Projections and diagnostics for Puerto Rico Spiny Lobster SEDAR 91 Sensitivity Runs

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Executive Summary

In April 2026, the Caribbean Fishery Management Council's (CFMC) Scientific and Statistical Committee (SSC) reviewed and recommended a key sensitivity run for the SEDAR 91 Puerto Rico Caribbean spiny lobster stock assessment that incoporated abundance indices (Caribbean Fisheries Branch 2026; Martínez Rivera and McCarthy 2026). The integration of commercial logbook abundance indices fundamentally improved the assessment's ability to separate changes in biomass from natural recruitment fluctuations. The model indicated that the Puerto Rico Caribbean spiny lobster stock was not overfished ($\mathrm{SSB}/\mathrm{SSB}_{\mathrm{SPR30\%}} > 1$) and overfishing was not occurring ($F/F_{\mathrm{SPR30\%}} < 1$).

Initially, a model configuration assigning a scaled Standard Error (SE) of 0.2 (Low Weight) to the index of abundance was integrated into the assessment to generate short-term management projections for Puerto Rico. However, evaluating similar analyses for the St. Thomas and St. John assessment led to the development of an alternative, high-weight configuration utilizing a scaled SE of 0.1 (High Weight). Both runs were subjected to a 5-year retrospective hindcast cross-validation. Although both configurations show a systematic retrospective pattern, the high-weight scenario achieved a slightly lower forecasting error.

Regardless of SE, the assessment identified a sustained period of relatively high recruitment over the past decade, consistent with increasing catch-per-unit-effort (CPUE) and commercial landings observed in recent years. However, recruitment estimates for the terminal years are weakly informed because recent years have limited length-composition data and uncertainty in reported landings. To prevent recent recruitment uncertainty from skewing forward-looking projections, the model was prepared by separating the timeline into data-driven informed years from highly uncertain terminal years.

Fishery observations and consistently high recent landings suggest that abundance and recruitment in the most recent years may be greater than represented in the mean recruitment across the entire time series. When generating these updated projections, catch

values for the immediate interim years (2025 and 2026) were updated to reflect the three-year geometric mean of recent landings (2022-2024).To evaluate the influence of recent productivity on management advice, an alternative projection was developed based on the South Atlantic SSC Catch Level Projections Workgroup Final Report (Schueller et al. 2022). The recruitment for Puerto Rico Spiny Lobster was based on the mean recruitment observed during six high recruitment years. This ranged the most recent ten years (2015-2024), but excluded four uncertain terminal years (2021-2024). This scenario is used to evaluate the sensitivity of OFL projections to alternative assumptions regarding recent recruitment and productivity and provide short-term management advice.

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Background and Objective

In April 2026, the Caribbean Fishery Management Council's (CFMC) Scientific and Statistical Committee (SSC) reviewed and recommended a key sensitivity run for the SEDAR 91 Puerto Rico Caribbean spiny lobster stock assessment that incoporated abundance indices (Caribbean Fisheries Branch 2026; Martínez Rivera and McCarthy 2026). By integrating commercial logbook abundance indices, this framework fundamentally improved the assessment's ability to separate shifts in biomass from natural recruitment fluctuations. The model indicated that the Puerto Rico Caribbean spiny lobster stock was not overfished ($SSB/SSB_{SPR30\%} > 1$) and overfishing was not occurring ($F/F_{SPR30\%} < 1$). This report revisits data weighting of the indices of abundance and provides projections of overfishing limits (OFLs) under alternative assumptions about future recruitment.

Data Weighting, and Performance Diagnostics

Initially, a model configuration assigning a scaled Standard Error (SE) of 0.2 (Low Weight) to the index of abundance was utilized to parameter population trajectories and generate short-term management projections for Puerto Rico. However, evaluating similar analyses for the St. Thomas and St. John assessment led to the development of an alternative, high-weight configuration utilizing a scaled SE of 0.1 (High Weight). Both runs were subjected to a 5-year retrospective hindcast cross-validation. Although both configurations show a systematic retrospective pattern, the high-weight scenario achieved a slightly lower forecasting error than the low-weight configuration.

Cross-validation error metrics are summarized in Table 1. Mean Absolute Scaled Error scores indicate that the High Weight configuration had lower forecasting error than the Low Weight configuration. Additionally, Figure 1 compares the model fits to the CPUE indices for both scenarios. Tightening the error threshold to SE = 0.1 forces the trajectory to capture recent annual fluctuations slightly more closely than the flatter SE = 0.2 sensitivity. Figure 2 shows the estimated population trajectories for the SE = 0.1 and SE = 0.2 configurations. The hindcast cross-validations are provided in Figure 3 and retrospective patterns for spawning stock biomass are shown in Figure 4.

Recruitment Diagnostics: Informed vs. Uninformed Years

Regardless of SE, the assessment identified a sustained period of relatively high recruitment over the past decade (Figure 2b). This result is consistent with increasing catch-per-unit-effort (CPUE) and spwning stock biomass in recent years (Figure 5). However, recruitment estimates for the terminal years are weakly informed because recent years have limited length-composition data and uncertainty in reported landings. To prevent recent recruitment uncertainty from skewing forward-looking projections, the model was prepared by defining data-driven informed years and estimating recruitment during the highly uncertain terminal years (2021-2024). Figure 6.

Projection Settings, Recruitment Alternatives, and Overfishing Limits

Fishery observations and consistently high recent landings suggest that abundance and recruitment in the most recent years may be greater than represented in the mean recruitment across the entire time series. When generating updated projections, catch values for the immediate interim years (2025 and 2026) were updated to reflect the three-year geometric mean of recent landings (2022-2024). Finally, to evaluate the influence of recent productivity assumptions on management advice, an alternative projection was developed where recruitment was based on the mean recruitment observed during specific recent years (2015-2020). This process has been documented as a best practice by the South Atlantic Fishery Management Council (SAFMC) SCC (Schueller et al. 2022). We explored this approach to provide OFL projections under an alternative assumption of high recruitment and productivity.

The full transition from historical commercial landings, through the fixed interim years (2025-2026), and into the final projections (2027-2036) is compared to the long-term MSY proxy in Figure 7 for the preferred SE = 0.1 scenario. The OFL values are also compiled in Table 2. Ultimately, these alternative projection scenarios provide the CFMC SSC with a data-driven framework to capture the continued high CPUE and reports of local abundance (Matos-Caraballo et al. 2024). Given the current limits of the available data and uncertainty in the fishery-dependent indices, this alternative approach should strictly be used for setting short-term management OFLs. However, the configurations that incorporate these indices and account for sustained high recruitment represent the best available measure of stock abundance currently integrated into the assessment framework. This provides the CFMC SSC with a quantitative approach for setting immediate OFLs until fishery-independent or cooperative indices become available, or a more mechanistic understanding of recruitment and environmental drivers can be formally integrated into future assessments.

Tables

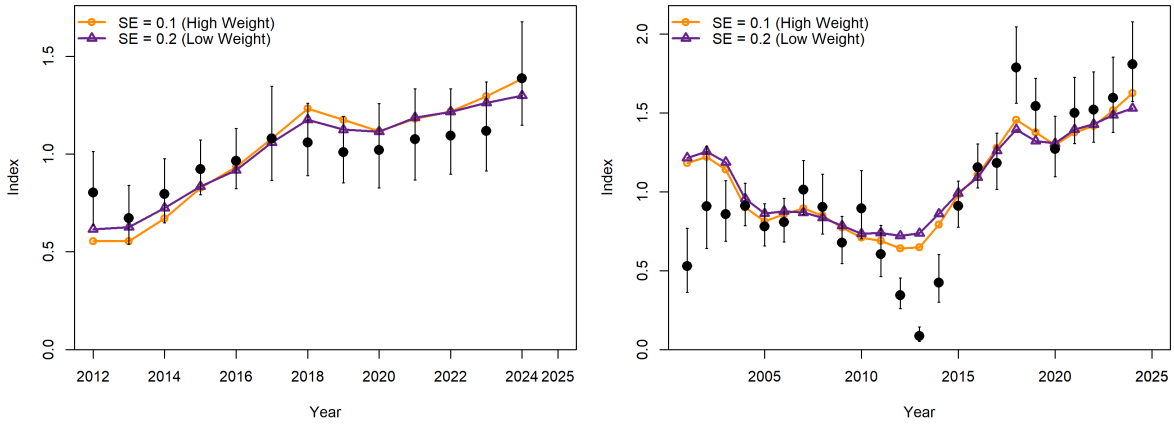
Table 1: Commercial CPUE Hindcast Cross-Validation Comparison. A Mean Absolute Scaled Error (MASE) score > 1.0 indicates that the model's one-step-ahead forecasts exhibit higher error than a naive projection.

Index / Fleet	Scenario SE = 0.2	Scenario SE = 0.1
Diving	3.600	3.339
Traps	3.649	3.559
Joint	3.631	3.478

Table 2: PR Spiny Lobster: Projected Overfishing Limits (OFL) for the SE = 0.1 model scenario in pounds. SRR represents the projections based on the stock recruitment relationship.

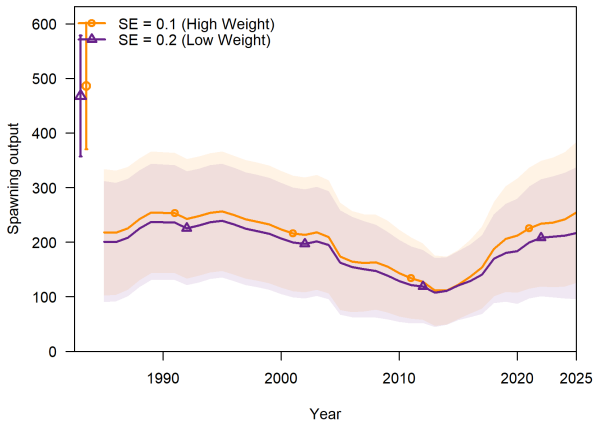
Metric	2025 Interim	2026 Interim	2027	2028	2029	2030
OFL Standard SRR	568,757	568,757	597,111	557,309	541,153	533,576
OFL Recent Recruitment	568,757	568,757	700,448	650,443	631,197	622,746
MSY SPR Proxy	522,888	522,888	522,888	522,888	522,888	522,888

Figures

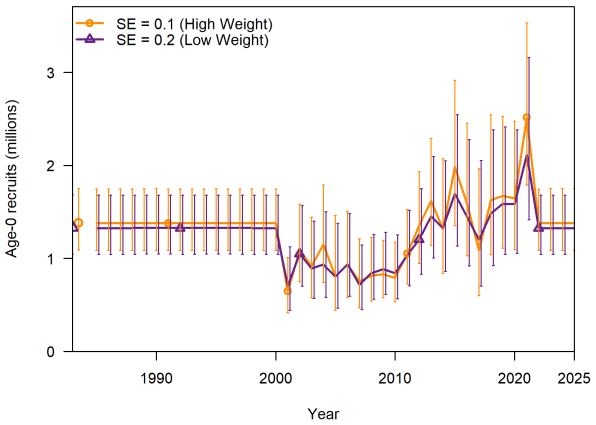


(a) Diving Fleet CPUE Index Fits (b) Trap Fleet CPUE Index Fits

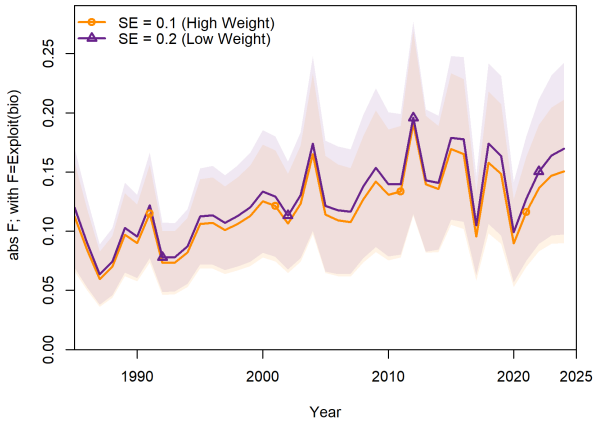
Figure 1: PR Spiny Lobster: Comparison of historical model fits to the empirical CPUE indices for both scenarios. Tightening the error threshold to SE = 0.1 forces the trajectory to capture annual fluctuations more closely than the flatter SE = 0.2 sensitivity.



(a) Spawning Biomass Comparison

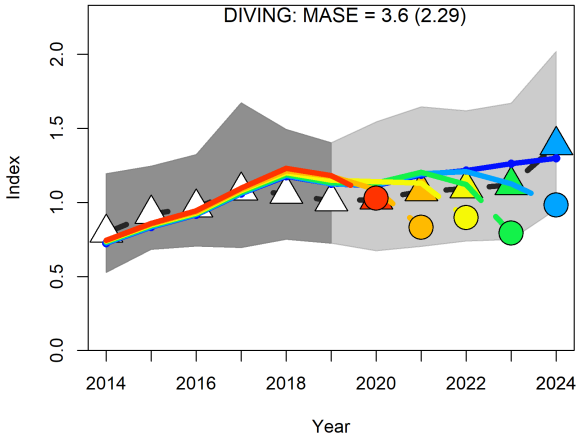


(b) Recruitment Comparison

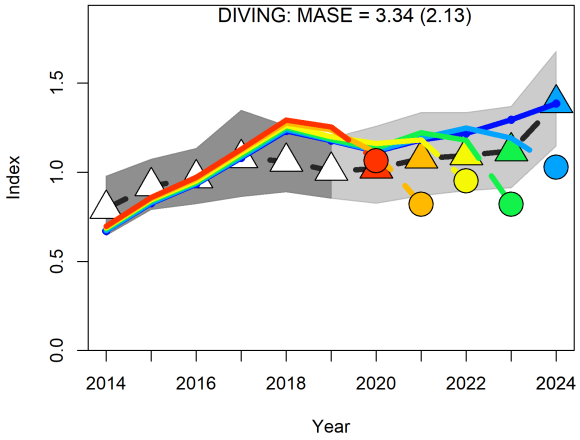


(c) Fishing Mortality Comparison

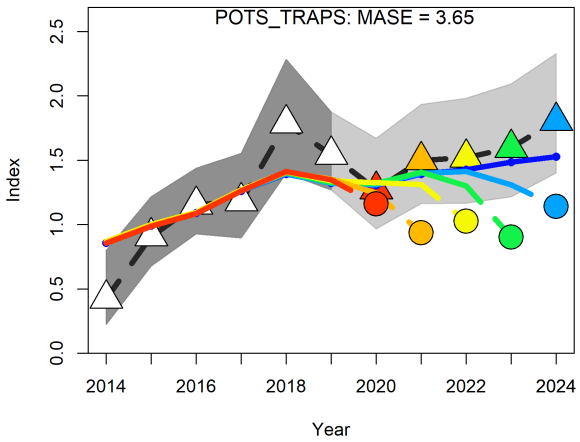
Figure 2: PR Spiny Lobster: Comparison of estimated population trajectories between the SE = 0.1 and SE = 0.2 configurations.



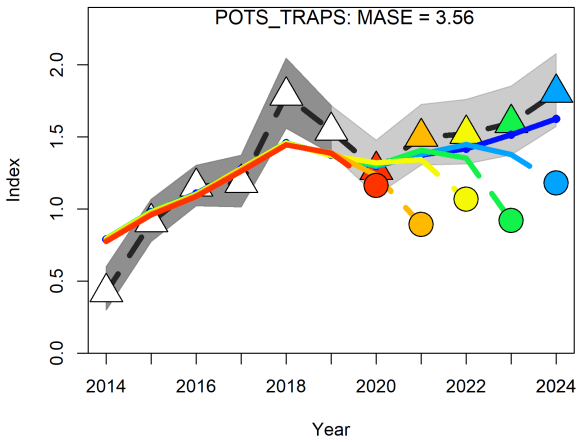
(a) Diving Fleet Hindcast (Scenario SE = 0.2)



(b) Diving Fleet Hindcast (Scenario SE = 0.1)

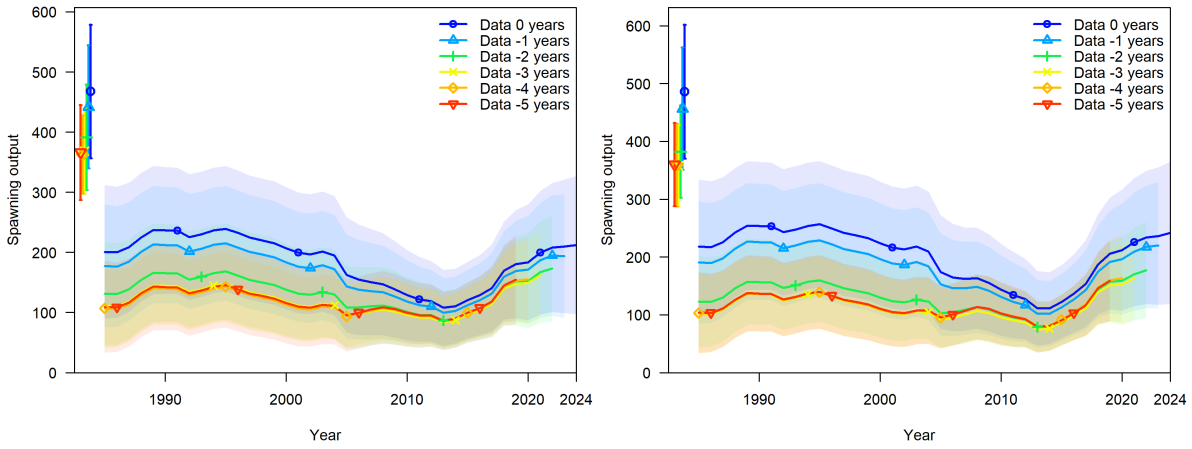


(c) Traps Hindcast (Scenario SE = 0.2)



(d) Traps Hindcast (Scenario SE = 0.1)

Figure 3: PR Spiny Lobster: Comparison of hindcast cross-validation trajectories for both fleets and data-weighting scenarios. Mean Absolute Scaled Error scores indicate that the High Weight configuration (SE = 0.1) had slightly lower forecasting error than the Low Weight configuration (SE = 0.2).



(a) Scenario SE = 0.2 Retrospective Peels (b) Scenario SE = 0.1 Retrospective Peels

Figure 4: PR Spiny Lobster: Standalone retrospective trajectories for Spawning Stock Biomass (SSB) across both weighting treatments, demonstrating consistent terminal downward scaling when data is sequentially truncated.

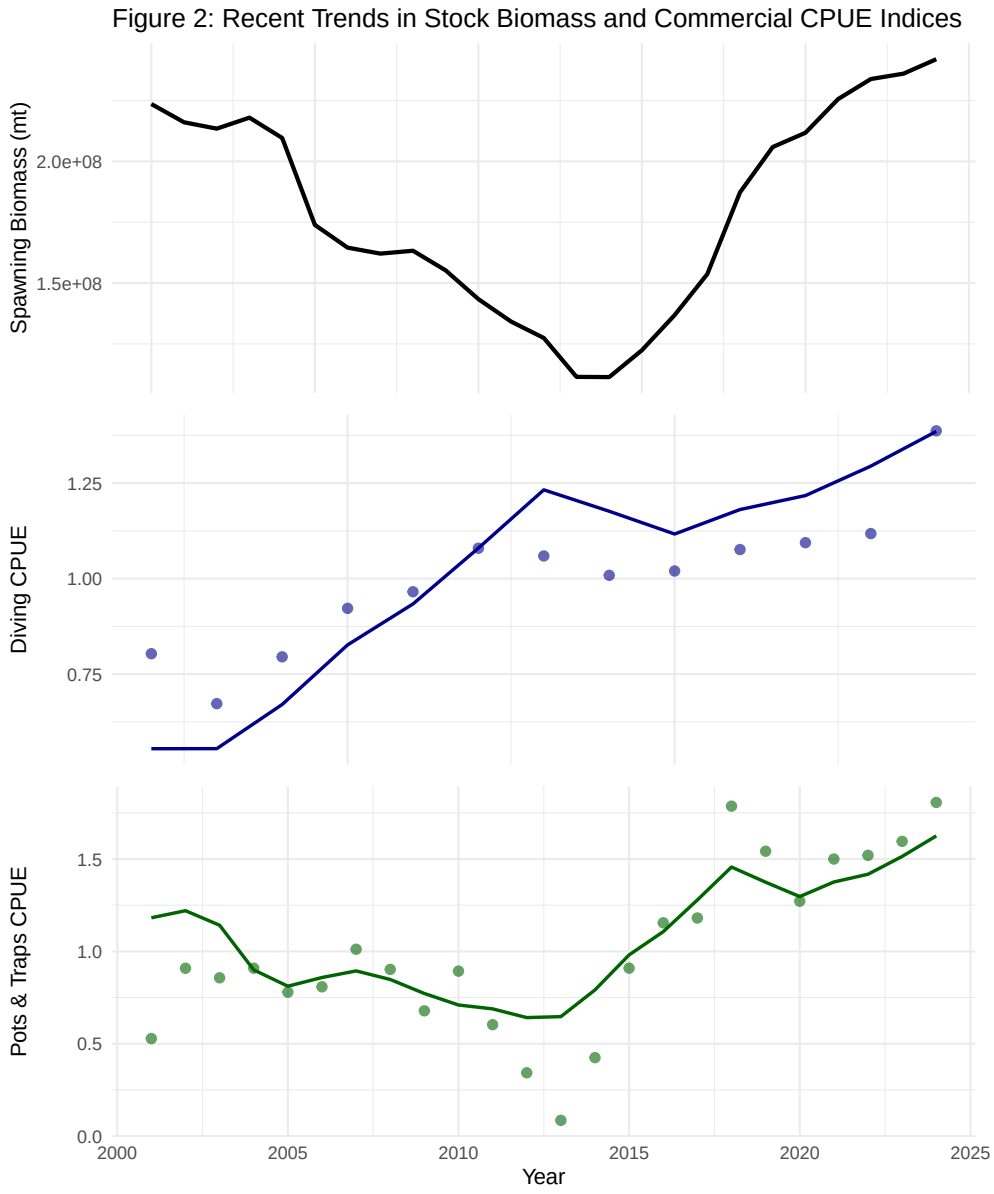


Figure 5: PR Spiny Lobster: Standardized Commercial CPUE and Estimated Spawning Stock Biomass (SSB) for the (SE = 0.1)

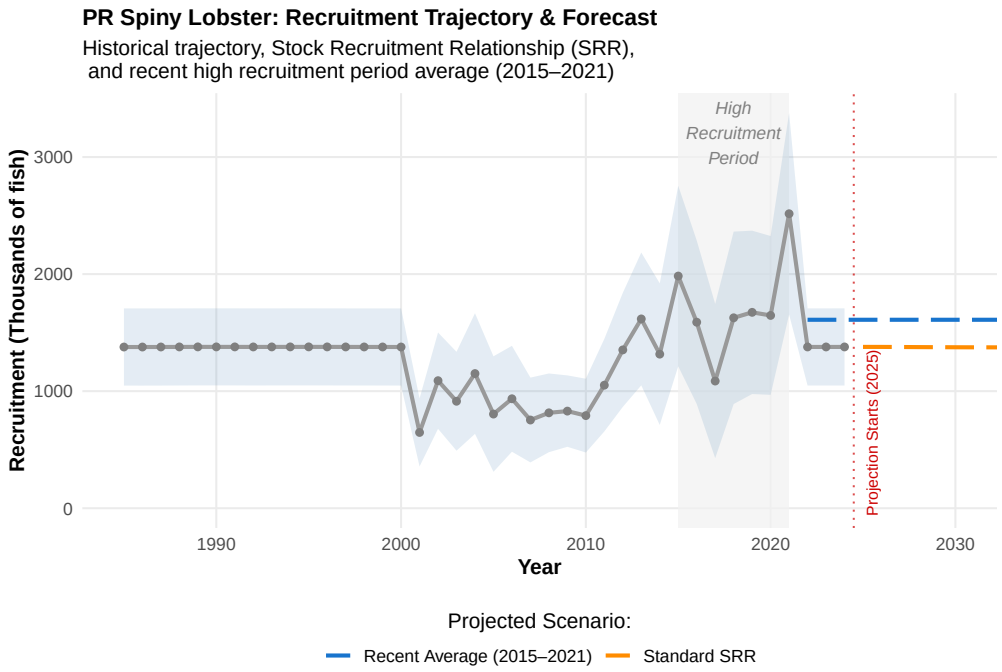


Figure 6: PR Spiny Lobster: Recruitment Projections Comparison (1985-2030) for the (SE = 0.1) Scenario. SRR represents the projections based on the stock recruitment relationship.

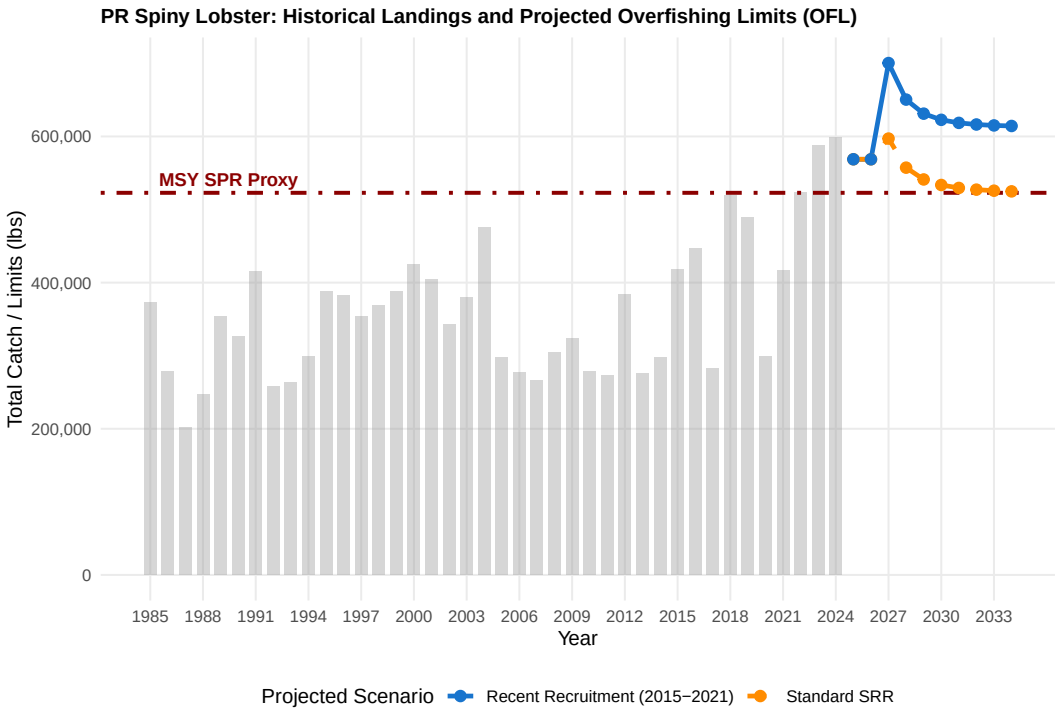


Figure 7: PR Spiny Lobster: Historical Landings and Projected Overfishing Limits (OFL) for the (SE = 0.1) Scenario. SRR represents the projections based on the stock recruitment relationship.

References

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