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Estimates of disclosure and victimization rates for fishery observers in the maritime workplace

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Seafarers working in remote ports and onboard fishing vessels often face isolated, high-risk environments, making them vulnerable to sexual harassment, intimidation, and assault. In the United States and other countries, scientists, called fishery observers, are required by the government to be deployed alongside fishing crews for extended periods to collect essential fisheries data and report potential fishing regulation violations they witness. Although many fishery observers who experience harassment submit official report statements, the true prevalence of the problem is unknown due to nondisclosure. This study uses anonymous responses from annual surveys distributed to North Pacific groundfish and halibut fishery observers to understand barriers to disclosure and estimate disclosure rates. By adjusting the annual counts of observers who submitted official harassment statements with these estimated disclosure rates, we provide the first estimates of the true number of victimized observers (prevalence) each year in a federal fisheries monitoring program in the United States. Model selection suggested that disclosure was influenced by the type of harassment experienced and not by observer demographics or employment year. Estimated disclosure rates (victimized observers who reported annually via official statement) were lowest for sexual harassment (0.18; 95% CI 0.11-0.29); higher for intimidation, coercion and hostile work environments (0.37; 95% CI 0.28-0.47); and highest for assault (0.57; 95% CI 0.41-0.73). Overall, 45% (95% CI 39-51%) of observers who experienced victimization disclosed harassment in a given year. We estimate that 22-38% of observers were victimized annually during the 2016-2022 study period, with rates of 24-60% for females and 12-24% for males. Victimization rates computed from raw survey summary statistics suffer from self-selection bias while rates derived solely from submission of official statements suffer from bias in underreporting. Supplementing official statements with estimates of disclosure rates from anonymous survey data provides a means of mitigating for these two forms of biases to obtain estimates of victimization untangled from fluctuations in reporting tendencies. When disclosure and victimization are teased apart, the effectiveness of risk reduction strategies can be better assessed over time.

KEYWORDS

fisheries, observer, workplace, harassment, bullying, victimization, nondisclosure, estimates

1 Introduction

Seafaring is one of the world's most dangerous occupations (Devereux, 2022). While the physical dangers presented by slippery decks, heavy equipment and rough seas are widely recognized, the emotional dangers presented to seafarers are relatively unexplored. The maritime work environment is susceptible to hostility and harassment as it is characterized by a strong power differential, isolation, valuable assets, confined spaces, and a culture tolerant of harassment (Ilies et al., 2003; Chappell and Di Martino, 2006). Recent studies have found that workplace bullying and harassment is a significant problem in the maritime industry (Piñeiro and Kitada, 2020; Osterman and Bostrom, 2022; Garcia, 2024). Osterman and Bostrom (2022) report that globally, workplace bullying and harassment at sea is experienced by 8% to 25% of seafarers, and by over 50% of female seafarers.

Fisheries observers are trained scientists who work alongside fishing crews to collect fisheries data in support of fisheries governance that has been positively linked to healthy fish stocks (Hilborn et al., 2020). There are over 2000 observers worldwide who typically operate independently from supervisors and coworkers for as little as a day to up to several months at-sea and in remote ports (Ewell et al., 2020). In the United States, fishery observers, employed by private contractors, are mandated under the Magnuson–Stevens Fishery Conservation and Management Act (MSA) to report potential law violations relevant to the conservation of marine resources to the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) Office of Law Enforcement (OLE) (Brooke, 2014). The data observers report could result in changes in allowable catch amounts, stricter regulation on types of fishing gear, enhanced enforcement of policies, or increased conservation efforts for protected species impacted by bycatch (Ewell et al., 2020). While observers contribute substantially to combating activities that are "illegal unregulated and unreported" (IUU), they cannot effectively be viewed as impartial by fishers when they also collect information that could result in more law enforcement (Porter, 2010). Consequently, observers are often viewed as outsiders. Fishermen have been documented to alter their behavior during observation so that observer data are not representative, leading to bias (Benoit and Allard, 2009; Faunce and Barbeaux, 2011). Observers find themselves labeled by industry members as 'fish cops' or 'snitches'; have been subject to intimidation, harassment, and assault (including sexual assault and rape); and have even gone missing at sea (Ewell et al., 2020; Dobson et al., 2023).

The experience of being a target of any type of workplace bullying and harassment is referred to as victimization (Osterman and Bostrom, 2022). Safety is the counter to victimization. In the United States, the NOAA OLE prioritizes observer safety and the MSA provides OLE with jurisdiction to protect observers. Six regional offices of the OLE strategize risk-reduction activities specific to their area of responsibility. Limited enforcement enterprises require efficient, timely, and reliable reports of violations (Donlan et al., 2020). To quantify victimization, authorities must rely on official statements submitted by observers. However, official statement tallies are not an accurate account of the prevalence of victimization because many victims tend not to disclose victimizing events they experience (Ballard and Easteal, 2018). Without understanding the rate at which victimization goes unreported, it is impossible to know the true prevalence of harassment throughout the industry, develop targeted risk-reduction strategies for combating those behaviors, and track efficacy of risk-reduction strategies over time.

Here we use multi-year data available from a large fishery observer program to examine patterns in disclosing victimization. We then use estimates of disclosure rates to construct corrected estimates of annual observer victimization - estimates that account for those observers who did not disclose but experienced victimizing behavior. These are the first estimates of disclosure and victimization produced for scientists serving as observers in a fisheries observer program, and it is a novel approach to estimating victimization in general. Through model selection, we assess the relative influence of observer demographics and harassment type on observers' willingness to disclose victimizing behaviors. We also explore reasons for nondisclosure and compare observer perceived against objectively defined harassment types.

2 Methods

2.1 The North Pacific Fishery Monitoring Program

The North Pacific Groundfish and Halibut Observer Program (observer program) is the largest fisheries monitoring program in the United States and accounts for over half of the Nation's fisheries monitoring. The observer program is administered by the Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center (FMA). Each year, 350 - 400 observers monitor hundreds of vessels operating in multiple fisheries using pot, longline, and trawl gears in the 2.3M km^2 Exclusive Economic Zone in the federal waters off Alaska. The observer program is divided into two portions: full coverage and partial coverage. The bulk of the catch and effort are completely monitored in the full coverage portion and the portion of the fleet which is partially monitored is done according to regulation and a hierarchical randomized design (Cahalan and Faunce, 2020). The program releases an Annual Deployment Plan[1] each year to describe how it intends to monitor partial coverage fisheries in the year ahead, and an Annual Report[2] that describes the activities from the prior year. A sampling manual and standard operating protocols have been developed for observers to standardize data collections (AFSC, 2023).

New observer candidates must successfully complete a 3-week certification training before they can be deployed on fishing vessels to collect data. Upon returning from deployment, all observers are debriefed to ensure data quality and integrity. During debriefing, observers are able to obtain clarification to methods, revise data, and communicate problems encountered during deployment (e.g.

1 https://www.fisheries.noaa.gov/tags/north-pacific-observer-program?title=annual%20deployment&field_species_vocab_target_id=& sort_by=created.

2 https://www.fisheries.noaa.gov/tags/north-pacific-observer-program?title=annual%20report&field_species_vocab_target_id=&sort_by=created.

harassment). Debriefing staff provide a written performance evaluation at this time and recommend any additional training based on an observer's data quality. Each year regardless of data quality, certified observers must attend a 3-day briefing to continue to be eligible for deployment. An assignment can last up to 90 days before observers are required to debrief, though 90 days may be surpassed on rare occasions by special request. A single assignment typically includes between one to four individual vessels or processing facilities but may be up to ten depending on the assignment. Catcher vessels take trips that average 3 to 5 days in length, while processing vessels may be at sea for one week to over a month at a time.

In recognition that observers may experience unwanted behaviors during their assignment, NMFS takes precautions to strengthen observer safety. Certification training includes harassment awareness and how to document experiences for investigation. Observers are trained to put their own safety as their highest priority. Scenario-based training gives observers exposure to potential situations to prepare observers for negative interactions and possible responses. Observers are encouraged to report to whomever they feel most comfortable with, whether it be an FMA staff member, a victim advocate, or someone from OLE. Since 2022, observers may also make a restricted report directly to NOAA's Office of Workplace Violence Prevention and Response (WVPR) that does not get reported to OLE. If a potential violation or safety issue is identified during debriefing, the observer is encouraged to submit an official statement. Statements are stored electronically in tables within the "NORPAC" database maintained by FMA. Once a statement is written and categorized by the observer, it is reviewed by a NMFS staff member and forwarded to the appropriate authority. Observers have up to 5 years to submit a statement after disembarking a vessel or onshore processing plant assignment. The OLE Alaska Division (AKD) has prioritized for investigation the deterrence and detection of observer sexual assault, assault, harassment, observer safety, interference, and significant sample bias violations (NOAA OLE, 2017).

2.2 Definitions of harassment

For this study, we were interested in three categories of harassment identified as 'AKD priorities': 1) intimidation, coercion, and hostile work environments; 2) sexual harassment and sexual assault; and 3) assault. The behaviors that define each harassment category are set by Federal regulations (Magnuson-Stevens Act Provisions, 2010). *Intimidation* is an act or behavior directed towards an individual that causes fear or apprehension in that person. *Coercion* is compelling someone to do some act against his or her will by the use of psychological pressure or threats. A *hostile work environment* can include intimidation, but it is more general harassment that may include unwanted conduct that has sexual connotations, has the purpose or effect of interfering with a person's work performance, or causes substantial emotional distress in the person. *Sexual harassment* is unwelcomed conduct that is based upon the recipient's sex, gender identity, or sexual orientation that has the purpose or effect of interfering with the recipient's work performance or creates an intimidating, hostile, or offensive work environment. *Sexual assault* is any act of sexual contact with another person without the other person's expressed consent and *assault* is an intentional act that puts a person in reasonable fear of imminent physical harm. AKD is unique to define another category, *disruptive/bothersome behavior (conflict resolved)*, hereafter, disruptive/bothersome behavior. *Disruptive/bothersome behavior* reflects behavior that is reminiscent of the AKD priority categories, but stops when the target of the behavior confronts the perpetrator, or another person intervenes on the target's behalf to stop the behavior.

2.3 Observer statements

Official statements submitted by observers from 2016 to 2022 pertaining to the three AKD priority categories as well as the category, disruptive/bothersome behavior, were reviewed by a special agent from the AKD (J.S.). The special agent assigned each statement to a harassment category based on how the incident would have been investigated by the AKD. At the time of submission, each statement was categorized by the observer; however, perceived harassment may differ by individual. It was therefore necessary for AKD to retrospectively assign a standardized classification of harassment so that actual behaviors could be examined rather than perceptions. Discrepancies between the observer assigned and the AKD agent assigned categories were visualized to illustrate the magnitude and nature of differences in perception between observers and the harassment categories defined by AKD regulations.

Statements were reviewed to ensure that each represented a unique event. Statements submitted from witness encounters (when describing events already described in a statement from first-person) and statements which occurred while off assignment during this timeframe were omitted. Statements from events that occurred off a stationed vessel or port (e.g. at a bar or other vessel) while off duty but while still on assignment were retained. Aside from the addition of a WVPR's participation for some training sessions in 2022, there were no major changes in training, AKD staffing or risk-reduction strategies during the study period.

2.4 Anonymous survey

Anonymous surveys that inquired about the previous years' experience were sent to observers by the AKD. Surveys were conducted in 2018, 2019, 2020, 2022, and 2023 via an emailed Google Form (survey questions are available in Supplementary Table 1). The first survey, however, included two previous years of inquiry for 2016 and 2017. Survey administration was targeted early in the calendar year though in some years, surveys were administered as late as August. No survey was distributed in 2021 due to complications that occurred during the global COVID-19 pandemic. Observers were

given 4 months to complete the form during which several follow-up reminder emails were sent. Anonymous survey responses (hereafter "survey data") were stored electronically within a private and secure NOAA Google cloud account.

The survey was designed similar to the National Crime Victimization Survey (NCVS) (DOJ, 2025). As a behavioral survey, respondents were asked to indicate if they experienced specific behaviors. This is in contrast to direct surveys that request respondents to indicate explicitly if they experienced specific harassment, which could be arbitrarily defined and differ by individual. Behavioral surveys are preferred to direct surveys when the desire is to understand prevalence of harassment rather than individual perception of harassment (Ilies et al., 2003; Clancy et al., 2014; NASEM, 2018). It is not uncommon for victims of harassment to avoid naming their experiences so direct query can introduce several forms of biases when attempting to quantify prevalence. Respondents were asked several questions pertaining to each harassment category so that the complete breadth of behaviors that make up a category were captured.

Survey respondents were asked to select from three options for each question: "No. I did not experience this issue;" "Yes, and I reported this to NMFS and/or OLE;" or "Yes. I did not report this issue." Respondents indicated their gender (male, female, other, or decline to answer), current age range (24 and under, 25 – 29, 30 – 34, 35 and over, or decline to answer), their employer, and year they started in the profession. For respondents who indicated "Yes. I did not report this issue", there was an option to select multiple choices from a provided list and a free-form box to narrate reasons for why they chose not to disclose.

2.5 Modeling disclosure rates

Analyses were conducted using R Statistical Software (v4.2.1; R Core Team, 2022). We estimated observer rates of disclosure ($\hat{p}$) with generalized linear models (GLMs) fitted to survey data from respondents who had experienced victimizing behavior pertaining to AKD priority harassment categories. Logistic regression models with a logit link were fitted to the data with the binary response indicating whether the observer disclosed at least one event of victimization during the year. We used a model selection process to assess the potential contribution of observer gender (male or female), age (<25, 25 - 29, 30 - 34, >35 years), experience (years since first assignment) and employment year in influencing the disclosure of victimizing events. Responses from observers who had indicated gender 'other' (n = 4) or elected to not provide responses to gender or age (n = 7) were not included in the data used for the model selection process. Performing model selection on a reduced dataset was necessary so that all model configurations would have the same number of observations and thus be directly comparable. In model selection, models were performed with combinations of the above potential explanatory variables and ranked by Akaike Information Criterion (AIC) and secondarily by the Bayesian information criterion (BIC). The model with the lowest AIC value was considered the top performing model from the set of candidate models. Although models that ranked within two AIC could be considered as performing equally as well (Burnham and Anderson, 2002), the preferred model has the least variables, and is the most parsimonious. Likelihood ratio tests were additionally performed between the top performing model and more complicated candidate models to confirm that the more complex models were better at capturing the data than the simpler model. If p-values were less than 0.05, the more complicated model was then considered the top performing model, and it was then compared to the next more complicated model until all models had been compared.

To assess the potential influence of the type of harassment category (e.g., assault) on observers' willingness to disclose victimizing events, we performed a second identical model selection process on the same reduced dataset as used for the GLM. This second model selection included the AKD priority harassment category as a possible explanatory variable in addition to the factors used in the GLM. However instead of a GLM, generalized linear mixed effect (GLMM) logistic regression models with a logit link were fitted to the data with the binary response indicating whether the observer disclosed at least one event of victimization for a given AKD priority category during the year. Because respondents may have experienced multiple forms of harassment from one or each of the AKD priority categories, some respondents were repeated in this dataset. Rates of disclosure are likely similar for a single individual but individuals have varying tendencies to disclose. To account for this lack of independence among observations, we included a random effect for the 'respondent' on the intercept. Mixed effect logistic regression models were fitted with the lme4 package (Bates et al., 2015).

Estimated 95% confidence intervals for estimated disclosure rates from both the GLM and GLMM models were constructed via bootstrapping following methods in Manly (1997). The survey dataset was sampled with replacement 1,000 times and for each replicate dataset the selected model was fit. Upper and lower limits for the 95% confidence intervals were the 2.5^{th} and 97.5^{th} percentile of the 1,000 bootstrap model estimates.

2.6 Estimating victimization

Observer annual victimization was estimated by expanding the number of observers who submitted official statements by the model estimated disclosure rate. While multiple statements may have been submitted during a single year from a single observer, we quantified the total number of observers that submitted at least one statement each year rather than the total number of statements. Following Thompson (2012), the total number of observers who submitted a statement pertaining to an AKD priority harassment category (y) can be expressed as the product of the total number of observers who were victimized (V) and the proportion of observers who disclosed victimizing behavior or who submitted a statement ($\hat{p}$). Hence, estimated victimization can be calculated as follows:

$$\hat{V} = y/\hat{p}$$

2.7 Study limitations

We were unable to examine the frequency of harassment over the course of a year. It is rare that victimization is isolated to a single event. About half of survey respondents who claimed to have experienced some form of victimization claimed to have experienced more than one type of harassment, and many observers who submitted official statements did so multiple times in a given year for events that happened on multiple assignments. Quantifying the frequency of harassment requires clear definitions of what would constitute a single victimizing event which can be unambiguous at times. A 2023 update to the North Pacific observer database that houses official statement data defined the entry field for the 'number of instances' in terms of harassment occurring within a *single day*. The field for 'number of instances' existed previously but the data were difficult to interpret since events were left to be interpreted by the observer. Regardless, since the survey inquired about the previous year, it was not possible to fit models to individual events; however, any more temporal granularity would risk maintaining the anonymity of the survey.

Language used in the survey specifically inquired if fishery observers 'reported' their experience. This study relies on the assumption that survey respondents who reported, did so by submitting an official statement. However, due to this language, survey respondents may have interpreted 'reported' to include not only submission of official statements, but any disclosure to their employer, NMFS or AKD staff. If that were the case, report rates presented here would be artificially high resulting in lower estimates of victimization. Although we believe the majority (if not all) of respondents who 'reported' did so via an official statement, we want to point out that if reports from the survey did not reflect only official statement reports that our estimates of victimization rates would be somewhat optimistic.

3 Results

3.1 Observer statements

There were 601 observer statements submitted from 2016 to 2022 categorized by observers as pertaining to either disruptive/bothersome behavior or to one of the three AKD harassment priority categories. After removing statements from witnesses and statements describing events which took place while off-duty, 546 statements were available for AKD special agent review and harassment type categorization. Ultimately, 443 statements were submitted by 355 observers that pertained to AKD priority categories that occurred while on assignment during the study period. This represented 37% of the 934 total observers who were deployed during the study period. Many observers submitted multiple statements for a given year.

Each year, 10 to 17% (38 - 59 individuals) of observers submitted at least one statement pertaining to the AKD priority harassment categories (Table 1A; Supplementary Table 2). Observers indicated that the perpetrator of the priority categories were crew or processing staff (203, 46%), captain or other officer (166, 37%), another observer (44, 10%), a named individual (16, 4%) or unknown (assumed undisclosed; 14, 3%). From 2016 to 2022, there were a total of 388 observers who submitted at least one statement pertaining to assault (14); sexual harassment (120); and intimidation, coercion and hostile work environment (254), respectively. Of those 120 who reported being sexually harassed, 13 described behaviors indicative of sexual assault. The majority of observers who submitted statements were female (68%) while females represented just under half the total observer population (Table 1A).

3.2 Perceived versus AKD harassment category

Of the 546 statements categorized by observers as belonging to one of the three AKD harassment categories (n = 349) or disruptive/bothersome behavior (n = 197), 81% ultimately pertained to AKD priority categories. While many observers likely elected to categorize statements as disruptive/bothersome behavior (conflict resolved) because their situation did resolve, there were many perceived harassment categories (observer assigned categories) that did not match AKD harassment categorization (Figure 1). In many cases, observers minimized the severity of their victimization. Of the AKD-defined sexual harassment statements, observers labeled 16% as intimidation, coercion, and hostile work environments and 29% as disruptive/bothersome behavior. It is not clear from the data if those 29% were actually minimized or if observers simply resolved the issue on their own. Similarly, observers perceived 43% of AKD-defined assault violations as intimidation, coercion, hostile work environments and 27% of AKD intimidation, coercion, and hostile work environments as disruptive/bothersome behavior.

There were cases of observers inflating their victimization as well. There were cases of observer perceived assault and sexual harassment that were ultimately deemed as intimidation by the AKD special agent (Figure 1). Some statements (13%) submitted and categorized by observers as AKD priority categories or disruptive/bothersome behavior were assigned to another non-harassment category entirely by AKD. AKD placed some statements into the categories of interference, sample bias or marine mammal harassment. There was one statement assigned as assault by the observer but was categorized as sexual harassment by the AKD because it involved unwanted sexual contact. Sexual assault is included in our definition of sexual harassment for this study.

3.3 Survey response

A total of 471 survey responses were received during the study period representing between 15 to 27% of observers each year (Table 1B). Females represented 45 to 66% of responses each year,

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TABLE 1 Number of North Pacific fishery observers deployed in a given year (N) and the number of observers who submitted at least one official statement (y) (section A). Number of observer survey respondents (S), number of respondents who made at least one report (y_s) and number of respondents who were victimized during the study period (section B). No survey distributed for 2020.

	Study Year						
	2016	2017	2018	2019	2020	2021	2022
A. Observer Statements							
Observers (*N*)	441	379	381	378	349	352	340
Percent female	44.4	43.3	47.2	47.6	47.6	46.9	47.6
Victimized at least once	These are the values our study seeks to estimate						
Made at least one report (*y*)	58	38	43	47	53	56	59
Assault	1	4	2	3	1	0	3
Sexual harassment	20	6	14	12	16	25	27
Intimidation, coercion, hostile work environment	43	32	31	34	44	38	32
Percent reported 100(*y*/*N*)	13.1	10.0	11.3	12.4	15.2	15.9	17.4
B. Survey							
Respondents (*S*)	110	101	57	60	–	72	71
Percent female	45.5	46.5	57.9	51.7	–	62.5	66.2
Victimized at least once	56	42	33	30	–	43	43
Assault	12	9	7	8	–	12	11
Sexual harassment	30	22	22	18	–	27	31
Intimidation, coercion, hostile work environment	50	31	27	25	–	36	39
Made at least one report (y_s)	26	18	16	13	–	16	23
Percent reported 100(y_s/*S*)	23.6	17.8	28.1	21.7	–	22.2	32.4
Percent survey response 100(S/N)	24.9	26.7	15.0	15.9	–	20.3	20.9

or a total of 54% of the survey response. Just over half of survey respondents (247 or 52%) experienced some form of harassment related to the three AKD priorities of intimidation, coercion, hostile work environment, assault, or sexual harassment during the survey year. Overall, between 18 to 32% of survey respondents made at least one report each year compared to 10 to 17% of observers who submitted at least one statement each year (Table 1). Similar to observer statements, respondents reported experiencing intimidation, coercion, and hostile work environments with the greatest frequency, followed by sexual harassment and assault (Table 1). Of those respondents who experienced sexual harassment, 33% experienced sexual assault.

Survey respondent demographics followed similar patterns as seen for all observers in regards to age and experience (Figures 2B, C). Observers ranged from 21 to 69 years old with 0 to 23+ years of prior experience, though most were less than 29 years old and had less than 5 years of experience. Gender demographics patterns of the survey population, however, did not match that of the observer population. While the observer population was composed year after year by more male than female observers, the survey response was composed of more female than male observers (Figure 2A).

3.4 Barriers to disclosure

There are many reasons for nondisclosure. From the survey, the most frequent reason for nondisclosure by victimized respondents was not perceiving the harassment as a big deal (52%). Respondents also indicated the reason for not reporting was because they thought nothing would be done about it (47%), did not want to get someone in trouble (29%), feared retaliation (21%), felt guilty (16%), and did not want anyone to know what had happened (15%). Similar percent frequencies were found (12%) for a lack of trust in their employer and NMFS staff, and the inability to recall the details of the event. Ten percent or fewer of reasons given for avoiding disclosure included: to avoid going to court, thought it was too late to report, or because they were afraid to lose their job. The least frequent reason to report was because the respondent did not trust OLE (4%).

3.5 Modeled disclosure rates

GLM Model Selection – We assessed the relative contributions of observer demographics and year of employment in influencing

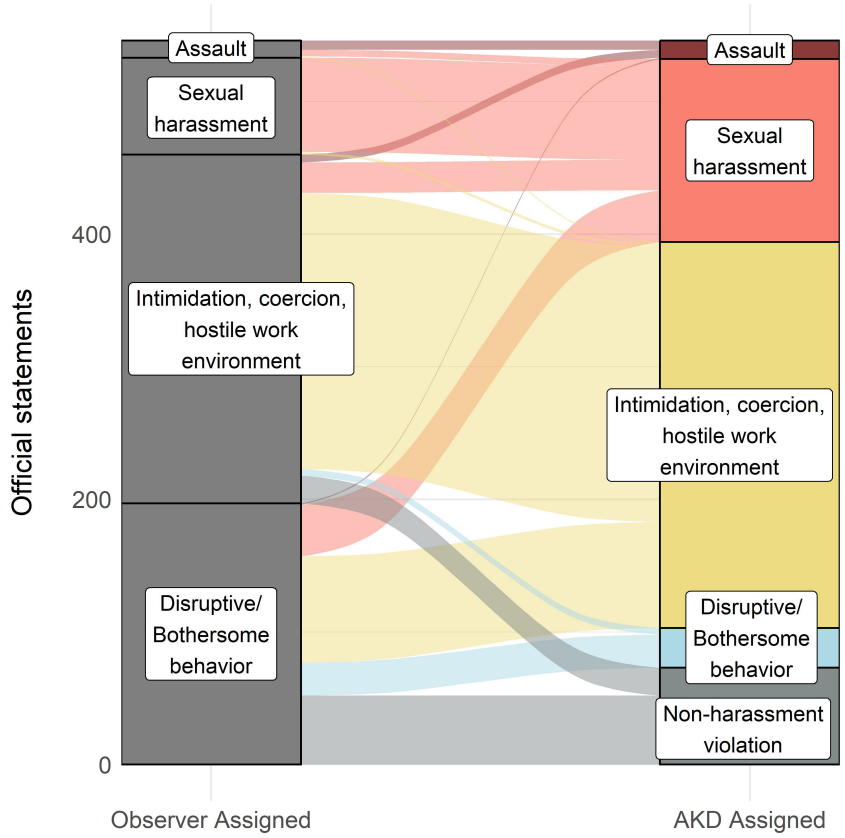

FIGURE 1
Alluvial plot depicting 546 statements pertaining to AKD priority harassment categories and disruptive/bothersome behavior as assigned by observers (left) and how those statements were assigned to harassment categories based on clear definitions by AKD (right).

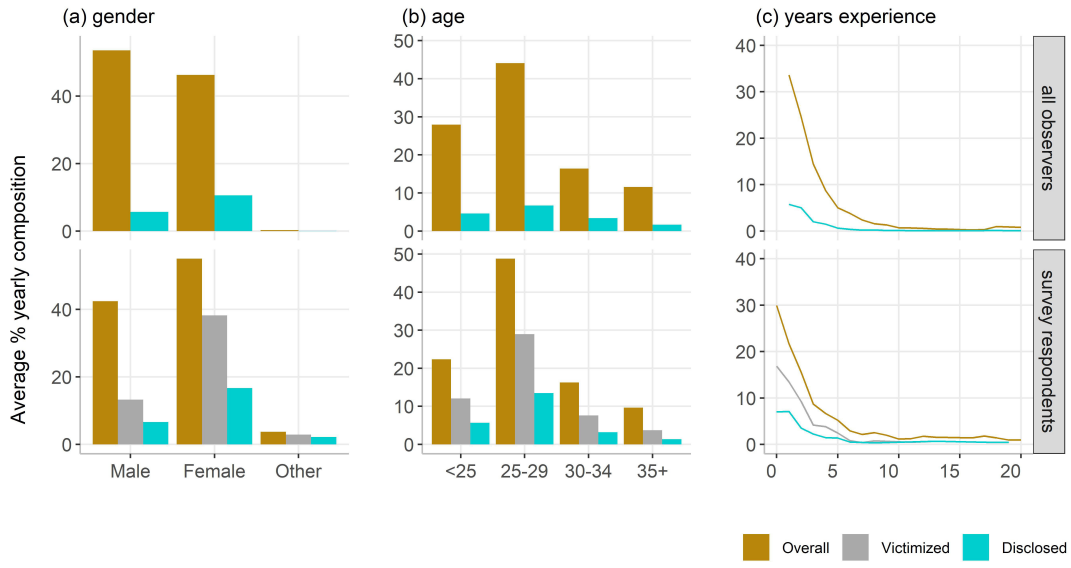

FIGURE 2
Demographics **(A–C)** from all North Pacific fishery observers (top row) and the survey respondents (bottom row). Data are summarized for overall, victimized observers (survey respondents only) and those that disclosed a violation/submitted a statement.

an observer's tendency to report via a GLM model selection process. The best performing model was the intercept-only model which had the lowest AIC and also the lowest BIC (Supplementary Table 2). None of the demographic variables nor year were included in the top performing model. The final intercept-only model was fitted with data from all observers including those who elected to not provide their gender or age and with those who identified as an 'other' gender (Supplementary Table 3). We estimate that the rate of disclosure for victimized observers was 0.45 (95% CI: 0.39 – 0.51; Figure 3; Supplementary Table 4). Less than half (45%) of observers who experienced victimizing behavior disclosed the event. While the GLM model containing gender as a covariate was within two AIC from the intercept-only model and considered as performing equally as well, it was not selected due to being slightly more complicated by having one more parameter than the intercept-only model and because likelihood ratio tests indicated that it did not outperform the intercept only model.

GLMM Model Selection - The relative contributions of harassment category in influencing an observer's tendency to report were assessed via a GLMM model selection process. The model with the lowest AIC as well as the lowest BIC included harassment category as a covariate (Supplementary Table 2). This indicates that type of harassment influences observers' tendency to disclose events of victimization (Supplementary Table 3). Estimated rate of disclosure for victimized observers was 0.57 (95% CI: 0.40 – 0.73) for those that experienced assault, 0.37 (95% CI: 0.28 – 0.47) for those that experienced intimidation, coercion, and hostile work environments, and 0.18 (95% CI: 0.11 – 0.29) for those that experienced sexual harassment (Figure 3; Supplementary Table 4).

3.6 Estimated annual victimization rates

Counts (y) of observers who submitted official statements of victimization annually were expanded by GLM modeled rates of disclosure (0.453^{-1}y) to account for undisclosed victimization and estimate total annual victimized observers during the time period. We estimate that the prevalence of victimization for fishery observers in the North Pacific varied from 22 to 38% of observers annually (Table 2; Supplementary Table 4). Compared to victimization estimates derived from raw counts of official statements, these estimates are approximately twice as high (Figure 4). Compared to victimization rates derived from the survey response, these estimates are much lower (Figure 4). While the use of official statements as a proxy for estimates of victimization results in rates that are low, and those derived directly from self-selected survey respondents are high, our bias-corrected estimates fall in between.

Estimates of observer victimization were also produced for each harassment category by expanding counts of observers who submitted observer statements in each harassment category by the respective GLMM estimated rates of disclosure. Our estimates of observer victimization among years indicate that 0.4 to 1.8% of observers experienced assault, 22 to 34% experienced intimidation, coercion, and hostile work environments, and 9 to 43% experienced sexual harassment (Figure 4, Table 2; Supplementary Table 4).

Female observers were at least twice as likely to become targets of victimization as males. During the study period, we estimate that 24 to 60% of female observers were victimized annually compared to 12 to 23% of male observers. There has been a steady increase in victimization rates since 2017 driven by an increase in female observer victimization (Figure 4). Male victimization rates remained steady over the study period. The same steady increase in victimization is observed in rates of sexual harassment as females make up 95% of observers who submitted official statements pertaining to sexual harassment.

4 Discussion

4.1 Fishery observer victimization

Victimization is especially troubling when individuals being targeted are isolated with restricted access to support from family and friends. Fishery observers operate at sea or from remote ports often without cellular service and from vessels where there is no immediate escape. Therefore, unless truly heinous, observers may find themselves stuck in unfavorable conditions and may be exposed to harassment on a regular basis for the extent of their assignment.

Testimony to the U.S. Congress illustrates how observers can quickly become victimized:

> …I have received first hand examples from observers of how this harassment starts. These examples include, but are not limited to, shuck scallops, clean the slime line, measure crab, or

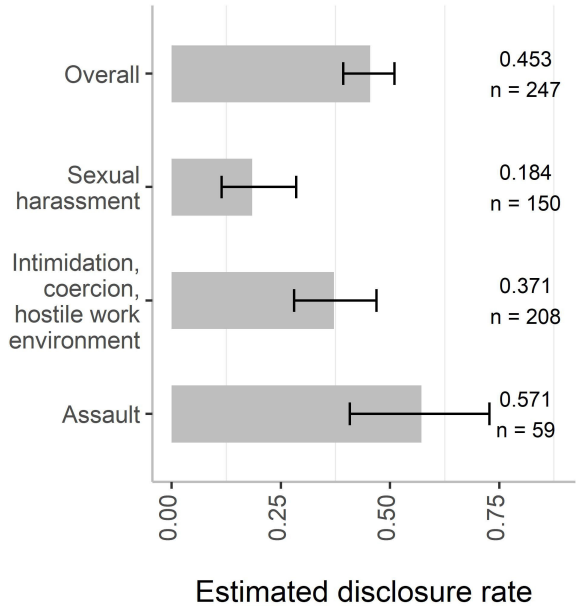

FIGURE 3
Model estimated disclosure rates and 95% confidence intervals from selected models. Overall rate estimated from the GLM intercept-only model, and estimates by harassment type are from the selected GLMM.

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TABLE 2 Estimated percent of observers victimized annually for each AKD harassment priority category, gender and overall.

Year	Assault	Sexual harassment	Intimidation, coercion, hostile work environment	Female	Male	Overall
2016	0.4 (0.2-0.5)	23.4 (15.2-37.6)	26.3 (20.9-34.7)	43.9 (38.8-50.5)	17.1 (15.1-19.6)	29 (25.9-33.6)
2017	1.8 (1.6-2.6)	8.6 (5.5-13.7)	22.8 (17.9-30.1)	24.2 (21.3-28)	20.5 (18.1-23.7)	22.1 (19.5-25.6)
2018	0.9 (0.8-1.3)	20 (12.9-32)	22 (17.3-29.1)	36.8 (32.8-42.2)	14.3 (12.4-16.4)	24.9 (22-28.6)
2019	1.4 (1.1-1.9)	17.3 (11.1-27.8)	24.3 (19-32)	44.1 (39.4-51.1)	12.3 (11.1-14.1)	27.4 (24.3-31.7)
2020	0.5 (0.3-0.6)	24.9 (16-40.1)	34 (26.9-45)	51.8 (45.8-59.6)	16.9 (14.8-19.7)	33.5 (29.8-38.7)
2021	–	38.6 (25-61.9)	29.1 (23-38.4)	48.1 (43-55.8)	23.6 (20.9-27.3)	35.1 (31.2-40.6)
2022	1.5 (1.2-2.1)	43.2 (27.9-69.4)	25.4 (20-33.5)	59.9 (53.1-69.1)	18.6 (16.3-21.3)	38.3 (34.1-44.1)

Lower and upper 95% confidence bounds are provided in parenthesis.

> even cook for the crew. These duties are not part of the observer's job, and the intent is to remove them from their assigned position so they are not able to perform their job functions. Therein lies the power and control. If an observer refuses to participate in these behaviors, they are not part of the team; and if they do participate, the crew then can hold over their heads that they were not at their assigned job. These harmful behaviors can escalate quickly and result in the observers not having access to food, sleeping quarters, bathroom facilities, or the captain's deck (Oral testimony Julie Dale McNeese, S.116-33 - 116th Congress, 2020).

The North Pacific Observer program has experienced a steady increase in submission of official statements pertaining to sexual harassment, intimidation, coercion, and hostile work environments since 2000 (Faunce et al., 2023). While Faunce et al. (2023) had inferred that the rise in statements was due to a rise in tendency to report, they were unable to confidently attribute the pattern to either victimization or disclosure. The results of our study demonstrate that the observed incline in submission of official statements from 2017 to 2022 was unfortunately due to a rise in victimization since tendency to disclose remained steady over the time period. For years prior to 2016, it is not possible to confidently attribute patterns to either disclosure tendencies or to victimization because ancillary information on disclosure rates does not exist for this time period. Reliance solely on sums of submitted statements represents a single metric encompassing both disclosure and victimization in one so it is not possible to decipher whether observed patterns are due to disclosure or victimization.

This recent rise in victimization is perplexing given that the harassment of observers is among one of AKDs top stated priorities, and that numerous efforts have been made to increase victim advocacy through outreach and demonstrated accountability through summary settlements. From 2017 to 2022, we can point to the rise in female victimization, namely the rise of sexual harassment, driving the rise in overall victimization. One explanation for the rise in victimization could be due to female observers increasingly participating in the observer program workforce. As long as females experience victimization at higher rates than males, shifting gender demographics in the workforce toward female scientists will likely increase the number of official statements submitted and increase overall victimization. In the relatively short period of this study, we saw an increase from 44% to 47% in female participation.

By our estimate, roughly one in three observers are victimized annually. How this estimate compares to other observer programs in the United States is unknown as similar analyses are not available from other U.S. observer programs. This estimate is, however, similar to bias-corrected rates estimated by the United States, Department of the Interior, National Park Service (NPS, 2017).

4.2 Self-selection survey bias

Victimization rates were not computed directly from surveys because we found evidence of a self-selection bias. We found evidence suggesting that individuals who had negative experiences may have been more prone to responding to the surveys as suggested by Clancy et al. (2014). First, over half of survey respondents experienced some form of harassment while only an average of 14% of observers submitted a statement. While statement submission is only a proxy for all victimization, this is a rather large disparity. The survey victimization rate was 3.9× higher than the statement submission rate. Second, the gender ratio from the survey respondents was opposite that of the whole observer population. The overall observer population was composed of slightly more male observers, while the survey population was composed of slightly less male than female observers (Figure 2A). This suggests that females, who experience higher rates of harassment than males (Osterman and Bostrom, 2022; NASEM, 2018; Piñeiro and Kitada, 2020), were more inclined to respond. These clues are not definitive but the flip in gender ratios and high survey victimization rate lends strongly to the idea that observers who had negative experiences were more prone to completing the survey. This tendency introduces a self-selection bias that likely produces an inflated population level estimate of victimization based on survey raw summary statistics alone. Other anonymous surveys requesting information on harassment also obtained more responses from female than male participants in STEM fields and reported high rates (72% and 75%) of victimization (Clancy et al., 2014; Maia et al., 2024).

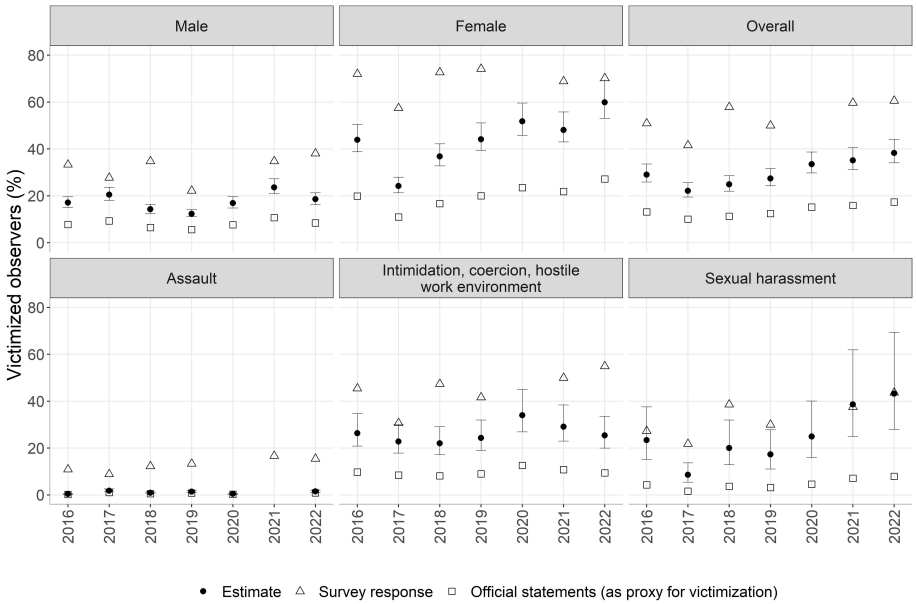

FIGURE 4
Estimated percent and 95% confidence interval of victimized North Pacific fishery observers by gender, harassment category and overall compared to raw computed percent of survey respondents who experienced victimization and to the percent of observers who submitted at least one official statement (a proxy for victimization) during the year. No survey was distributed for 2020. Further details are provided in Supplementary Table 4.

By using the survey data to understand disclosure rates, rather than victimization, we were able to minimize this bias. Rather than considering the whole observer population, we instead considered only victimized observers and examined disclosure tendencies. We minimized the self-selection bias because the population of interest became observers who had negative experiences. In fact, any population level self-selection bias toward individuals with negative experiences worked in our favor to increase sample sizes. Models were fitted with survey data from only victimized observers and this allowed us to make the easier assumption that victimized respondents' tendency to disclose was an adequate representation of the population of victimized observers.

Biases involved with self-selection were likely not eliminated. One reason is that victims of the most traumatic experiences are often less inclined to respond to this type of survey to avoid triggering negative emotions (Clancy et al., 2014). In addition, as suggested by the NPS (2017), employee demographics may influence tendency to complete voluntary surveys which is not something we accounted for. We recognize demographics may play a role but assumed that tendency to complete the survey was more strongly influenced by observer exposure to negative experiences and that tendencies based on age, gender or experience were minimal.

4.3 Barriers to disclosure

The observer community is small and close-knit, and observers may hesitate to report their harasser or assaulter because the observer may have learned about the offender's home life and the family they are supporting. About a third of victimized survey respondents in this study reported that they did not disclose because they did not want to get someone in trouble and some observers reported a fear of being the 'mean' observer. This barrier is related to offender tactics where offenders are typically known to their victims.

More often, victimized observers viewed the offense insignificant enough to report. This view will vary greatly depending on individual tolerance to unwelcome behaviors and understanding of appropriate workplace behavior. Continued exposure to crude behaviors in the workplace may shift one's tolerance for unwelcome behavior. Observers commented on the survey that they could not possibly submit a statement for every offense they experienced because there would be too many and demand too much time.

Many respondents also claimed that their reluctance to report was because they didn't think anything would be done about it. In support, Faunce et al. (2023) reported that most harassment related cases from 2010 to 2020 resulted in dismissal or failure to prosecute because of missing or incomplete information.

While the majority of reports are not prosecutable cases, the AKD does attempt to take action via outreach and education. Observers are encouraged to disclose victimization, have strong support from the department, and have presumably been the beneficiaries of efforts to promote victim advocacy by AKD and NMFS (AFSC, 2023). Observers are encouraged to report to whomever they feel most comfortable and are provided contact information for different victim advocacy resources. The WVPR provides an alternate reporting option for observers who experience victimization aside from reporting to NMFS or AKD. If it is a restricted report, the information will not be shared outside of WVPR. If the report is unrestricted, WVPR will notify law enforcement so an investigation can be launched. Reports through WVPR are the only option for restricted reporting.

As part of AKD's risk-reduction strategy, the fishing industry is encouraged to become active bystanders and capable guardians, and

to collaborate with the AKD to improve the work environment for observers. To encourage the fishing industry to be active participants in providing a safe environment for observers, the AKD also offers voluntary training titled, "Ensuring a Safe Working Environment for Observers" to the fishing industry. This training has been provided via virtual sessions directly to companies upon request and at in-person outreach meetings. In addition to the AKD, the WVPR also conducts outreach and education to the fishing industry. In our study, the pressures to not report victimization were evident no matter the observer gender, experience, or employment year. Less experienced, younger employees in more entry level positions often experience higher rates of harassment and lower rates of disclosure due to a power imbalance with those in more senior roles (Clancy et al., 2014; Aguilar and Beak, 2020). Because we only looked at observers and not the complete fishery workforce, we were likely unable to detect an effect of experience and age since all observers are positioned in a similar hierarchical level of power in relation to captain and crew members. Had there been a big change in NMFS leadership, AKD staffing, substantial changes to risk reduction strategies, or an overall cultural shift (i.e. the #metoo movement), we would have expected employment year to influence observer tendency to report. Our finding that gender is not influential to one's tendency to report illuminated that females did not submit more statements (Supplementary Table 4) simply because they were more inclined to report than males, but in fact experienced victimization more than male observers – an important distinction.

Similar to results from other studies (Wolitzky-Taylor et al. 2011; Maia et al., 2024), observer reporting rates in our study were strongly influenced by the type of harassment experienced. Assault cases were disclosed most often - for every observer that reported assault during the year, there were 0.75 who did not. Comparatively, for every one observer that reported sexual harassment, there were another 4.43 observers that did not report. Because sexual harassment is so highly correlated with gender, we did see that the second-best GLM model included a gender explanatory variable in lieu of harassment category (Supplementary Table 2). Nearly all sexual harassment statements were reported by female observers.

Nondisclosure in the face of victimization is not unique to fishery observers (Chappell and Di Martino, 2006; Ullman et al., 2020; Maia et al., 2024). Victims may attempt to endure (ignore the situation), detach (avoid the harasser), deny (pretend nothing happened), relabel (re-interpret the event), and apply illusory control (blaming one-self) before resorting to reporting their situation (Piñeiro and Kitada, 2020). Victims of sexual harassment frequently avoid disclosure in an effort to resist labeling themselves as having been discriminated against thereby promoting their own victimhood (NASEM, 2018).

4.4 Impacts of harassment

Intimidation, coercion, and harassment can be a daily struggle that has a profound impact on an observer's well-being, performance, and professional development. It leads to a loss of job satisfaction, lower job engagement and loss of commitment to the organization (NPS, 2017). Victims of harassment report high stress levels, low self-confidence, depression, and sleep disorders (Vartia, 2001). They cite feelings of anger, insecurity, hopelessness, and a lack of motivation for work (Maia et al., 2024). Bystanders that witnesses to these types of behaviors can experience similar effects (Vartia, 2001). The experience of assault or harassment in the workplace has the potential to have lasting impacts on an individual and can weaken their motivation for returning to the program and continuing in their careers (Nelson et al., 2017; NASEM, 2018; Leaper and Starr, 2018). For female observers, the negative impact on career trajectories further perpetuates the gender gap for women in science (Clancy et al., 2014).

Impacts of harassment in the workplace also impact the employer. The physical and psychological toll of harassment leads to decreased work productivity, absenteeism, and turnover leading to costs associated with recruitment and training (Popovich and Warren, 2010; Bartlett and Bartlett, 2011). In STEM-related fields, harassment and aggression in the workplace can lead to a decrease in data quality and quantity and/or falsification of data which then can cause data to be deemed unsuitable for use in research or in guiding management decisions. This can have serious management implications in fisheries because decisions are based on the data collected by observers. A loss of quality data can increase uncertainty in fishery stock assessments, catch limits, appropriate levels of biological removals, and impacts on protected species and bycatch, all of which can have serious implications in the management process. Future research that quantifies the impacts to data quality and quantity are needed to fully understand the magnitude in which workplace harassment impacts fisheries management. Additionally, future research is needed to quantify observer tenure relative to experiences of harassment and assault to realize the monetary costs associated with observer turnover, and to understand the rate in which career trajectories are disrupted.

4.5 Observers as scientists and law enforcement assets

The collection of fishery data by observers on active commercial fishing vessels is crucial to supporting sustainable fisheries throughout the world (Ewell et al., 2020). Intensively managed, well-regulated, and well-enforced fisheries carry numerous benefits for fishers, fish stocks, and fishing communities. The scientific role of observers to document the catch and collect biological information supports both stock assessment and successful fisheries management (Sutinen, 1999; Hilborn et al., 2020). Each potential violation of a rule reported by observers is an example of illegal, unregulated, and unreported (IUU) fishing (Shirley and Gore, 2019). Fisheries typified by low incidences of IUU fishing possess stock levels indicative of a fishery that is not overfished (Agnew et al., 2009; Hilborn et al., 2020; Temple et al., 2022). Placing observers on vessels for long periods of time in remote ports is dangerous; however, observers in the North Pacific are the main source of information on IUUs (Porter, 2010) and fishery stocks. Contrary to Porter (2010), the benefits observers provide to fisheries management do not outweigh observer safety. Observer safety in

hazardous conditions is a core labor right, and regulatory authorities should be duty-bound to protect this right (Nakamura et al., 2022; Belhabib and Le Billon, 2022).

4.6 Public transparency

As it is important for observer programs and government entities to track disclosure and victimization to understand the effects of risk-reduction strategies, it is also important to provide that information in a systematic and comparable format to the public (Ewell et al., 2020; Belhabib and Le Billon, 2022; Dobson et al., 2023). Public transparency has the means to hold observer programs and government entities charged with observer safety accountable and strengthen trust within the observer community (Arnason, 2013). It sends a signal to the observer community, fishing community, and general public that the overseeing agency is prioritizing observer safety. Transparency boosts observer confidence that the agency will protect observers and takes charges of harassment seriously. When observer harassment statistics are provided to the public in a comparable format across programs, it is possible to make comparisons among regions and evaluate regional risk-reduction strategies to adopt those that may be more effective.

Despite these benefits, the North Pacific Observer Program is the only major program in the United States that provides details of harassment to the public (Dobson et al., 2023). The program publishes an annual report that includes summary statistics of submitted statements pertaining to observer perceived AKD priority harassment categories by region, coverage type, management program, gear type and vessel/processor category (i.e. North Pacific Observer Program 2022 Annual Report). These data were first included in annual reports in 2013 and were updated in 2019 to be in terms of 1,000 observer days. These data, though available to the public annually, would be too granular and therefore difficult to compare to other regions that may use a different suite of coverage types, management programs, gear types and vessel/processor categories.

A lack of transparency from a program does not equal a lack of harassment. The North Pacific Observer Program is hardly unique in experiencing workplace harassment. Major observer programs in the United States and other national observer programs would benefit from developing a systematic approach to providing observer harassment statistics to the public in a comparable format among regions.

4.7 Conclusion

Quantification of official statements of harassment is often used as a proxy for victimization. This method relies on the willingness of individuals to disclose their experiences, but in reality, many victims choose not to report. As long as disclosure is less than 100%, enumeration by official statements will always produce victimization rates that are lower than the true prevalence. Our work presents a method for tracking and gauging the true prevalence of assault and harassment that accounts for nondisclosure. We produced the first estimates of victimization for field scientists serving as fishery observers in a federally managed program. The method is broadly applicable to other fishery monitoring programs or to any other workplace that keeps record of official statements of harassment and is able to distribute anonymous surveys. It is hoped that this research encourages others to embark on the meaningful and difficult work of reporting victimization so that we may be more effective at reducing risk.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Office of Management and Budget (OMB) for the anonymous survey (information can be found at https://www.federalregister.gov/documents/2019/06/11/2019-12196/submission-for-omb-review-comment-request). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because participation was voluntary for the anonymous survey and because statement data collected regularly from observers by NMFS falls under the MSA and is subject to confidentiality requirements that were met under this research.

Author contributions

LJ: Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. CF: Conceptualization, Funding acquisition, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing. AK: Conceptualization, Data curation, Writing – review & editing. JS: Conceptualization, Investigation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2024.1461655/full#supplementary-material

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