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ANALYSIS OF TAG SEEDING DATA FOR THE 2026 BIGEYE AND YELLOWFIN ASSESSMENTS: REPORTING RATES FOR PURSE SEINE FLEETS

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Executive summary

The reduced rate of tag seeding experiments in the WCPFC Convention Area has raised concerns around the ability to use seeding data to monitor for temporal trends in reporting of returns of tropical tuna in purse seine catches. Traditionally, observers have attempted to seed tags without the knowledge of crew, to best represent the rates of detection and reporting of returns of PTTP tags. The difficulties in successfully implementing this approach motivated the development of a new tag seeding protocol, where the observer seeds fish directly into the well, but without attempting to hide this from crew. The introduction of a plain-sight protocol, coupled with a renewed focus on tag seeding more generally, resulted in a strong increase in the rate of tag seeding experiments from 2024 onwards.

This report documents an updated methodology that can be applied to data from both traditional and plain-sight seeding experiments and applies this to tag seeding data from 2007 to 2024 to estimate reporting rates for purse seine fleets operating in the WCPO. These fleet-specific estimates were then used to generate penalty distributions for purse seine fisheries in the 2026 assessments of bigeye and yellowfin tuna in the Western and Central Pacific Ocean.

The means of the estimated reporting rate penalty distributions are appreciably lower than those used in the 2023 assessments, with a reduction of 10 – 24% depending on the species and region. This reduction in estimated reporting rates is largely driven by the inclusion of the double-tag effects in the reporting rate models. Double-tagged fish are associated with higher reporting rates, which may reflect the increased visibility of a tag when multiple tags are used, or the influence of tag-shedding. Coefficients of variation (CV) of the reporting rate penalty distributions are broadly similar to those used in the 2023 assessments.

We invite the Scientific Committee to consider the following recommendations for the tag seeding experiments and analysis:

- Note the increase in the rates of tag seeding experiments in 2024, due to the focus on tag seeding experiments coupled with the introduction of the plain-sight protocol.
- Endorse continued tag seeding while wild tag recoveries occur, targeted to fleets and regions where these wild tag recoveries are most likely.
- Endorse continued tag seeding experiments using both the traditional and plain-sight protocols, to best inform reporting rates across the full tuna supply chain.
- Note the updated methodology for estimation of reporting rates, which incorporates observations from both the traditional and plain-sight protocols.
- Consider that with enough tag seeding data, more detailed analyses of variables influencing tag reporting rates have potential benefits for informing reporting rate parameters for stock assessments of WCPO tuna species, as well as independent analyses of tagging data.

Introduction

SPC have tagged and released tunas in the Western Central Pacific Ocean (WCPO) since 1977, across three tagging programmes: the Skipjack Survey and Assessment Programme (SSAP), 1977 to 1981; the Regional Tuna Tagging Programme (RTTP), 1989 to 1992; and, the current Pacific Tuna Tagging Programme (PTTP), since 2006. Tag seeding experiments have been undertaken as a component of both the RTTP and PTTP. Traditionally, observers have undertaken tag seeding experiments on purse seiners by surreptitiously marking caught tuna with conventional plastic tags, thereby 'seeding' the catch with tagged fish. These seeded fish then enter the tuna supply chain along with the rest of the catch and allow monitoring of the rates at which the seeded fish are reported as having been recovered, as well as the accuracy of information provided by the tag finder on the date and location of the fishing event where the fish was caught.

The MULTIFAN-CL stock assessments of WCPO tropical tuna stocks account for recovered tags that are not detected and/or reported to SPC using fishery and tagging programme specific reporting rates, i.e. the proportion of caught, tagged fish that are subsequently reported. Incorporation of reporting rates in the assessment model addresses systematic under-estimation of fishing mortality rates and over-estimation of stock biomass due to under-reporting of tag recoveries. Reporting rates are estimated within the assessment model and are constrained by reporting rate penalty distributions which are provided as an input, based on either analyses of data external to the assessment model or more subjective determinations of plausible reporting rates. These penalty distributions penalise estimated reporting rates that are further away from the mean of the prior distribution, with the strength of the penalisation controlled by a penalty term. Historically, purse seine tag reporting rate penalty distributions for MULTIFAN-CL assessments have been estimated using tag seeding experiments, using the proportion of seeded tags that are subsequently detected and reported to SPC (e.g. Hampton 1997; Berger et al., 2014).

The number of tag seeding experiments undertaken per year by observer programmes in the WCPFC Convention Area has decreased through time, which has prevented robust monitoring of temporal changes in reporting rates of PTTP tag recoveries (e.g., SPC-OFP, 2025). The difficulties faced by observers in tagging fish on purse seiners without detection by crew has been communicated as one of the main reasons preventing an increase in the rate of tag seeding experiments. As a result, in 2024 a new tag seeding protocol was implemented, referred to in this report as 'plain-sight' seeding, where observers do not attempt to tag the fish in secret. Instead, the observers simply tag the fish and place them directly in the well. As with the traditional (secret) tag-seeding protocol, the observers then record whether they noticed that crew were aware that tag seeding had taken place, or whether the crew enquired about what they were doing. The plain-sight protocol does not provide information on reporting rates during fishing operations, only from the processes of unloading or transferring of wells through to butchering of fish at processing facilities, but has the advantage of being easier to implement compared to the 'traditional' (secret) tag seeding protocol. Since 2024 tag-seeding experiments have been undertaken using both the traditional and plain-sight protocols, with one protocol followed per tag seeding experiment. Throughout this report, 'tag seeding experiment' refers to an observer trip on a specific fishing vessel, during which tags were seeded.

This information paper estimates reporting rate priors based on tag seeding experiments for application in the 2026 yellowfin and bigeye stock assessments, using a new modelling approach that allows incorporation of data from both the traditional and plain-sight tag seeding protocols.

Methods

Tag release and recovery information were extracted from SPC's TUFMAN2 tagging database for all tag seeding experiments undertaken from 2007 to 2024 inclusive (Table 1). The larger number of tag seeding experiments from 2025 onwards were excluded to ensure sufficient time for seeded tags to be detected and reported to SPC and thus minimise downwards bias in estimated reporting rates in recent years.

This analysed dataset included 490 seeding experiments, representing 10,539 individuals marked with tags. A total of 6,258 recaptures were reported to SPC, of which 3,425 (54.7%) were found on the fishing vessel whilst fishing, unloading or during well transfers, with the remaining 2,833 (45.3%) found in subsequent stages in the supply chain. The majority of individuals were seeded using the traditional protocol (9,361), with 1,178 individuals accounted for by the plain-sight protocol. The majority of seeded individuals had a single tag (n = 8,486), with the remainder double tagged (n = 2,053). Plastic anchor tags were used for all single-tagged fish. Double tagged fish were either marked with two plastic anchor tags (n = 1,805), or one plastic and one steel anchor tag (n = 248). The distribution of tag-seeding experiments per flag and year is provided in Table 2.

Since 2009, observers have recorded whether they believed that fishing vessel crew had seen the seeding of tags, or whether crew had asked questions that suggested that they were aware that tag seeding had taken place, i.e. whether the tag seeding experiment was likely to have been compromised. Higher rates of detection and reporting of tags on fishing vessels have been associated with seeding experiments that were considered likely to have been compromised (Peatman et al., 2016). Here, we retained all tag seeding experiments in the analysed dataset, regardless of whether the tag seeding experiment was considered likely to have been compromised.

Exploratory data analysis was undertaken to inform how to jointly model data from both traditional and plain-sight tag seeding experiments. Theoretically, any effect of the tag seeding protocol on reporting rates should reflect different levels of awareness of tag seeding by potential tag finders due to that protocol, and should only impact reporting rates in the initial stages of the supply chain; after a particular stage of the tuna-product supply chain, the protocol used should have no bearing on whether potential tag finders are aware that tag seeding took place.

Restricting comparisons to seeding experiments from 2024, the proportion of plain-sight seeded tags that were found on the fishing vessel and reported (51.7%) was approximately twice that of tags seeded with the traditional tag seeding protocol (24.1%, Figure 2). Additionally, the overall proportion of total seeded tags that were detected and reported as recovered was higher for the plain-sight protocol (67.4%) compared to the traditional tag seeding protocol (47.6%). When excluding seeded tags that were found on the fishing vessel (i.e., treating these individuals as not having been tagged in the first place), the overall proportions of seeded tags detected and reported were similar for the two tag seeding protocols, though differences remained in the proportions of seeded tags that were found at different stages in the supply chain (Figure 3). In combination, these suggest that reporting rates on fishing vessels may be higher with the plain-sight protocol compared with the traditional tag seeding protocol.

Beta-binomial models of reporting rates were fitted in R version 4.5.1 (R Core Team, 2025) using the brms package (Bürkner, 2017) which acts as an interface to Stan (Carpenter et al., 2017; Stan

Development Team, 2026) via the cmdstanr package (Gabry et al., 2025). A multivariate model structure was used, with two response variables: the number of seeded tags reported as recovered in an initial stage(s) of the supply chain; and, the number of remaining seeded tags reported as recovered across the following stages of the supply chain. This approach allows for separate estimation of the effect of tag seeding protocol on reporting rates at different stages in the supply chain, and similarly for the effect of crew being aware that tag seeding took place under the traditional protocol. Additionally, the use of multivariate models allows for incorporation of correlation in effects between the initial and subsequent stages of the model, e.g., correlation in temporal effects.

The response variable for the initial stage was defined as the reporting of tags on the fishing vessel. The response variable for the second stage of the reporting rate model was defined as the reporting of tags post-fishing vessel, i.e., on reefer vessels, at port / market, in cold storage or in canneries. Recoveries from an unknown location were considered less likely to have been from the fishing vessel, and so were included as post-fishing vessel recoveries. Our *a priori* expectation was that detection and reporting of tags on the fishing vessel would be affected if the crew were aware that seeding had taken place, but that post-fishing vessel reporting would be unaffected (Peatman et al., 2016). Similarly, the effect of tag-seeding protocol was assumed to effect reporting rates on the fishing vessel, but not post-fishing vessel reporting rates.

The specification of the model component for reporting rates on the fishing vessel was:

$$\mathrm{E}(rec_{nt}^{A}) = rel_{nt} \cdot \mu_{nt}^{A}$$

$$\mathrm{Var}(rec_{nt}^{A}) = rel_{nt} \cdot \mu_{nt}^{A} \cdot (1 - \mu_{nt}^{A}) \left[1 + \frac{\sigma^{A}}{1+\sigma^{A}}(rel_{nt} - 1)\right]$$

$$\log\left(\frac{\mu_{nt}^{A}}{1-\mu_{nt}^{A}}\right) = \beta_0^{A} + protocol_{nt}^{A} + double_{nt}^{A} + seen_{nt}^{A} + \alpha_{year_t}^{A} + \alpha_{flag_t}^{A}$$

where:

- μ_{nt}^{A} is the fishing vessel reporting rate for fish from seeding experiment t seeded with n tags
- rel_{nt} is the total tags seeded and rec_{nt}^{A} is the total number of reported recoveries found on the fishing vessel
- β_0^{A}, is the global intercept
- $protocol_t^{A}$ is a categorical variable for tag seeding protocol
- $double_{nt}^{A}$ is a categorical variable for whether the fish were double (TRUE) or single (FALSE) tagged
- $seen_{nt}^{A}$ is a categorical variable for the observer's judgement on whether the crew had seen the observer during the seeding of tags ("seen"), questioned why the observer was seeding tags ("crew asked"), the observer was uncertain if he had been seen ("uncertain"), the observer did not think the crew had seen seeding of tags ("not seen"), or no information was available from the observer as to whether they had been seen by crew whilst seeding ("unknown")
- $\alpha_{year_t}^{A}$, a random intercept for the year of the mean date of seeding
- $\alpha_{flag_t}^{A}$, a random intercept for the vessel flag-state
- σ^{A} an overdispersion parameter.

The specification of the model component for post-fishing vessel reporting rates was:

$$\mathrm{E}(rec_{nt}^{B}) = a_{nt}^{B} \cdot \mu_{nt}^{B}$$

$$\mathrm{Var}(rec_{nt}^{B}) = a_{nt}^{B} \cdot \mu_{nt}^{B} \cdot (1 - \mu_{nt}^{B}) \left[1 + \frac{\sigma^{B}}{1 + \sigma^{B}} (a_{nt}^{B} - 1)\right]$$

$$\log\left(\frac{\mu_{nt}^{B}}{1 - \mu_{nt}^{B}}\right) = \beta_0^{B} + double_{nt}^{B} + \alpha_{year_t}^{B} + \alpha_{flag_t}^{B}$$

where:

- μ_{nt}^{B} is the fishing vessel reporting rate for fish from seeding experiment t seeded with n tags
- a_{nt}^{B} is the number of seeded tags available for detection post-fishing vessel ($a_{nt}^{B} = rel_{nt} - rec_{nt}^{B}$)
- rec_{nt}^{B} is the total number of reported recoveries found post-fishing vessel
- β_0^{B}, is the global intercept
- $double_{nt}^{B}$ is a categorical variable for whether the fish were double (TRUE) or single (FALSE) tagged
- $\alpha_{year_t}^{B}$, a random intercept for the year of the mean date of seeding
- $\alpha_{flag_t}^{B}$, a random intercept for the vessel flag-state
- σ^{B} an overdispersion parameter.

The random intercepts for year and flag had correlation parameters $c_{year} = \mathrm{corr}(\alpha_{year_t}^{A}, \alpha_{year_t}^{B})$ $c_{flag} = \mathrm{corr}(\alpha_{flag_t}^{A}, \alpha_{flag_t}^{B})$ respectively.

Model parameters were estimated using four chains, each with 4,096 iterations from which the first 2,048 were discarded. Model convergence was assessed based on examination of posterior samples of parameters, with posterior predictive checks used to assess the fit of the model to observations.

We used the expected log-predictive density (ELPD; Watanabe, 2010; Vehtari et al., 2017) to test support for adding effects on tag seeding protocol ($protocol_{nt}^{B}$) or whether the observer thought they had been seen by crew seeding fish ($seen_{nt}^{B}$) to the model component for post-fishing vessel recoveries. We also used ELPD to test support for addition of an interaction between $protocol_{nt}^{A}$ and $seen_{nt}^{A}$.

Posterior samples of model parameters were used to estimate vessel reporting rate (RR^{A}) and post-fishing vessel reporting rates (RR^{B}) per flag and year, using the estimated probabilities of tags being detected and reported, i.e., μ_{nt}^{A} and μ_{nt}^{B}. Reporting rates were estimated with the double-tag effect set to FALSE, as PTTP tag releases typically had a single tag (> 99.7%). Additionally, tag seeding protocol was set to traditional (i.e., secret) and *seen* effects set to "not seen", to reflect reporting of wild tags under typical conditions. As with earlier iterations, we used the posterior estimates of the Chinese Taipei flag effect for Japan, due to concerns around the accuracy of the estimates for the Japanese fleet (e.g., Berger et al., 2014).

The overall reporting rate (RR) per flag and year was then calculated as:

$$RR = RR^{A} + (1 - RR^{A}) \cdot RR^{B}$$

Assessment region-specific reporting rate distributions for the duration of the PTTP were obtained by calculating the weighted mean of the flag and year-specific reporting rates, weighted by the product of flag and year-specific reported catch of the species (bigeye or yellowfin) in the region, and the number of PTTP releases of the species (in all regions). This ensures that flags with higher catches have more influence on a region's overall reporting rate distribution, and similarly for years with more PTTP releases. Throughout this report, region numbers refer to the five-region structures provided in Figure 1. For yellowfin, purse seine fisheries in region 4 were split by subarea (4-WEST & 4-EAST), and so subarea specific reporting rates were prepared. For bigeye, purse seine fisheries in region 3 were not specific to subarea (3-ARCH & 3-WEST), and so estimated reporting rates were specific to region. The region or subarea-specific reporting rate distributions were then mapped to purse seine fisheries in the 2026 bigeye and yellowfin assessments.

The mean and variance of the region-specific reporting rate distributions were then extracted, with the penalty parameter given by $penalty = (2 \cdot variance)^{-1}$. Flags that did not contribute a minimum of 1% to the total catch for any assessment region were excluded. Catches of the domestic Indonesian and Philippines purse seine fisheries were also excluded, on the assumption that available tag seeding data are only representative of reporting rates for the distant water fishery in region 2.

Results

All models successfully converged, and model fits were considered adequate (e.g., Figure 4). There was no support for the addition of *protocol* effects in the model specification of post-fishing vessel reporting rates (ΔELPD with addition = - 1.1, SE of ELPD 28.2), or the addition of *seen* effects in the model specification of post-fishing vessel recoveries (ΔELPD with addition = 0.3, SE of ELPD 28.2). There was also no support for addition of an interaction between *protocol* and *seen* effects in the model specification of fishing-vessel reporting rates (ΔELPD with addition = - 1.8, SE of ELPD 37.5).

There was substantial variation among flag states for both fishing vessel and post-fishing vessel reporting (Figure 5a, Figure 6a). Reporting rates on fishing vessels demonstrated an increasing temporal trend from 2007 through to 2013, with no clear temporal trend for 2014 onwards (Figure 5b). In contrast, post-fishing vessel reporting rates demonstrated a generally decreasing but variable temporal trend throughout (Figure 6b), though with lower reporting rates for 2015 to 2018 (inclusive). Double tagged fish were associated with higher reporting rates both on fishing vessels (0.35, 95% CI 0.14 – 0.56; Figure 5c) and post-fishing vessel (0.42, 95% CI 0.21 – 0.63; Figure 6c). The plain-sight tag seeding protocol was associated with higher fishing vessel reporting rates (0.46, 95% CI -0.05 – 0.97). Seeding experiments where crew had seen seeding had taken place (based on the judgement of the observer) were associated with higher reporting rates (0.42, 95% CI 0.11 – 0.74), as were seeding experiments where the crew had asked the observer questions relating to the seeding of tags (0.52, 95% CI 0.11 – 0.92; Figure 5a).

The resulting posterior distributions of assessment region-specific reporting rates for bigeye are provided in Figure 7. Estimated reporting rates in region 3 and region 4 had a similar mean, though region 4 had a higher variance due to the relatively large contributions to catches from flags with limited coverage in the tag seeding dataset and so uncertain flag effects, e.g., Ecuador (EC). The reporting rate penalty distribution parameters are provided in Table 3.

The resulting posterior distributions of assessment region-specific reporting rates for yellowfin are provided in Figure 8. Estimated reporting rates in region 3 were higher than for 4-WEST and EAST due to the relatively large contributions to catches from flags in region 3 with high estimated reporting rates, e.g., Papua New Guinea (PG) and the Philippines (PH). The reporting rate penalty distribution parameters are provided in Table 4.

Discussion

This report provides an updated methodology for the estimation of penalty distributions for purse seine reporting rates for use in assessments of tropical tuna in the WCPFC Convention Area, using data from both the traditional (secret) tag-seeding protocol as well as the more recent plain-sight protocol.

The introduction of the plain-sight protocol, coupled with renewed focus on tag seeding experiments more generally, was motivated by the reduction in the number of tag seeding experiments per year which has compromised robust monitoring of temporal trends in reporting rates in the region (SPC-OFP, 2025). The rates of tag seeding experiments increased substantially in 2024, along with an increase in the coverage of purse seine fleets. Maintaining the current rates of seeding in the region should allow for robust detection of temporal trends into the future. The current rates of seeding experiments may also allow for explicit incorporation of spatial variation in estimation of reporting rates, which could lead to a more accurate representation of the variability in reporting between assessment regions resulting from differences in the supply chains (e.g., ports of unloading and cannery sites). Furthermore, the current rates of seeding, if continued, may allow for consideration of differences in reporting rates between species, which may result from different treatment of species in the supply chain. There are also benefits from the increase in the rate and coverage of tag seeding experiments that have already been realised in the estimation of reporting rates provided here. The tag seeding dataset now has coverage for all key purse seine fleets and as such it is no longer necessary to apply reporting rates from proxy fleets in cases where flag-state specific reporting rate estimates were not available.

Following earlier analyses (e.g., Berger et al., 2014), the estimated Japanese flag effect in the reporting rate models was considered to be too low given the numbers of reported PTTP recoveries from Japanese vessels relative to other flag states. The Chinese Taipei flag effect was applied to Japan when estimating flag-specific reporting rate distributions. We note that Japanese vessels unload catches in Japanese ports, in contrast to other purse seine fleets operating in the WCPO. As such reporting rate estimates for Chinese Taipei purse seiners, or indeed those of other purse seine fleets, may not reflect those for Japanese vessels due to differences in the supply chains of product between the fleets.

Earlier work identified an apparent reduction in reporting rates in 2015. The updated methodology implemented here, with separate estimation of reporting rates on fishing vessels from post-fishing vessel reporting rates, suggests that the reduction in 2015 was largely driven by reductions in detection and reporting of tags post-fishing vessel. This may be associated with changes in, or increasing complexity of, the tuna-product supply chain. Reported recoveries of PTTP data are not inconsistent with this, with a higher proportion of recoveries found on the fishing vessel from 2015 onwards relative to the period 2007-2014 (Figure 9). The models presented here also provide insight into other apparent changes in reporting rates. The increasing temporal trend in estimated reporting rates from 2007 to 2014 identified by Peatman et al. (2025) is attributed to increased rates of detection and/or reporting of tags on fishing vessels. This increasing temporal trend may reflect a gradual increase in the awareness of the PTTP by fishers in the early years of the tagging programme. We also note that the analysis supports the association of increase reporting rates on fishing vessels with traditional seeding experiments that were considered likely to have been compromised (Peatman et al., 2016).

The means of the reporting rate penalty distributions are lower than those used in the 2023 assessments (Peatman & Nicol, 2023). For bigeye, the means of the updated penalty distributions are 15 to 24% lower than those that would have been obtained in 2023 with the use of the 2026 region and fishery definitions. For yellowfin, the means of the updated penalty distributions are 10 to 21% lower than those from the 2023 assessments. This reduction in estimated reporting rates is largely driven by the inclusion of the double-tag effects in the reporting rate models. The influential double-tag effects for reporting rates, both on fishing vessels and downstream in the supply chain, may reflect the increased visibility of a tag when multiple tags are used, or the influence of tag-shedding, i.e., a greater probability of a tag being retained when multiple tags are used (all else being equal). It is important to note that the double tag effects may also partially reflect the (unmodelled) effect of tag-type, as steel-headed tags were only used when fish were double tagged (with one steel-head tag and one plastic tag). Peatman et al. (2025) did not find support for the inclusion of tag-type effects as well as double-tag effects, though this may reflect the limited number of fish seeded with steel-headed tags.

Coefficients of variation (CV) of the reporting rate penalty distributions are broadly similar to those used in the 2023 assessments (in the range of 0.03 – 0.06), which may reflect the additional tag seeding experiments in this year's analysed dataset offsetting the increased complexity of the reporting rate models. However, as mentioned in the Results section, the penalty distribution for bigeye in region 4 is an exception to this, with a relatively low CV (0.09) due to the high contribution to catches from fleets with low numbers of tag seeding experiments.

Reporting rates for the 'large scale' purse fisheries in region 2 were generated using the approach from the 2019 skipjack assessment (Vincent et al., 2019), i.e. by estimating a reporting rate distribution for the equatorial large-scale fishery outside of archipelagic waters and then applying a 50% reduction to the penalty parameter to reflect the greater uncertainty. For yellowfin, estimated reporting rates were based on catch data from subareas 4-EAST and 4-WEST, with catch data from subarea 3-WEST and region 4 used for bigeye. The percentage of purse seine catches from Japanese vessels in the large scale purse seine fisheries in region 2 is also relatively high, which further supports the reduction applied to the penalty parameter given uncertainties around reporting rates on Japanese vessels. Available tag seeding data may not be representative of reporting rates for the domestic purse seine fisheries of Indonesia and the Philippines in region 2, due to differences in fishing vessel characteristics, product flows of catches through the supply chain etc. As such, we recommend that the reporting rate prior is only used for the 'large scale' fisheries in region 2, and not the domestic fisheries of Indonesia and the Philippines.

As described above, the recent increase in the rate of tag seeding experiments, facilitated by the introduction of the plain-sight protocol, has already improved the coverage of the tag seeding dataset. Additionally, the continuation of the current rate of seeding experiments has the potential to lead to substantial improvements in the representation of reporting rates in assessment models of skipjack, bigeye and yellowfin tuna. Here, we jointly modelled reporting rates on fishing vessels, and reporting rates downstream in the tuna supply chain. In the future, with additional plain-sight seeding experiments, it may be possible to revisit how to separate the two stages of the tuna supply chain to best isolate and account for the effect of seeding protocol, as well as other covariates influential in the reporting rates of tagged fish, when estimating reporting rates of PTTP recoveries. If applied to independent analyses of tagging data for which reporting rates are highly influential (e.g. Ducharme-Barth et al. 2026), the possibility to use these tag seeding data using a different approach that is not bound to the regional-fishery strata of the current stock assessment models should also be explored.

Recommendations

We invite the Scientific Committee to consider the following recommendations for the tag seeding experiments and analysis:

- Note the increase in the rates of tag seeding experiments in 2024, due to the focus on tag seeding experiments coupled with the introduction of the plain-sight protocol.
- Endorse continued tag seeding while wild tag recoveries occur, targeted to fleets and regions where these wild tag recoveries are most likely.
- Endorse continued tag seeding experiments using both the traditional and plain-sight protocols, to best inform reporting rates across the full tuna supply chain.
- Note the updated methodology for estimation of reporting rates, which incorporates observations from both the traditional and plain-sight protocols.
- Consider that with enough tag seeding data, more detailed analyses of variables influencing tag reporting rates have potential benefits for informing reporting rate parameters for stock assessments of WCPO tuna species, as well as independent analyses of tagging data.

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Declaration of generative AI and AI-assisted technologies in the SC paper preparation process.

No AI technologies were used in the preparation of this paper.

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Tables

Table 1 Tag seeding experiments per year and protocol in the analysed dataset used to estimate reporting rate penalty distributions.

Year	Traditional	Plain-sight	Total
2007	11	0	11
2008	15	0	15
2009	22	0	22
2010	16	0	16
2011	47	0	47
2012	79	0	79
2013	80	0	80
2014	30	0	30
2015	19	0	19
2016	15	0	15
2017	9	0	9
2018	7	0	7
2019	7	0	7
2020	5	0	5
2021	3	0	3
2022	10	0	10
2023	21	0	21
2024	45	49	94
Total	**441**	**49**	**490**

Table 2 Tag seeding experiments in the modelled dataset by year and flag for the a) traditional and b) plain-sight protocols.

a) Traditional protocol

Year	CN	EC	ES	FM	JP	KI	KR	MH	MX	NR	NZ	PG	PH	SB	SV	TV	TW	US	VU	Total
2007	0	0	0	0	0	0	0	1	0	0	0	5	1	0	0	0	2	1	1	**11**
2008	1	0	0	0	0	0	0	3	0	0	0	5	3	0	0	0	0	3	0	**15**
2009	0	0	0	0	0	0	0	0	0	0	3	8	1	0	0	0	0	10	0	**22**
2010	0	0	0	0	0	0	4	1	0	0	0	2	0	0	0	0	0	8	1	**16**
2011	0	0	0	1	1	0	12	2	0	0	0	3	5	3	0	0	1	19	0	**47**
2012	1	1	0	2	4	6	21	2	1	0	0	12	3	1	3	0	5	17	0	**79**
2013	0	0	0	0	3	10	12	4	0	0	2	26	8	0	0	0	0	14	1	**80**
2014	0	2	0	0	0	0	5	3	0	0	1	7	3	1	0	0	3	5	0	**30**
2015	0	0	0	0	4	4	0	0	0	0	0	0	1	1	1	0	2	6	0	**19**
2016	0	0	0	0	0	4	0	1	0	0	0	0	0	0	1	0	1	8	0	**15**
2017	0	0	0	1	1	3	0	0	0	0	0	1	0	0	0	0	0	3	0	**9**
2018	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	5	0	**7**
2019	0	0	0	1	1	0	0	0	0	0	0	3	0	1	0	0	0	1	0	**7**
2020	0	0	0	0	1	0	0	0	0	0	0	3	1	0	0	0	0	0	0	**5**
2021	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	**3**
2022	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	1	0	0	0	**10**
2023	0	3	1	0	0	2	0	0	1	1	0	1	0	0	2	0	0	10	0	**21**
2024	0	1	1	10	0	4	0	7	0	5	0	3	0	4	0	0	0	10	0	**45**
Total	**2**	**7**	**2**	**16**	**15**	**33**	**54**	**24**	**2**	**6**	**6**	**92**	**26**	**11**	**7**	**1**	**14**	**120**	**3**	**441**

b) Plain-sight protocol

Year	CN	EC	ES	FM	JP	KI	KR	MH	MX	NR	NZ	PG	PH	SB	SV	TV	TW	US	VU	Total
2024	0	0	0	2	5	0	0	0	0	1	0	16	3	11	0	0	4	7	0	**49**

Table 3 PTTP reporting rate prior distribution parameters for purse seine fisheries in the 2026 bigeye assessment.

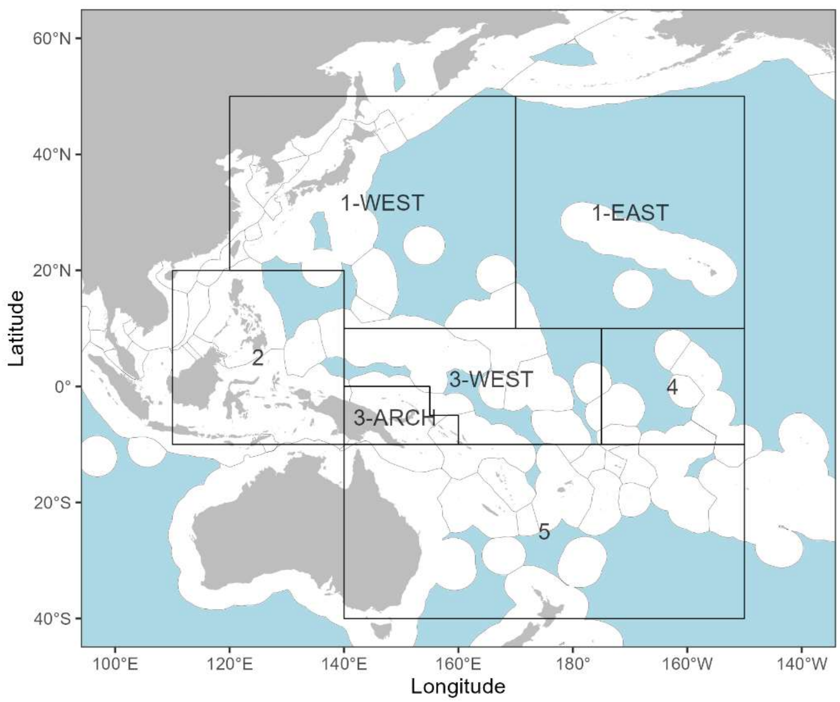
Region	Fishery	Mean	Penalty
2	PS.ASS.2 & PS.UNA.2	0.496	354
3	PS.ASS.3 & PS.UNA.3	0.512	739
4	PS.ASS.4 & PS.UNA.4	0.528	231

Table 4 PTTP reporting rate prior distribution parameters for purse seine fisheries in the 2026 yellowfin assessment.

Region	Fishery	Mean	Penalty
2	PS.ASS.2 & PS.UNA.2	0.502	260
3	PS.ASS.3 & PS.UNA.3	0.647	722
4-WEST	PS.ASS.4.WEST & PS.UNA.4.WEST	0.514	428
4-EAST	PS.ASS.4.EAST & PS.UNA.4.EAST	0.474	632

Figures

a) Bigeye



b) Yellowfin

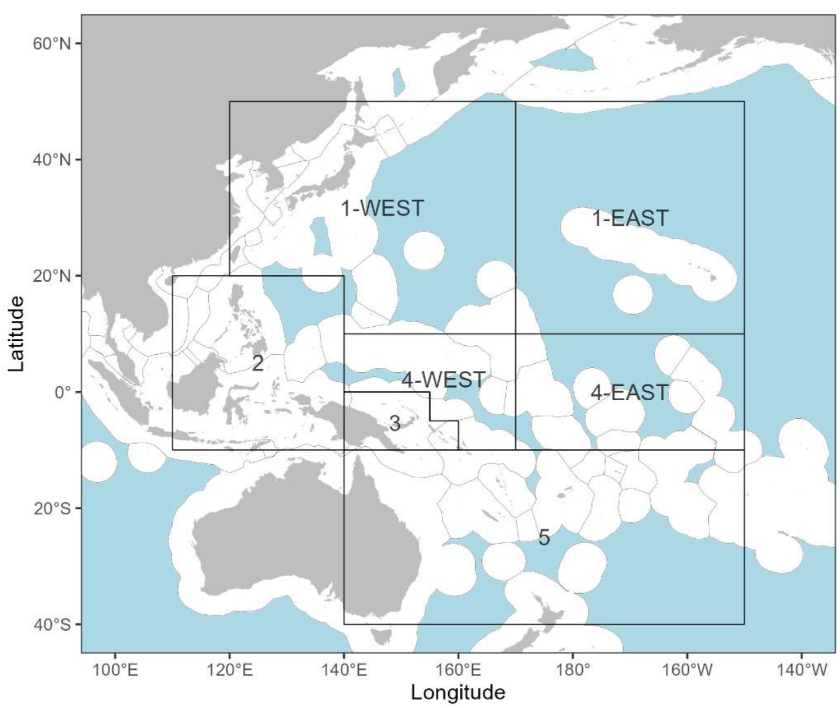


Figure 1 Region structures for the 2026 a) bigeye and b) yellowfin assessments used in this report.

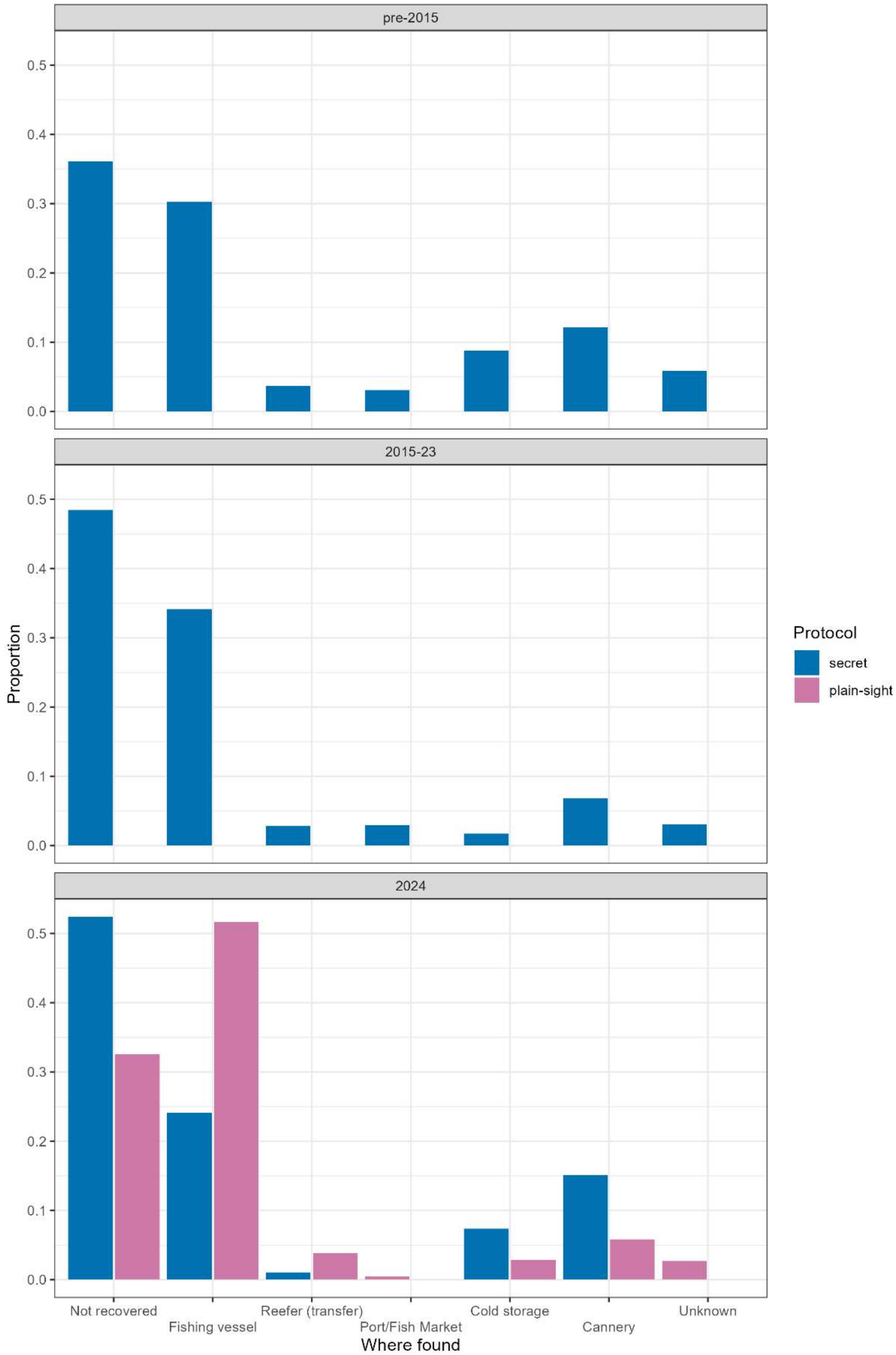


Figure 2 The proportion of seeded tags found at different stages of the supply chain (on the fishing vessel, reefer vessels, at port / market, in cold storage or in canneries) per protocol for 2007-2014 (top panel), 2015-2023 (middle) and 2024 (lower panel). The proportion of seeded tags that were not reported as recovered is included for reference ('not recovered').

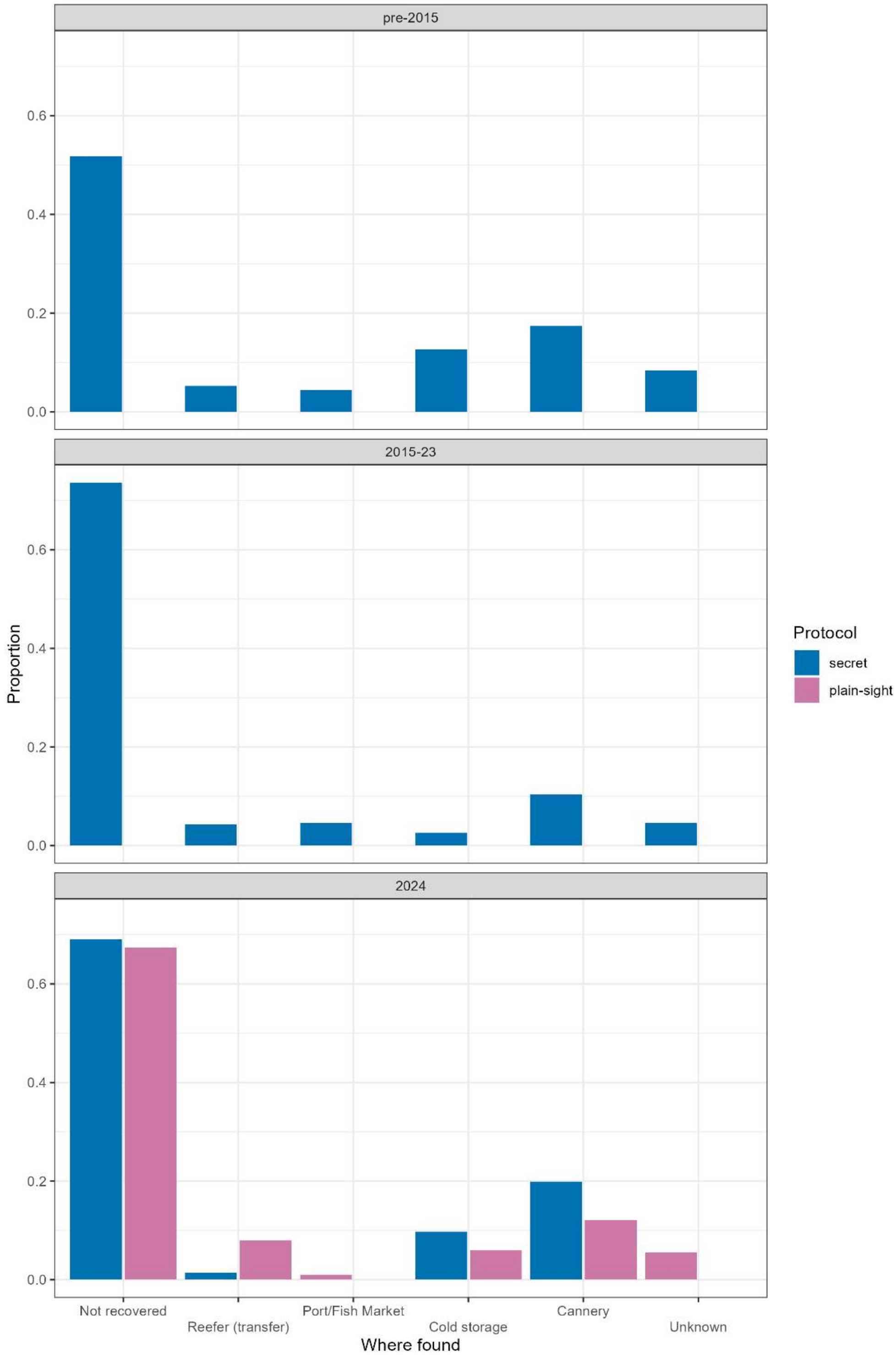
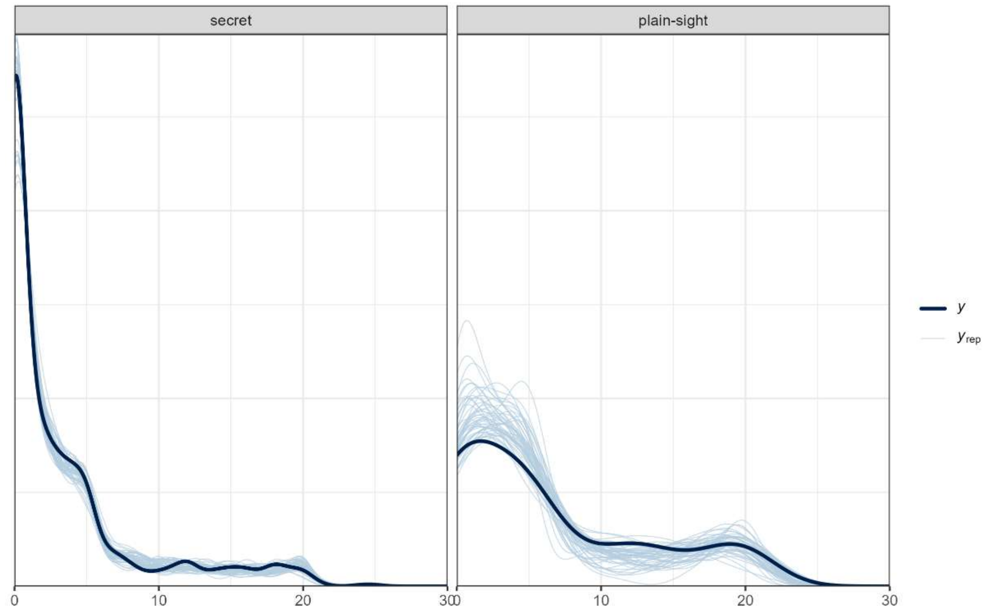


Figure 3 The proportion of seeded tags found at different stages of the supply chain (on reefer vessels, at port / market, in cold storage or in canneries) per protocol for 2007-2014 (top panel), 2015-2023 (middle) and 2024 (lower panel), excluding tags found on the fishing vessel. The proportion of seeded tags that were not reported as recovered is included for reference ('not recovered').

a) Fishing vessel recoveries



b) Post-fishing vessel recoveries

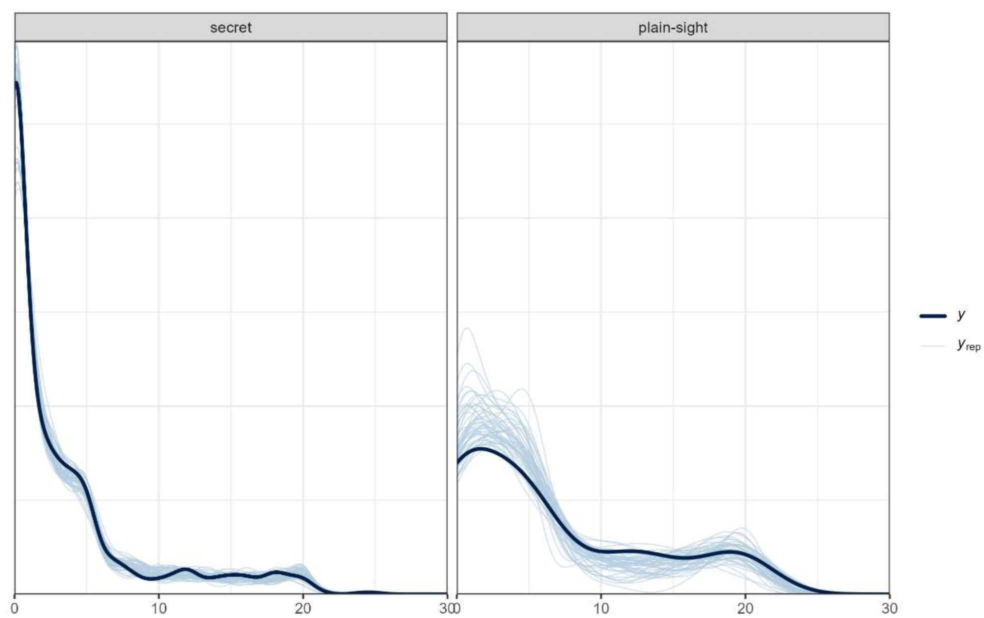
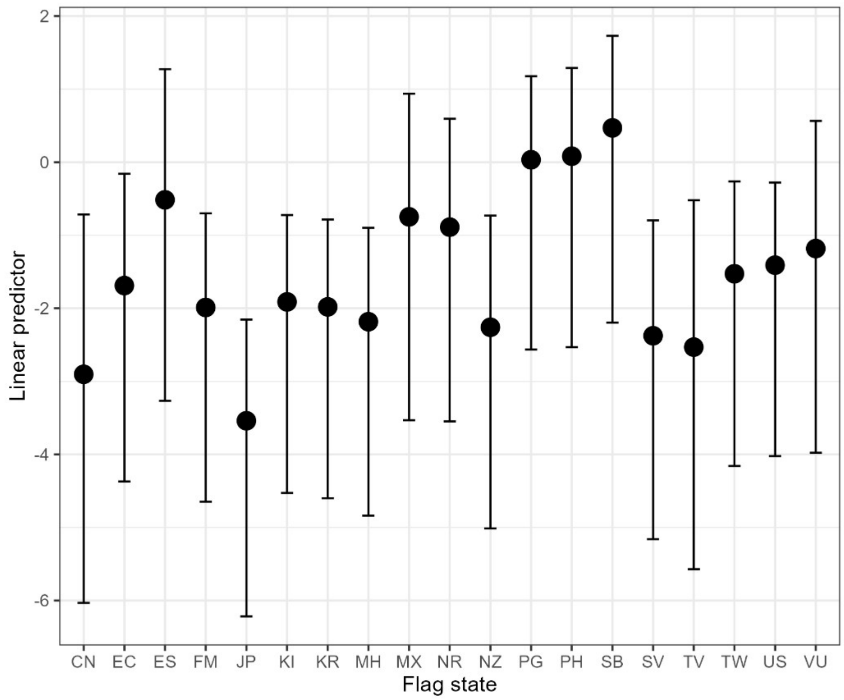


Figure 4 Posterior predictive density plots for a) fishing vessel recoveries and b) post-fishing vessel recoveries, for secret (traditional – left column) and plain-sight (right) protocols.

a) Flag



b) Year

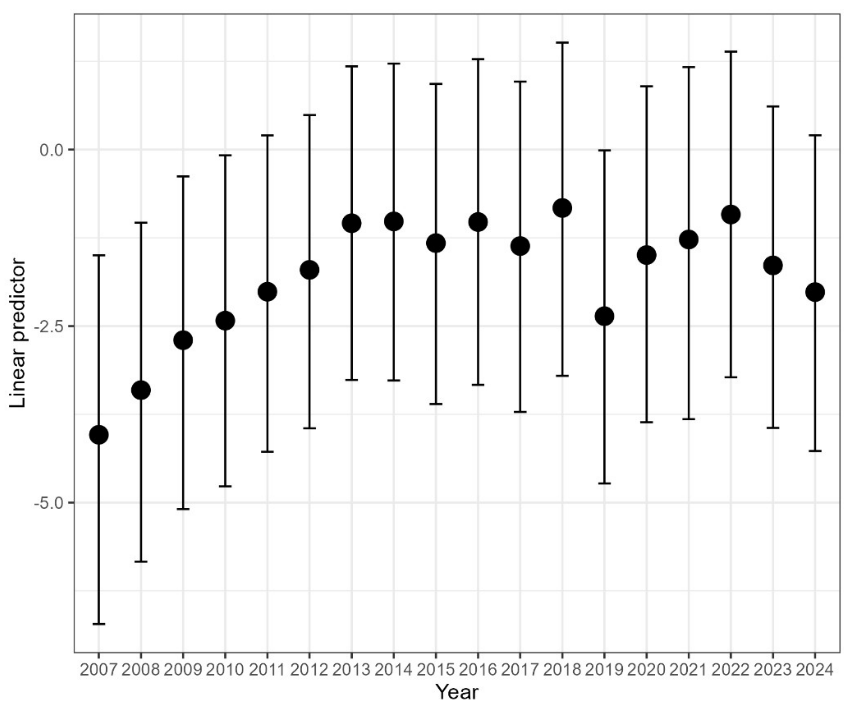


Figure 5 Conditional effects plots (median with 95% CI) for the fishing vessel component of the selected reporting rate model: a) flag, b) the year of the seeding experiment, c) double tag, d) tag seeding protocol, and e) whether the observer thought crew had seen the seeding of tags. The effect of each covariate was estimated in turn by holding the remaining covariates constant at reference levels (double tag = FALSE, seen by crew = Not seen, protocol = traditional).

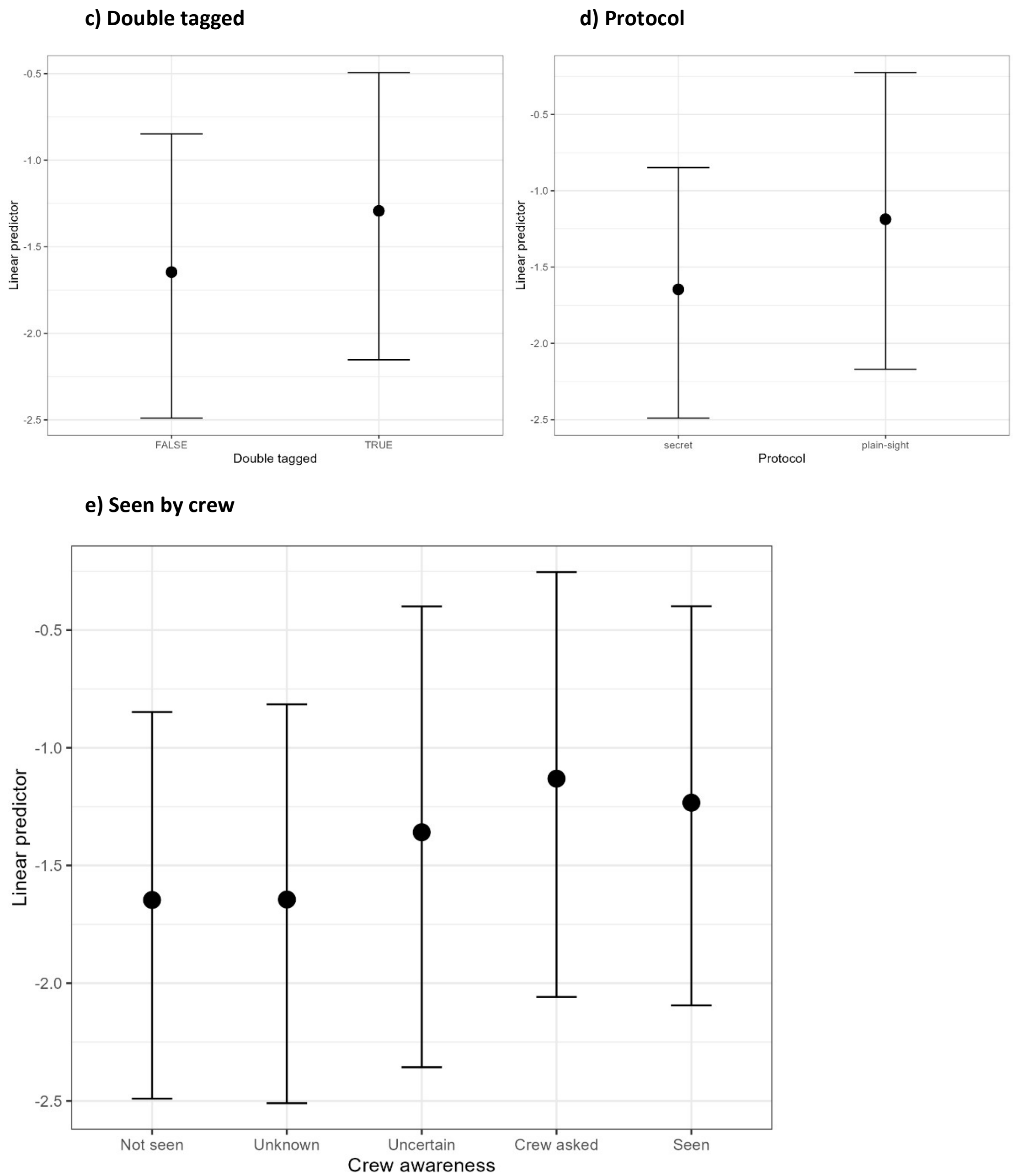
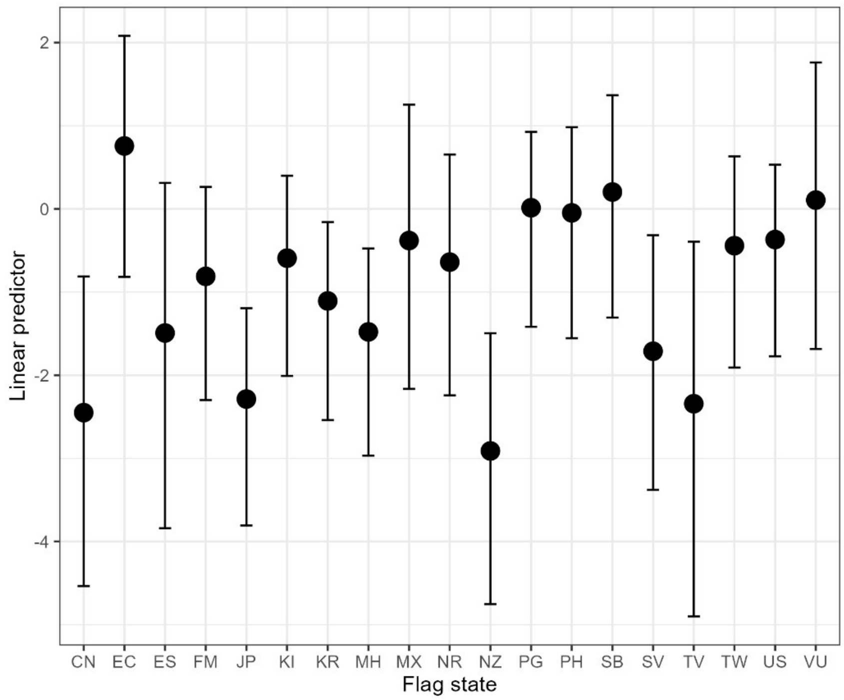


Figure 5 continued.

a) Flag



b) Year

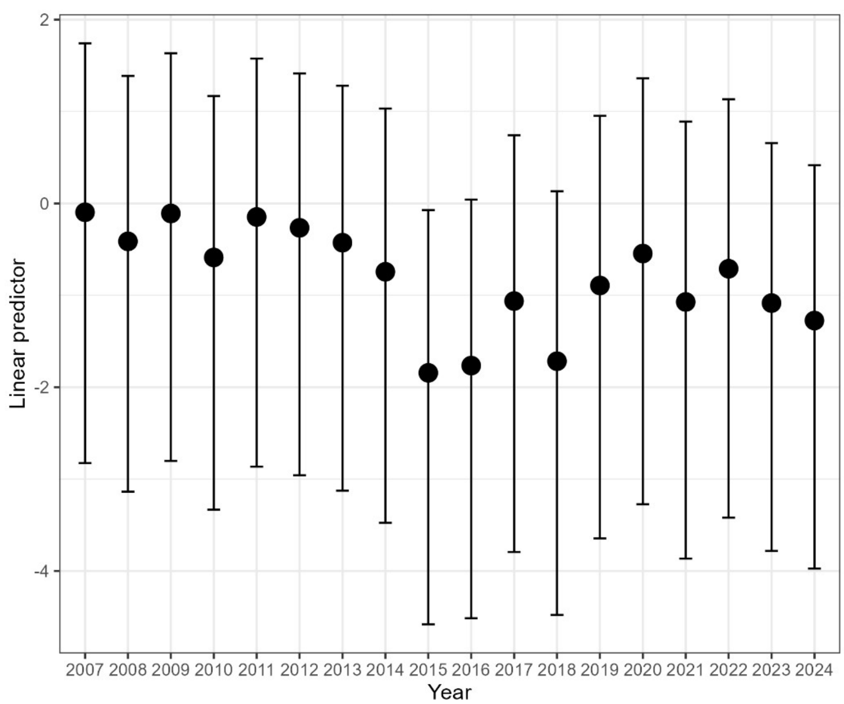


Figure 6 Conditional effects plots (median with 95% CI) for the post-fishing vessel component of the selected reporting rate model: a) flag, b) the year of the seeding experiment, and c) double tag. The effect of each covariate was estimated in turn by holding the remaining covariates constant at reference levels (double tag = FALSE).

c) Double tagged

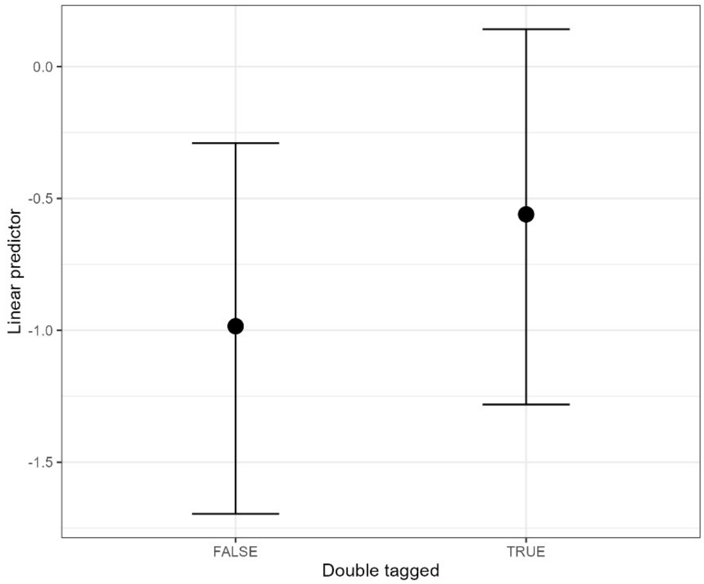


Figure 6 continued.

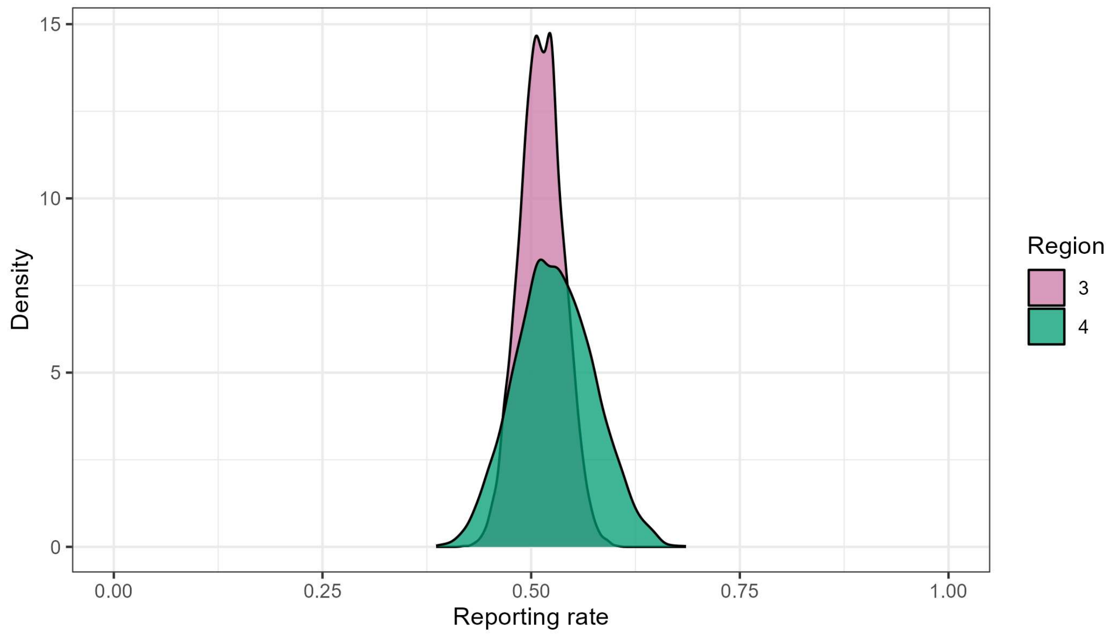


Figure 7 Region-specific reporting rate distributions for bigeye with the five region structure from Figure 1.

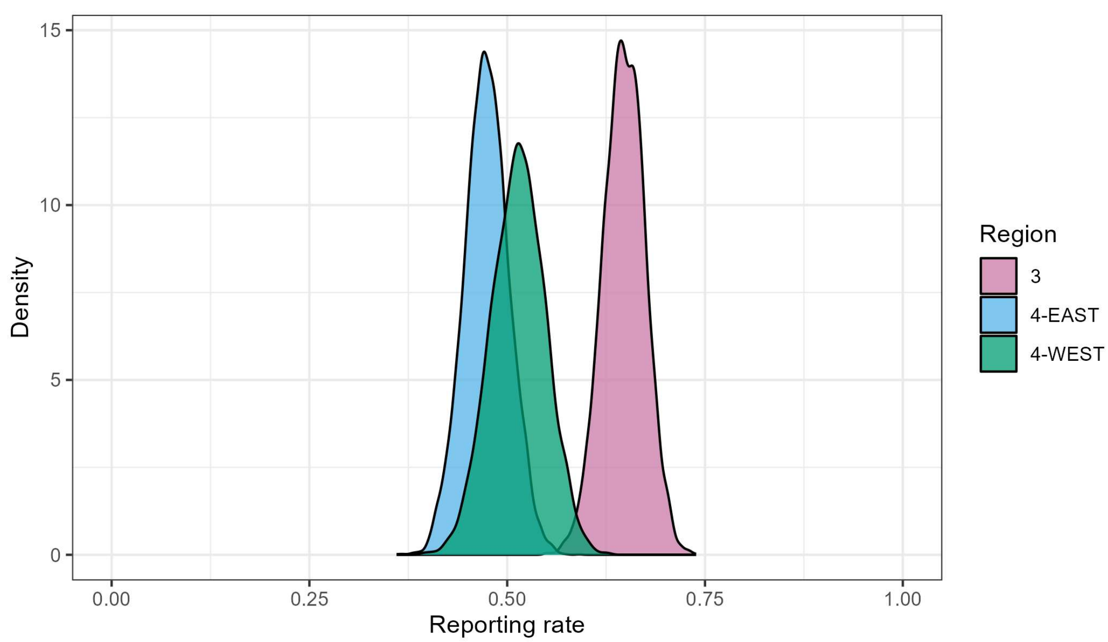


Figure 8 Region-specific reporting rate distributions for yellowfin with the five region structure from Figure 1.

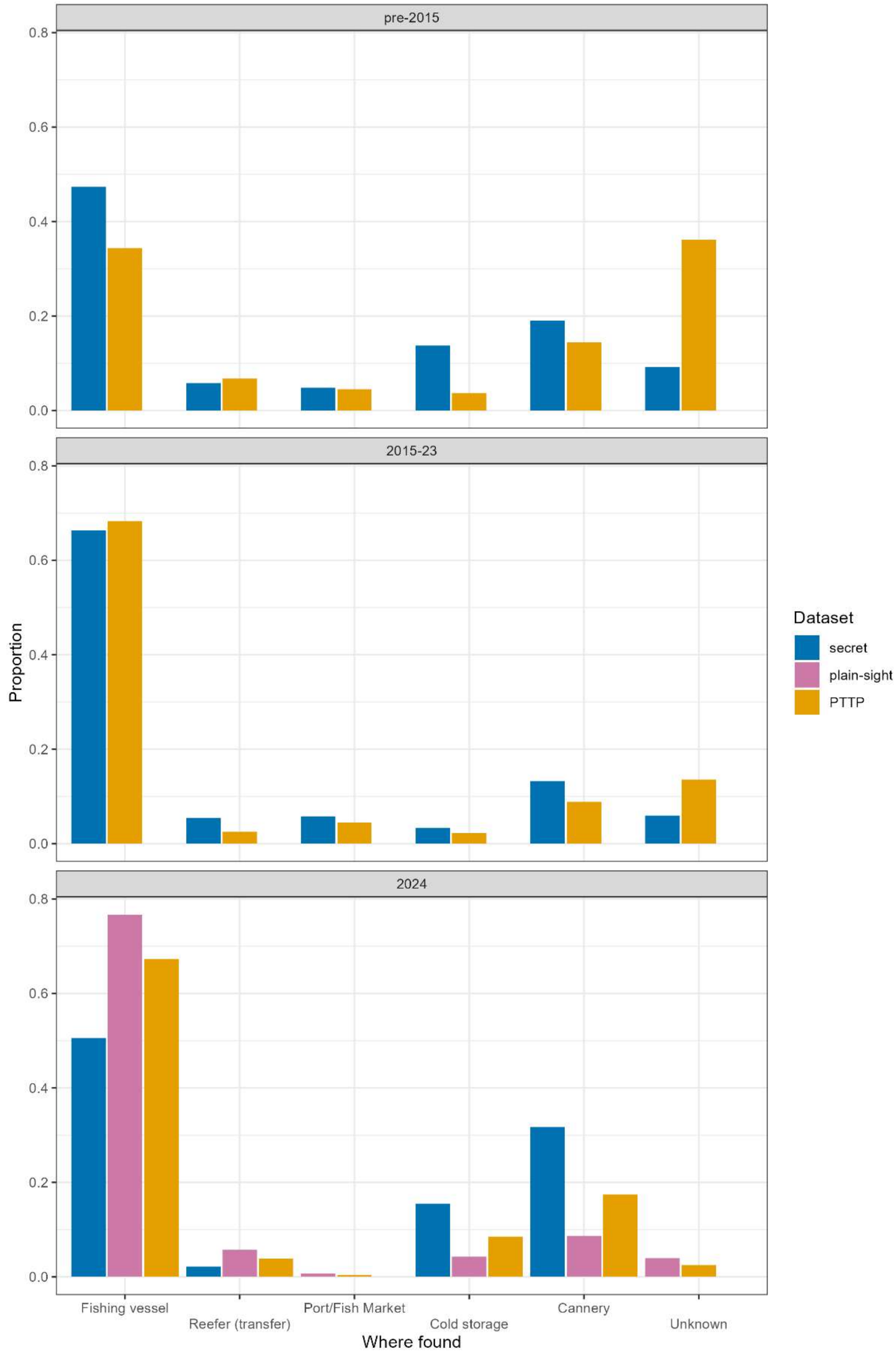


Figure 9 The proportion of reported recoveries of seeded tags and PTTP tag releases that were found at different stages of the supply chain (on the fishing vessel, reefer vessels, at port / market, in cold storage or in canneries) for 2007-2014 (top panel), 2015-2023 (middle) and 2024 (lower panel).