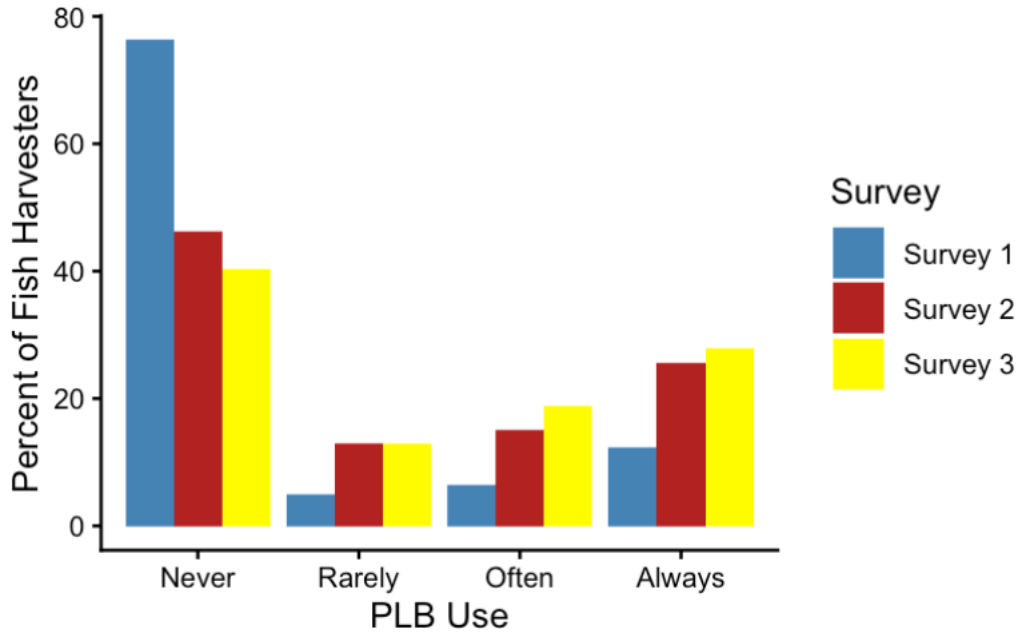


Figure 5 Percentage of fish harvesters reporting frequency of PLB use, stratified by survey

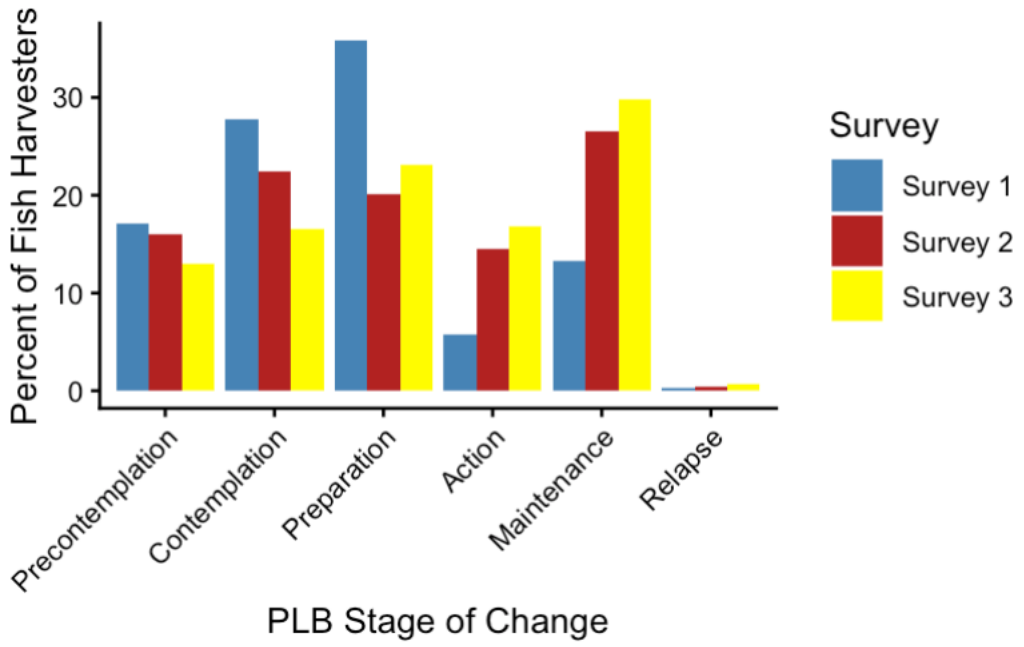


Figure 6 Percentage of fish harvesters by stage of behaviour change for PLB use, stratified by survey

3.5 PLB Knowledge and Perceived Effectiveness

When asked about the steps for activating a PLB, only 23% could correctly identify the steps in Survey 2, while almost 34% choose an incorrect sequence of steps and 44% indicated that they were unsure. The proportion of fish harvesters that could correctly identify the steps for activating a PLB increased slightly to 28% in Survey 3, with those choosing an incorrect sequence of steps staying about the same at almost 33% and those indicating they were unsure decreasing to 39%. This question was not asked in Survey 1. (Figure 7)

Figure 8 shows that the majority of fish harvester reported that PLBs are very effective in all three Surveys, with 62% in Survey 1 decreasing slightly to 59% in Survey 2 and then increasing again to 65% in Survey 3.

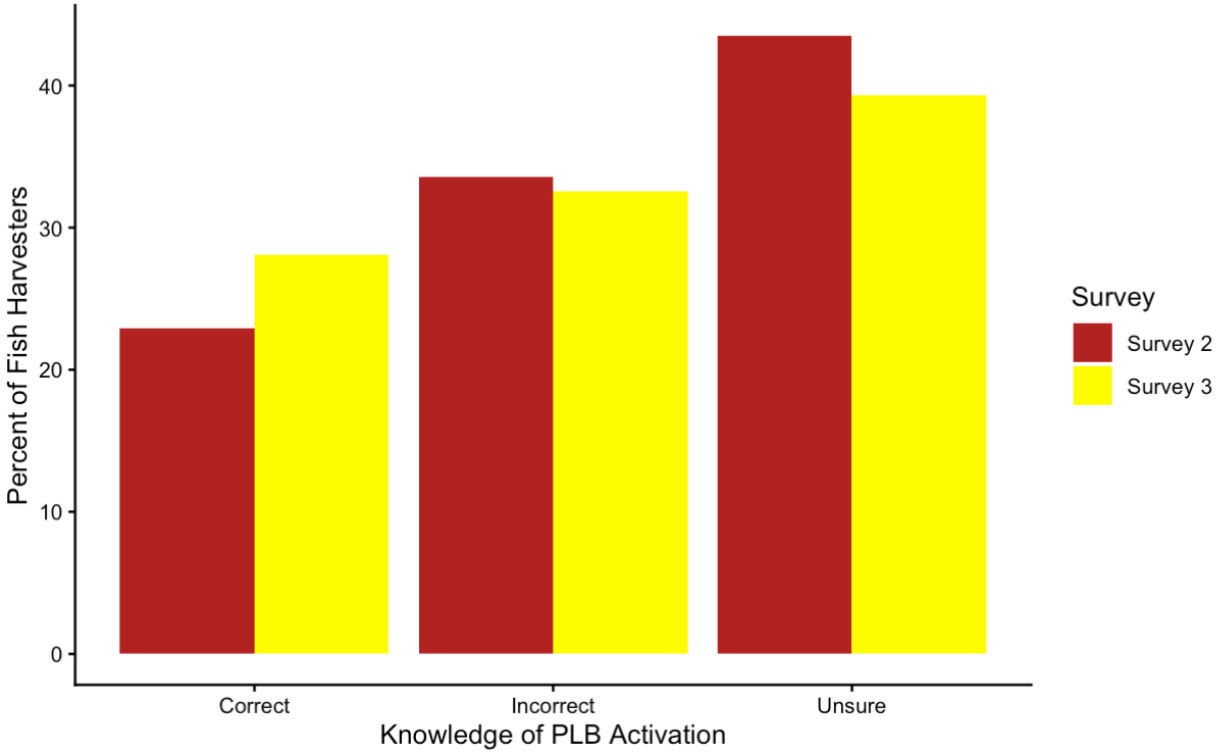


Figure 7 Percentage of fish harvesters correctly identifying the steps for activating a PLB, stratified by survey

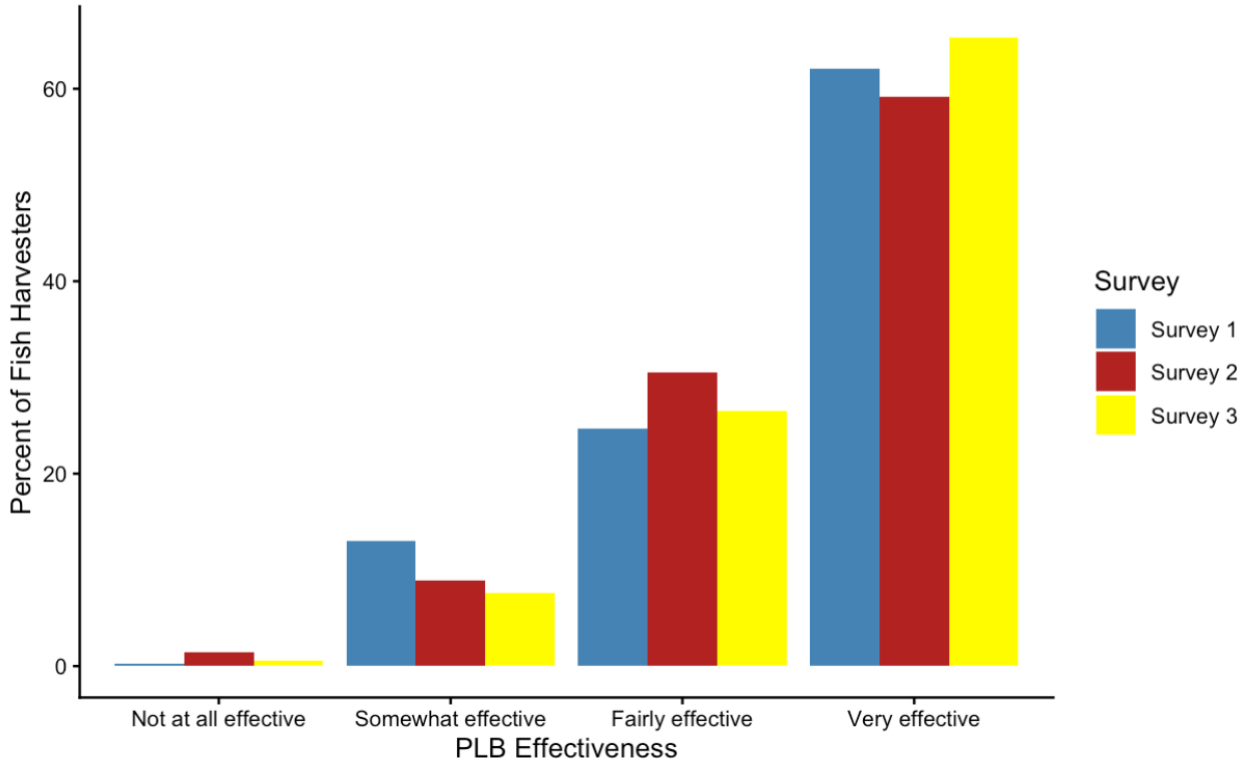


Figure 8 Percentage of fish harvesters reporting perceived effectiveness of PLBs, stratified by survey

3.6 Perceived Barriers

The proportions of fish harvesters that perceive PLBs to be affordable (Figure 9) and accessible for purchase in stores (Figure 10) are presented below. Fish harvesters' perceptions of PLB affordability varied across surveys. In Surveys 1 and 3, fewer fish harvesters agreed that PLBs were affordable (43% and 46%, respectively) than those who disagreed (57% and 54%, respectively). In Survey 2 more fish harvesters agreed that PLBs were affordable (54%) than those who disagreed (46%).

Overall, there appears to be an even split of fish harvesters that perceive PLBs to be easily found in stores for purchase across all three surveys, with slightly more disagreeing (51%) than agreeing (49%) in Survey 3.

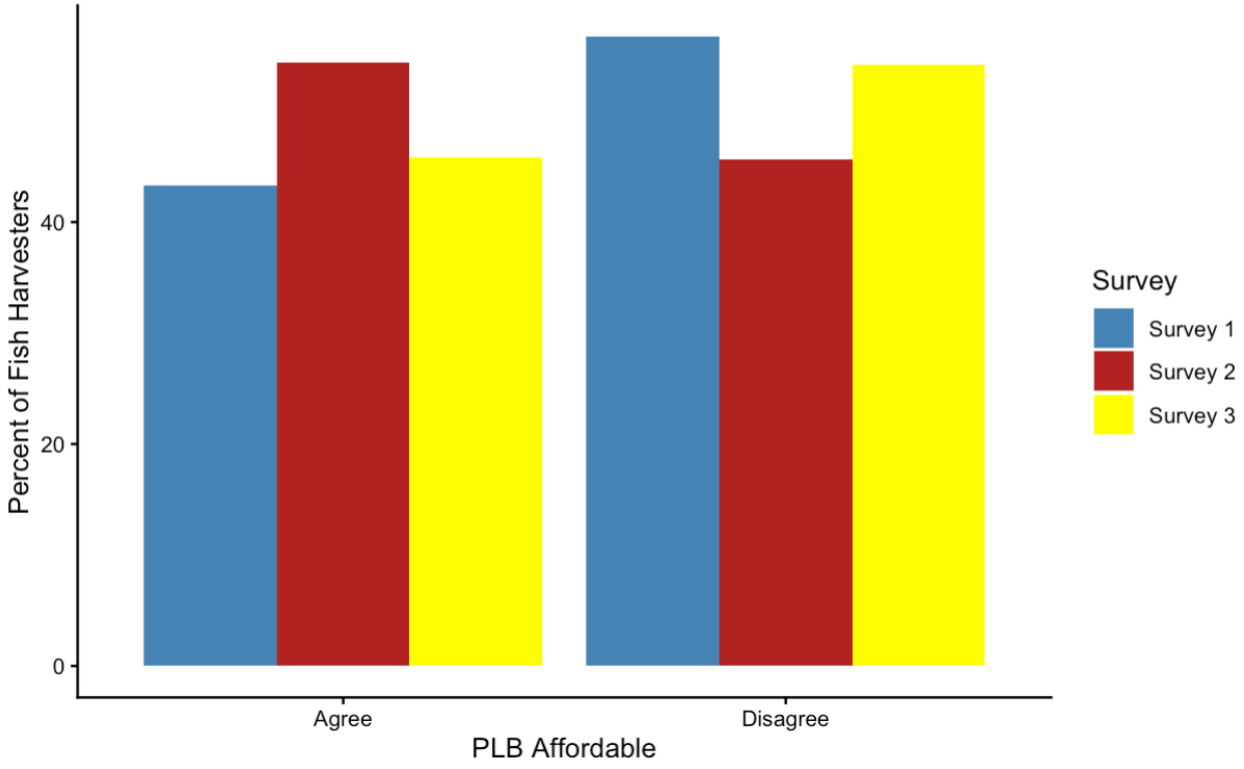


Figure 9 Percentage of fish harvester reporting PLB are affordable, stratified by survey

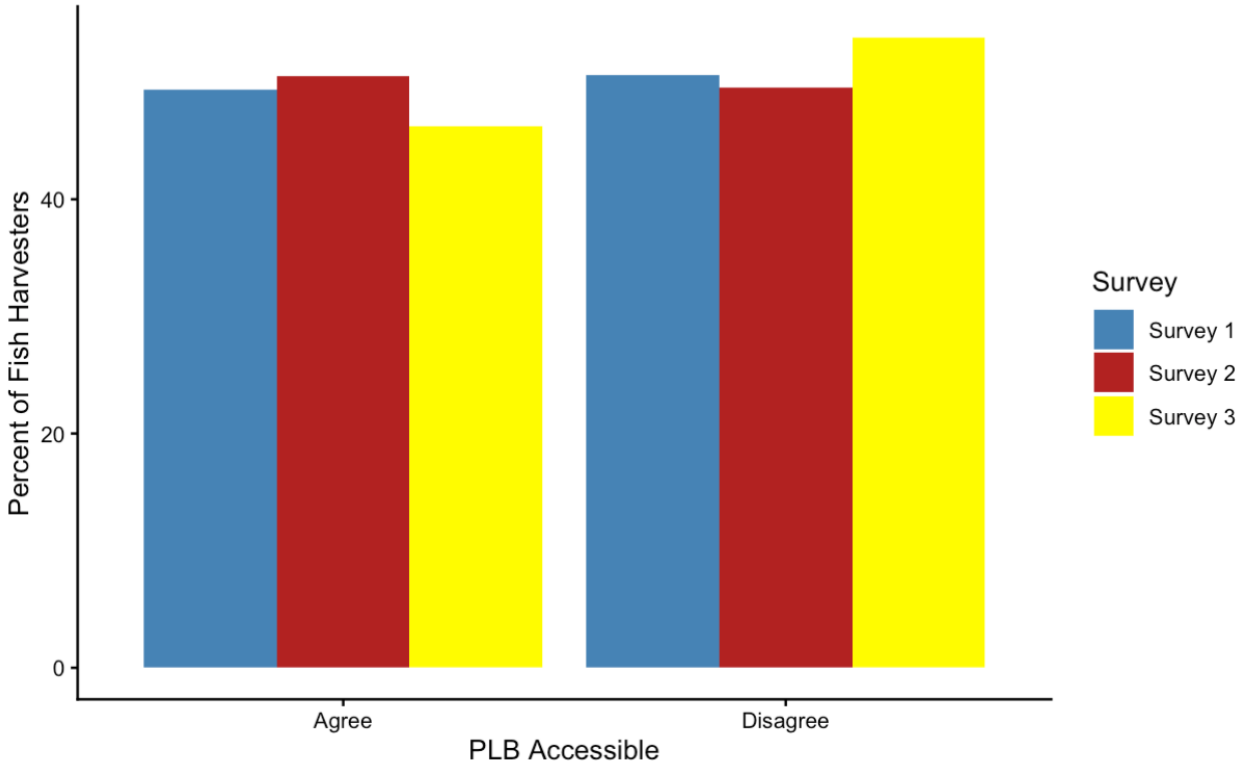


Figure 10 Percentage of fish harvesters reporting PLB can be easily found in stores for purchase, stratified by survey

3.7 PLB Registrations

The number of PLBs registered in NL with that Canadian Beacon Registry increased over time. The total number of PLB registrations in NL prior to the intervention in 2022 was 384. By the end of 2022, the number had increased to 805 (a 110% increase), by the end of 2023 it was 2043 (a 432% increase), and by the end of 2024 it was 2781 (a 624% increase). The largest increase occurred in 2023 with 1238 PLBs being added to the registry that year alone. (Figure 11)

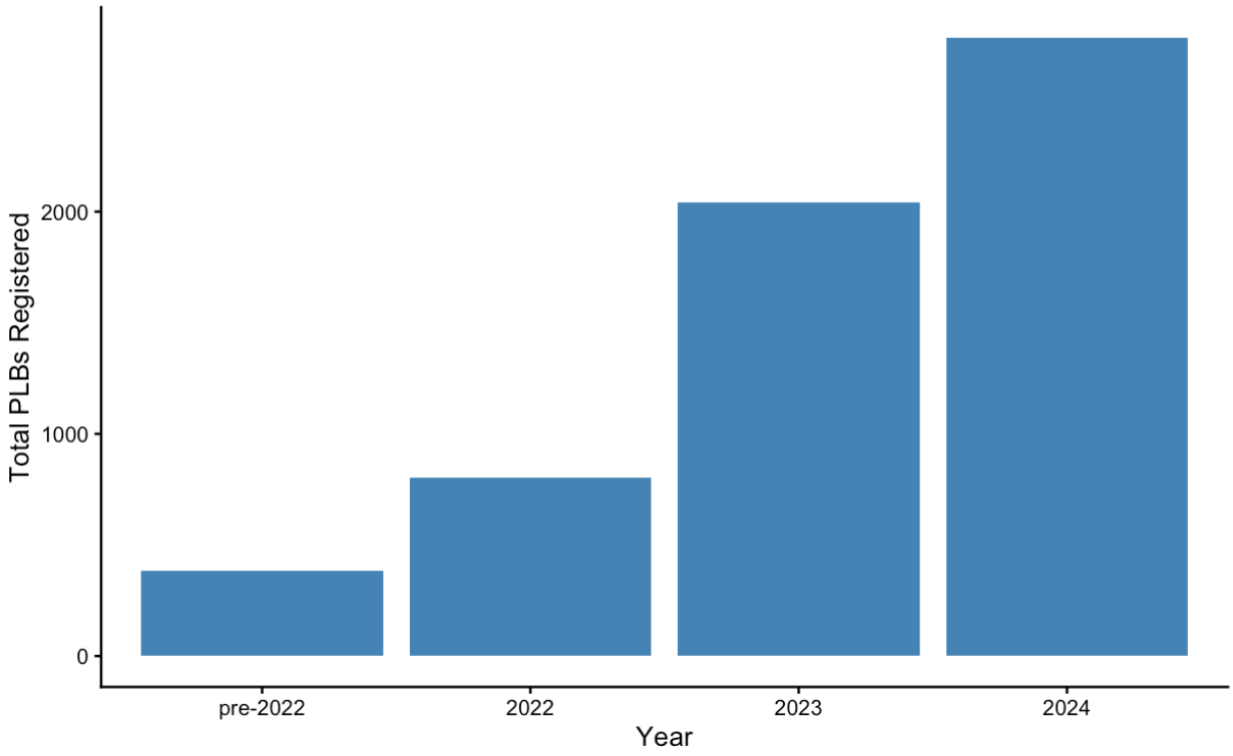


Figure 11 Annual number of PLBs registered in Newfoundland and Labrador from inception to the end of 2024. Registrations prior to 2022 were aggregated to illustrate uptake before the intervention.

3.8 Focus Group Findings

As mentioned above, we conducted four focus groups representing women fish harvesters, 2 groups of young harvesters, and more experienced fish harvesters completing their Fishing Master, Third Class (FM3) certificate. Fish harvesters demonstrated high awareness of PFDs and PLBs in all four of the focus groups, however they reported inconsistent use of PFDs. Work interference and entanglement risks, comfort and fit issues, equipment reliability, fatalistic views around cold water, cost, maintenance, and social norms were all identified as barriers to use of PFDs. While some indicated they always wear a PFD, others reported never wearing one.

Fish harvesters in the women's group tended to indicate more consistent PFD use, but identified fit as an important concern particularly for women. They also indicated that many other fish harvesters they know still refuse to wear PFDs. The group of more experienced fish harvesters indicated low PFD use while fishing, and mentioned it was more common to use PFDs for recreational boating with family. In contrast to the social influence of family motivating the use of PFDs, other fish harvesters pointed out that not wearing a PFD is often common practice among experienced fish harvesters which can influence younger harvesters to do the same. The younger fish harvesters seemed more open to adopt safety practices and suggest innovation such as integrating the PLB into a PFD as a possible facilitator to increase PFD adoption. They did express cost as a barrier to both PFD and PLB use and the young fish harvesters suggested subsidizing PFDs.

PLBs were generally viewed as a valuable safety tool, though the more experienced fish harvesters and some of the young harvesters expressed fatalistic views and a strong belief that survival was unlikely regardless of the equipment because they would freeze in the cold water before rescue was possible. While a number of fish harvesters reported having a PLB, they indicated that they don't always wear them because it is difficult to attach to themselves without creating an entanglement hazard. One fish harvester mentioned their solution was to create a modified pocket on the inside of their raincoat, which shows an effort to adopt safety practices.

4 Discussion

The objectives of this study were to identify factors associated with PFD and PLB use, assess PFD and PLB use and awareness among fish harvesters in NL, and to evaluate the impact of the PLB campaign on this group. To address these objectives, a mixed-methods approach was used that included a systematic literature review on factors associated with PFD and PLB use; three cross-sectional surveys of fish harvesters in NL (Survey 1: n=392); Survey 2: n=340; Survey 3: n=358; total n=1,090); four focus groups; and analysis of PLB registration data.

The systematic review identified several factors associated with PFD use among fish harvesters across 16 studies found in the peer-reviewed literature. Barriers included discomfort, interference with work, perceived risk of entanglement, social and cultural norms, and cost. Facilitators included exposure to previous incidents and participation in PFD education. Notably, only three of the 16 studies examined the effectiveness of interventions aimed at increasing PFD use among fish harvesters, highlighting a limited evidence base for intervention strategies in this population.

The results of Survey 1 showed that fewer fish harvesters were using PLBs than PFDs. However, overall PFD use was also relatively low, and perceptions that PFDs are uncomfortable, interfere with work, or are not available in appropriate sizes may contribute to these low PFD use rates.. By comparison, the majority of fish harvesters reported that PLBs are not affordable indicating that cost may be perceived to be a barrier to PLB use.

The findings from the surveys were consistent with those from the systematic review of factors associated with PFD and PLB use among fish harvesters. A main finding of the survey was that NL fish harvesters reported PFDs to be uncomfortable. Forty-five percent of fish harvesters indicated that PFDs are somewhat or very uncomfortable, which aligns with previous studies reporting PFD discomfort led to decreased use of PFDs (Ahmad et al, 2017; Sorensen et al, 2019). The perception that PFDs interfere with work and create entanglement hazards were also notable factors reported by NL fish harvesters with 46% indicating that PFDs somewhat interfere with work and 48% indicating that PFDs somewhat create entanglement hazards. This is consistent with the work of Lucas et al. (2013) and Well et al. (2016) who reported that that PFDs interfered with work restricted fish harvesters' movement, and created entanglement hazards.

Oporia et al. (2022) reported a perception that using a PFD was for women only. While the survey findings indicate that a few NL fish harvesters agreed that using a PFD is a sign of inexperience, the majority disagreed with such cultural perceptions. This may indicate a shift in norms towards increased acceptance for PFD use. This shift may be the result of increased safety awareness through ongoing interventions or recent safety-related incidents or accidents.

The cost of PFDs was another barrier highlighted in the literature (Sorensen et al., 2021). However, it appeared to be less of an issue in our sample, with 74% of NL fish

harvesters agreeing that they are affordable. Unlike PFDs, the survey findings indicated that the majority (57%) of fish harvesters believe PLBs are not affordable.

Across all surveys, the results suggest that the PLB campaign reached the majority of fish harvesters and there was increased and sustained PLB uptake and use over time. These findings suggest that the PLB campaign likely contributed to these observed increases in PLB awareness and uptake, particularly through efforts to reduce cost barriers and enhance industry-wide promotion. With more than 89% of fish harvesters reporting awareness of the PLB campaign, and an increase in PLB acquisition through the campaign, the intervention's delivery approach (i.e., efforts to reduce cost barriers and provide direct access to in-stock devices) appears to have been effective. In addition, there was a noticeable shift in both harvesters' reported PLB use and their intention to use PLBs (as evidenced through movement towards later stages of behaviour change across the three survey waves). The shift from preparation to maintenance suggests that the PLB campaign may have supported both the initial adoption of PLBs and their sustained use.

Objective data obtained from the Canadian Beacon Registry further support our study's findings, with registrations increasing from 384 for all years prior to 2022 to 2,781 by the end of 2024, representing an approximate 624% increase. The largest increase occurred in 2023, one year after the PLB campaign was implemented. The increase in registrations is an indicator of increased PLB use. While the Canadian Beacon Registry

data are not specific to fish harvesters, the timing of the increase in PLB registrations aligns with the implementation of the PLB campaign, further suggesting that the campaign contributed substantially to PLB uptake within the province.

Although our study demonstrates an improvement in the ownership and use of PLBs among NL fish harvesters, the importance of knowing how to properly operate it should not be overlooked. The majority of fish harvesters in this study, were unable to correctly identify the steps required to activate a PLB. This finding highlights the need for future interventions and studies to evaluate strategies that incorporate operational training when promoting the uptake of new safety devices such as PLBs. While previous research has examined factors associated with PFD use (Lucas et al., 2012; Weil et al., 2016), few studies have evaluated intervention effectiveness in this population (Sorensen et al., 2019), and to our knowledge no studies have examined interventions aimed at improving PLB use among fish harvesters. It is one thing to own safety equipment, but it serves no purpose if it cannot be properly operated when needed.

For PLB use, the perceived barriers of cost and accessibility remained somewhat high across all surveys, with about half of fish harvesters reporting that PLBs were not affordable or easy to purchase in stores. While the campaign addressed these barriers, it is important to note that once the campaign ends the cost and accessibility may remain barriers that will influence decision-making for some fish harvesters in the future. Continuing to address these barriers by educating on cost-benefit and ensuring access in stores may help further improve uptake.

The focus group provided important context to the survey findings. Some of the barriers to PFD and PLB use that were identified include: work interference and entanglement risk, comfort and fit issues, cost, social norms, and fatalistic views around cold-water survival. Fish harvesters also identified potential facilitators, such as integrating PLBs into PFDs, subsidizing PFDs, and modifying equipment to integrate PLBs. Overall, these findings highlight that while awareness is high, physical, operational, and social factors influence the use of PFDs and PLBs among fish harvesters.

The use of multiple time points and integration of survey, focus group, and registration data are key strengths of this study. Some limitations of this study should be acknowledged: since responses could not be reliably linked across surveys, analyses were limited to cross-sectional comparisons, and individual-level changes over time could not be assessed. Additionally, the data collected using self-reported questionnaires and focus group approaches, are susceptible to recall bias and social desirability effects. As a result, reported rates of PFD and PLB use may be overestimated relative to actual behaviour.

It is also important to note that the Canadian Beacon Registry data is not specific to fish harvesters in NL, but rather all NL registrations and, thus, could also include devices owned by recreational boaters, hikers, and hunters. However, the only other PLB intervention that we are aware of during this time was a distribution of PLBs to the Canadian Coast Guard Auxiliary members, whom the majority are fish harvesters. We do not know of any other PLB interventions directed at recreational boaters or those

participating in on-the-land activities, therefore the observed increase in PLB registration is likely influenced by uptake by fish harvesters or others who have directly or indirectly heard about PLBs through the PLB campaign. This interpretation is also supported by information from the NL-FHSA, indicating that the number of PLBs distributed through the program is broadly consistent with the observed increase in registrations, and that devices distributed through the program were required to be registered during the time of purchase. Overall, these findings indicate a progression toward sustained PFD and PLB use among fish harvesters over time.

5 Conclusion and Recommendations

Findings from the surveys and focus groups indicate that comfort, fit, work interference and entanglement risk, cost, social norms, and fatalistic views around cold-water survival are some barriers to PFD adoption. These barriers were also identified in our systematic review. While cost, adaptability, and fatalistic view around cold-water survival have been identified as some of the main barriers to PLB adoption.

The results of the cross-sectional study and PLB registration data suggest that the PLB campaign was effective in reaching fish harvesters and was associated with increased PLB uptake and use among NL fish harvesters. However, improving adoption alone is not sufficient, and further efforts are needed to ensure that fish harvesters know how to properly operate a PLB in an emergency.

Based on these findings, the following recommendations are proposed:

- While the NL-FHSA has shared additional educational material on the use and operation of PLBs throughout the duration of the intervention, it is recommended that promoting PLBs, PFDs, or other safety equipment should be supplemented by educational material, and the education should be ongoing.
- If the cost-share program cannot continue, efforts should be made to educate fish harvesters on the cost-benefit of a PLB and provide information on where they can be purchased. In addition, engaging local retailers to improve PLB availability and visibility may further support access and uptake.
- To improve PFD use, future interventions should focus on addressing the barriers, including exploring difference designs that would minimize interference with work and risk of entanglement, as well as fit for women. PFD interventions can also focus on addressing the fatalistic view around cold-water survival and shifting the social norms around PFD use.
- Explore design options for the integration of PFDs and PLBs.
- Future intervention should focus on long-term use, reinforcing PLB carriage, proper maintenance, and familiarization with proper operation.

In conclusion, our results indicate that the PLB campaign was an effective intervention for improving PLB uptake and use. Efforts need to continue to further increase the uptake and ensure sustained and proper use of PFDs and PLBs by fish harvesters.

6 Acknowledgements

The research team would like to acknowledge the Canadian Center for Fisheries Innovation (CCFI) and WorkplaceNL for funding this research. In addition, we would like to thank John Cullen for his assistance with cleaning of the dataset for detailed analysis.

7 References

Food and Agriculture Organization of United Nations. (2024). *Committee on Fisheries, Safety at Sea and Decent Work in Fisheries and Aquaculture: Executive Summary.* FAO. https://openknowledge.fao.org/server/api/core/bitstreams/82a5f03f-2672-49ce-a27c-be960ba9a1c7/content

International Labour Organization. (2023, April 28). *Nearly 3 million people die from work-related accidents and diseases*. https://www.ilo.org/resource/news/nearly-3-million-people-die-work-related-accidents-and-diseases

International Labour Organisation. Sectoral Activities Programme. (2000). *Note on the proceedings : Tripartite Meeting on Safety and Health in the Fishing Industry, Geneva, 13-17 December 1999 /*.

Jensen, O. C., Petursdottir, G., Holmen, I., Abrahamsen, A., & Lincoln, J. (2014). A review of fatal accident incidence rate trends in fishing. *International Maritime Health*, *65*(2), 47–52. https://doi.org/10.5603/IMH.2014.0011

Lincoln, J. M., & Lucas, D. L. (2010). *Fatal occupational injuries in the U.S. commercial fishing industry: Risk factors and recommendations (East Coast region)*. National Institute for Occupational Safety and Health (NIOSH).

Lucas, D., Lincoln, J., Somervell, P., & Teske, T. (2012). Worker satisfaction with personal flotation devices (PFDs) in the fishing industry: evaluations in actual use. *Applied ergonomics*, *43*(4), 747–752. https://doi.org/10.1016/j.apergo.2011.11.008

Petursdottir, G., Hannibalsson, O., & Turner, J.M.M. (2001). *Safety at sea as an integral part of fisheries management* (No. 966). Rome: FAO Fisheries Circular.

Prochaska, J. O., & Velicer, W. F. (1997). *The transtheoretical model of health behavior change*. American Journal of Health Promotion, 12(1), 38–48. https://doi.org/10.4278/0890-1171-12.1.38

Qualtrics. (2024). *Qualtrics XM Platform* [Computer software]. Qualtrics. http://www.qualtrics.com

Sorensen, J. A., Weil, R., Echard, J., Hirabayashi, L., Scribani, M., & Jenkins, P. (2019). Lifejackets and Lobstermen: Giving Safety Equipment a Competitive Advantage. *Journal of agromedicine*, *24*(4), 381–390. https://doi.org/10.1080/1059924X.2019.1635935

Transportation Safety Board [TSB]. (2022). *Commercial Fishing Safety Watchlist 2022.* Ottawa, Canada. Retrieved from https://www.tsb.gc.ca/eng/surveillance-watchlist/marine/2022/marine-01.html#

Transportation Safety Board [TSB]. (2012). *Marine Investigation Report : Safety Issues Investigation into Fishing Safety in Canada* (No. M09Z0001). Ottawa, Canada. Retrieved from https://www.tsb.gc.ca/eng/rapports-reports/marine/etudes-studies/m09z0001/m09z0001.pdf.

Transportation Safety Board [TSB]. (2019). *Statistical Summary : Marine Transportation Occurrences in 2018*. Ottawa, Canada. Retrieved from https://www.tsb.gc.ca/eng/stats/marine/2018/ssem-ssmo-2018.pdf.

Weil, R., Pinto, K., Lincoln, J., Hall-Arber, M., & Sorensen, J. (2016). The use of personal flotation devices in the Northeast lobster fishing industry: An examination of the decision-making process. *American journal of industrial medicine*, *59*(1), 73–80. https://doi.org/10.1002/ajim.22537

Willis, S., Bygvraa, D. A., Hoque, M. S., Klein, E. S., Kucukyildiz, C., Westwood-Booth, J., & Holliday, E. (2023). The human cost of global fishing. *Marine Policy*, *148*, 105440. https://doi.org/10.1016/j.marpol.2022.105440