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The stock status of narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lacépède, 1800) in the southern Arabian Gulf: a case study using multiple length-based assessment approaches

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This study evaluates the stock status of *Scomberomorus commerson* in the southern Arabian Gulf, particularly in Abu Dhabi waters, using length-based models to address data limitations in fisheries assessments. The findings contribute critical insights into management practices using four length-based models, namely, LBI, LBB, LBSPR, and LIME, to analyze length frequency distributions from commercial catches between 2011 and 2023. The results indicate that the stock is overfished, with low proportions of mature and optimal-sized individuals and an excessive harvest of juveniles, as shown by the model estimates of F/M ratios and SPR values below target levels. From 2011 to 2019, the biomass declined sharply, but signs of recovery were evident by 2023 due to management actions, such as a gillnet ban introduced in 2019. The final-year estimates revealed a B/Bmsy ratio of 1.0 and F/M of 1.2, suggesting ongoing but reduced overfishing pressures. These outcomes underscore the importance of ongoing data-limited assessment methods in monitoring exploited stocks, providing evidence that restrictive measures have positively impacted biomass recovery. The convergence of outputs across methods, such as the indication of overfishing in *S. commerson* stocks, suggests that implementing multiple models enhances the robustness of management recommendations, including the enforcement of minimum size limits or reductions in fishing efforts or restriction of certain fishing methods. Overall, this study highlights the importance of using multiple models and choosing appropriate priors to improve the quality of stock assessments in data-limited fisheries.

KEYWORDS

data limited, stock assessment, reference points, sustainability, fisheries management

Introduction

Fish and fishery products are one of the most traded food commodities globally and provide about 20.5% of the world's animal protein (Bellmann et al., 2016; FAO, 2022). Worldwide marine fisheries catch has increased markedly from 16.8 million tonnes (t) in 1950 to a peak of 86.4 million t in 1996. It has since stabilized at about 80 million t and, simultaneously, the number of overexploited stocks has increased from 10% in 1974, to 26% in 1989, to 34.2% in 2009, and to 35.4% in 2019 (FAO, 2022). Failure to arrest this overexploitation of marine species has resulted in severe stock declines (Worm et al., 2009) and is thought to have caused 55% of marine extinctions over the last two centuries (Dulvy et al., 2003) with resultant risks to food security (McClanahan et al., 2015). There are many cases in which high exploitation, combined with ineffective fisheries management, has resulted in irreversible depletion or "collapse" of fish stocks.

Regular stock assessment provides information on the status of fish populations and supports management decisions to ensure their sustainable use. However, conducting proper stock assessments can be challenging due to data limitations, especially in small-scale fisheries where comprehensive data sets on catch, effort, and life history parameters are often unavailable. Data-limited assessments are used when traditional stock assessment data are insufficient. Length-based assessments, a subset of data-limited methods, use fish length data to estimate stock parameters. Collecting length data is straightforward and cost-effective, making it a practical choice for data-poor fisheries (Munro, 1983; Pauly, 1998; Hordyk et al., 2015; Nadon et al., 2015). There are several methods developed for length-based stock assessments, and each has unique characteristics and applicability. Froese's length-based indicator (LBI) uses catch-length composition data by estimating three simple and easily understood indicators, namely, the percentage of mature fish, optimal-sized fish, and "mega-spawners", to assess the status and trends of the fishery (Froese, 2004). The length-based Bayesian (LBB) method employs Bayesian methods to estimate biomass and fishing mortality from length data, incorporating prior knowledge and uncertainty (Froese et al., 2018; 2019). Length-based spawning potential ratio (LBSPR) estimates the proportion of mature fish in a population, helping to understand the impact of fishing on reproductive biomass (Hordyk et al., 2014, 2015; Chong et al., 2019). Length-based integrated mixed effects (LIME) combines length data with other available information to assess stock status, accounting for variability and uncertainty (Chong et al., 2020; Dowling et al., 2015). LBB and LIME incorporate more complex statistical frameworks compared to LBI and LBSPR, which are more straightforward but still effective for many fisheries.

Fisheries have long been an important part of Abu Dhabi's heritage, providing economic and cultural benefits. In 2022, the combined fisheries and aquaculture production in Abu Dhabi amounted to 1,571 t, valued at USD 13 million. The fisheries sector alone produced 1,223 t of seafood worth USD 5.1 million by providing job employment to 1,556 individuals, reflecting its role in supporting local livelihoods. In 2022, the fishing fleets generated a total number of 11,971 fishing trips in a total of 12,082 fishing days, employing a total of 1,416 crew members (EAD, 2023). The fishing sector is predominantly artisanal, with fishers using traditional and modern techniques. The primary fishing vessels include the local ones called Tarads, which are small, open fiberglass boats with outboard engines, and Lanshes, traditional wooden dhows that have ceased operating since May 2019. The fishing sector in the Emirate of Abu Dhabi used a variety of fishing gears in the past, However, a number of these gears are now banned and, in other cases, are only allowed in specific areas. Pelagic nets that target large pelagic species, locally known as Ghazal nets, were banned in 2018, and round-shaped fishing traps, locally known as Gargour traps, were banned in 2019. Furthermore, the use of some of the gears is restricted to exclusive fishing rights areas locally known as Buhoor where specific fishermen are authorized to fish in specific areas, and the rights can be passed on as inheritance through generations. In the present day, the gears utilized by fishing boats in Abu Dhabi waters are hand lines for all fishermen, and additionally for Buhoor, permit holders' inter-tidal barrier nets locally known as Sakkar, encircling nets locally known as Defara, and inter-tidal encloser traps locally known as Hadra can be utilized within the Buhoor areas only (EAD, 2023).

A variety of fish species are caught in Abu Dhabi waters, but key species include *Scomberomorus commerson*, *Epinephelus coioides*, and *Lutjanus ehrenbergii*. Those species used to be mainly caught using gillnets, and today most of their catch are by using hand lines from fiberglass boats. Specifically, *S. commerson*, also known as "Kanaad", is of significant importance to the local fishery and the entire Arabian Gulf (FAO, 2020). The average landings of *S. commerson* during 1986–2020 was 25,649 t in the Arabian Gulf. This fish is caught using various fishing gears, predominantly the gillnet which is highly selective and hand line. Over the recent years, the production of *S. commerson* has seen fluctuations. Historical data shows a significant decrease in the production of this species, aligning with overall trends in the fisheries sector following the implementation of stricter regulations and gear bans (Figure 1). In response to the declining trends and overexploited status (EAD, 2023), regulatory measures such as banning of gillnets were implemented. These measures have contributed to a decrease in the total catch, especially since 2019.

Considering its significant importance in fisheries, stock assessment studies conducted in Abu Dhabi waters were very limited and indicated recruitment over-fishing associated with the intensive differential harvesting of young immature fish (Grandcourt, 2013). Other previous studies also reported a high exploitation ratio (Alrashada, 2022) in Saudi Arabian waters and high fishing pressure (Al-Shehhi et al., 2021) in Oman Sea. Moreover, nearly 65% of the individuals that landed were immature, having less than 80 cm FL in the Arabian Gulf (Jayabalan et al., 2011; Roa-Ureta et al., 2019). Here we aim to assess and understand the stock status of *S. commerson* and determine biological reference points based on life history parameters and length frequency time series data by four length-based assessment methods, namely, LBI, LBB, LBSR, and LIME. These results could be relevant to the management of *S. commerson* and additionally offer insights on the application potential of different length-based assessment models in data-poor fisheries more generally.

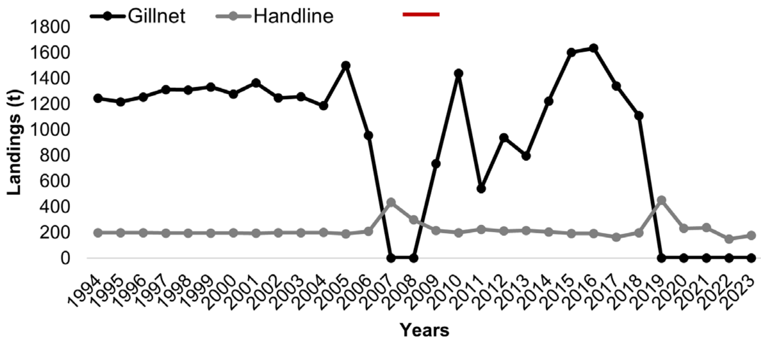

FIGURE 1
Annual landings of *S. commerson* by two main fishing methods, gillnet and hand line, between 1994 and 2023 in UAE waters.

Materials and methods

Length frequency (LF) data were obtained from a total of 13,552 fish sampled from hand liners in Abu Dhabi port (Figure 2) from 2011 to 2023, with data gaps in 2012, 2015 and 2020. Fork length (FL) was measured to the nearest 0.1 cm. The growth parameters L_{inf}, k, and t_0, female maturity size, and natural mortality values are based on those from the most recent study (Francis et al., 2020), which are used as the prior values for length-based models (Table 1).

The LBI model utilizes length frequency distributions from catches or landings to assess fish stock status. These indicators are compared to reference levels derived from life history parameters, providing insights into conservation, optimal yield, and length distributions relative to maximum sustainable yield (MSY) expectations. The model provides indicators such as (i) the upper portion of the length frequency distribution, comparing large individuals to the asymptotic length to assess the degree of truncation caused by fishing (L_{max} 5%), (ii) the proportion of mega-spawners that are larger than the optimum length (P_{mega}), and (iii) conservation of immature individuals, adhering to the principle of Froese (2004) “let them spawn” to ensure sustainable reproduction ($L_{25\%}$ and L_c).

The LBB model has been designed to analyze length frequency data from exploited fish or invertebrate populations. It uses the Bayesian Monte Carlo Markov Chain (MCMC) approach to

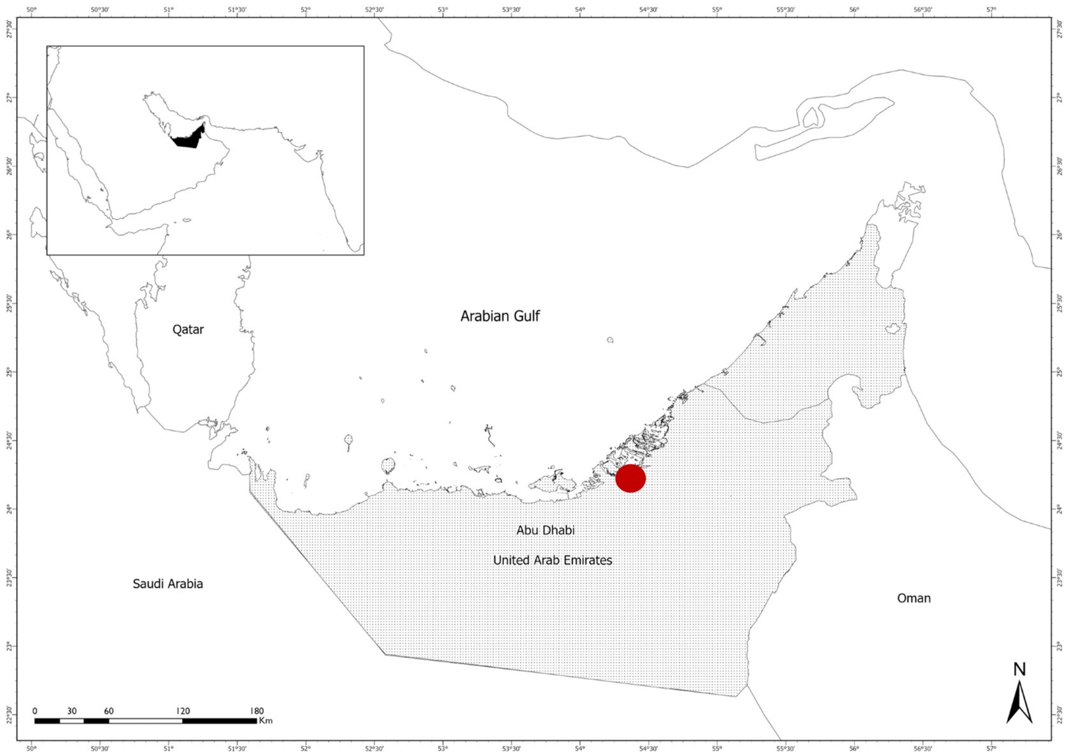

FIGURE 2
Map of the sampling locations (red dot) in Abu Dhabi Emirates coastal area.

TABLE 1 Input of life history parameters (Francis et al., 2020) to assess the stock status of *S. commerson* in Abu Dhabi waters using length-based data-limited methods.

Parameters	Input	Model
L_{inf}	135.3 cm FL	LBI, LBB, LBSPR, LIME
k	0.14 (year^{-1})	LBI, LIME
t_0	-2.3 year	LBI, LIME
L_{m50}	78.7 cm FL	LBI, LBB, LBSPR, LIME
L_{m95}	93 cm FL	LBSPR, LIME
M	0.26 (year^{-1})	LBI, LBSPR, LIME
WL_a	0.0167	LBI, LIME
WL_B	2.81	LBI, LIME

estimate all relevant parameters (Table 1) simultaneously (Froese et al., 2018). This method provides a comprehensive framework to evaluate stock status based on length frequency data. It generates several key parameters that describe the population status such as (i) the average length at which individuals are first captured by the fishery (L_c) and the length at first capture that would maximize catch and biomass given the current fishing effort (L_{c_opt}), (ii) the ratio of natural mortality to the growth rate (M/K), (iii) the ratio of fishing mortality to the growth rate (F/K), and (iv) an estimate of the biomass relative to the unfished biomass that can produce the maximum sustainable yield (B_{msy}/B_0) (Froese et al., 2018; 2019).

The LBSPR model is grounded in the life history parameters (Table 1) and length frequency distribution of an exploited population. It estimates the spawning potential ratio (SPR), which reflects the reproductive capacity of a population under fishing pressure compared to its unfished state. In other words, SPR is calculated by comparing the equilibrium spawning biomass under current fishing pressure to the equilibrium spawning biomass without fishing pressure (Hordyk et al., 2015).

On the other hand, the LIME model is designed to assess fish stocks using length composition data from the catch combined with life history information (Table 1). The model provides estimates of (i) fishing mortality (F) as the rate at which fish are removed from the population due to fishing, (ii) recruitment as the number of new individuals entering the population, and (iii) SPR (Rudd and Thorson, 2018).

Analyses were performed using R statistical software (version 4.4.0; R Core Team, 2024) with source codes provided in the following links: R code for LBB (https://github.com/SISTA16/LBB), R code for LBSPR (https://cran.r-project.org/web/packages/LBSPR), and R code for LIME (https://github.com/merrillrudd/LIME).

Results

The LBI estimated that L_{opt} was 82 cm FL (Figure 3B) and the minimum length of the mega-spawner was 90.2 cm FL, while the L_{m95} was 89.7. Length frequency data analysis of the composition of the landing showed that 0.7% to 23.5% of the fish were of mature size (P_{mat}), while 3.1% to 35% were of optimal size (P_{opt}) between 2011 and 2023. Among the caught fish, the percentage of older, larger individuals known as mega-spawners (P_{mega}) ranged between 0.3% and 16.6% (Figure 3A). The lowest reference points were detected at the beginning of the time series. Since the year 2011, a gradual increase was observed in the proportions until 2019 when the landings of *S. commerson* sharply collapsed. The highest proportions of reference points were estimated in 2023 while the landing was its lowest (Figure 3A).

The LBB models produced values for reference points L_{mean}/L_{opt}, L_c/L_{c_opt}, L_{95th}/L_{∞}, M/k, F/M, B/B_0, and B/B_{msy}. The L_{mean}/L_{opt} and L_c/L_{c_opt} ratios were lower than 1, suggesting a truncated length structure and fishing of undersized individuals. The L_{95th}/L_{inf} ratio was close to 1 (>0.95), suggesting that at least some larger fish were still present. The proportion of juveniles in the catch was 65%. L_{mean} was estimated as 82.2 cm, while F = M. The F/M ratio has shown a decreasing trend since 2016, while B/B_0 was in an increasing trend and reached 0.5 B_{msy} in 2020 and B_{msy} in 2023. The final year estimated value of the reference point B/B_{msy} was 1.0, and F/M was 1.2, suggesting ongoing overfishing (Figures 4A–F).

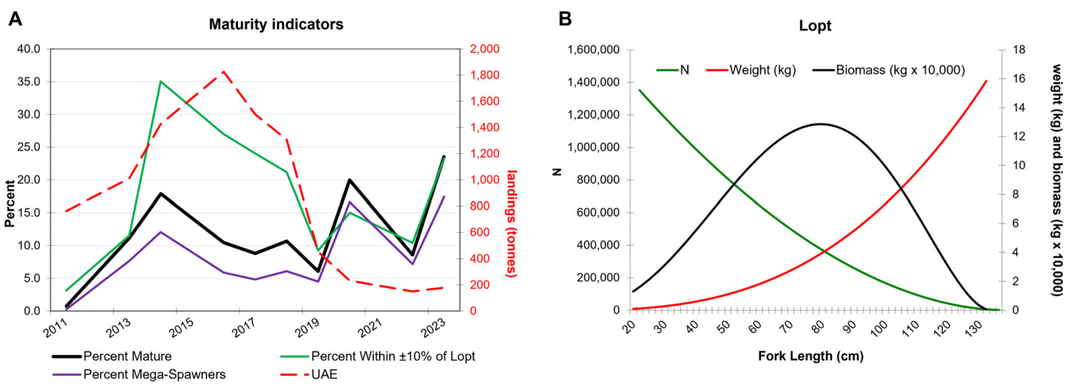

FIGURE 3
Outputs of the LBI model, showing times series change of **(A)** percent of mature (black line), percent of mega-spawners (purple line), percent within ±10% of Lopt (green line), and landings of *S. commerson* in UAE waters; **(B)** estimated number of population size (N, green line), weight of individual fish (red line), and total biomass (black line) per fork length class between 2011 and 2023.

The LBSPR results for the reference points SPR and F/M and selectivity parameters SL_{50} and SL_{95} are estimated. The parameters SL_{50} and SL_{95} were substantially lower than Lm_{50} in all years, suggesting that the fishery targeted undersized individuals (Figures 5A, C). SPR estimates resulted in low values (below 40%) over the entire period (2011–2023), and in 2023, SPR was 31%, indicating that this stock is below proxies that would be consistent with ongoing recruitment fishing (Figures 5B, E). The F/M ratio was substantially greater than 1 over the entire period except in 2020 and 2023, showing a decreasing trend in recent years, but still suggesting overfishing since current exploitation is generally above the optimum mortality (F = M) (Figure 4D). Based on study periods, the LBSPR results presented a decreasing trend in SPR and an increasing one in F/M (Figure 5).

The LIME results showed that the recruitment was less variant (21.4%) than SPR, ranging between 0.61 and 1.28 million per year. The recruitment was mostly continuous, with marginal peaks observed at a gap of 2 to 3 years (Figure 6A). The SPR ranged between 0.11 and 0.34, with an average of 0.21 (CV = 42.5%). Out of the 10 observed years, the SPR values were below the recommended target reference point (TRP) of 0.4, and it went above the LRP of 0.20 in the recent years (Figure 6B). The annual mean length of the catch ranged from 37.2 to 57.8 cm, with an average mean length of 55.6 cm (Figure 6C).

The outputs of the four models used in this study were evaluated for the stock status of *S. commerson*. The results show that the stock is overfished and that conservation of immature and larger individuals mainly failed, generally not meeting the optimum fishing mortality and spawning biomass (Table 2). On the other hand, for the year 2023, fishing mortality was greatly reduced and spawning stock slightly recovered, while increasing trends were also detected in the conservation approach.

Discussion

This study applied length-based stock assessment methods to evaluate the fishery of *S. commerson*, a key species in Abu Dhabi's fisheries, using data collected over 10 years through a fishery monitoring program. The models LBI, LBB, LBSPR, and LIME were used to analyze length frequency distributions from commercial catches, producing complementary outputs that highlight significant recruitment overfishing due to heavy fishing pressure (Table 2). The LBI method found that the optimal length was higher, with mega-spawners also showing a greater minimum length. Over the years, a lower percentage of the fish were of mature size, with slightly higher proportions being of optimal size and mega-spawners. The lowest reference points were seen in earlier years, increasing until a sharp decline, with the highest proportions

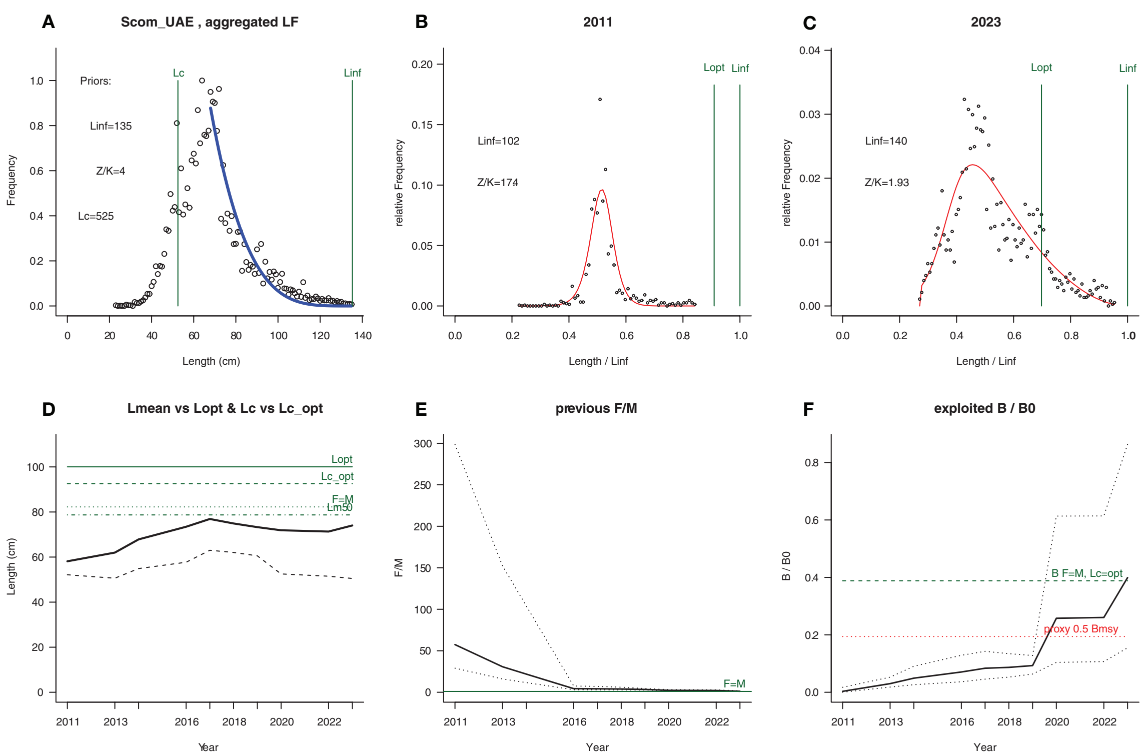

FIGURE 4
Outputs of the LBB model showing **(A)** aggregated LF data to estimate priors L_c, L_{inf}, and Z/K; **(B, C)** LF data for the first and last year of 2011 and 2023 in the time series with estimates of Z/K and L_{inf}; **(D)** L_{mean} (bold curve) relative to L_{opt} and L_c (lower dashed curve) relative to L_{c_opt}; **(E)** relative fishing pressure F/M (bold curve), with 95% confidence limits (dotted curves), with indication of the reference level where F = M (horizontal line); and **(F)** relative biomass B/B_0 (bold curve) with 95% confidence limits (dotted curves), with indication of a proxy for B_{msy} (dashed line) and a proxy for B_{pa} or 0.5 B_{msy} (dotted line).

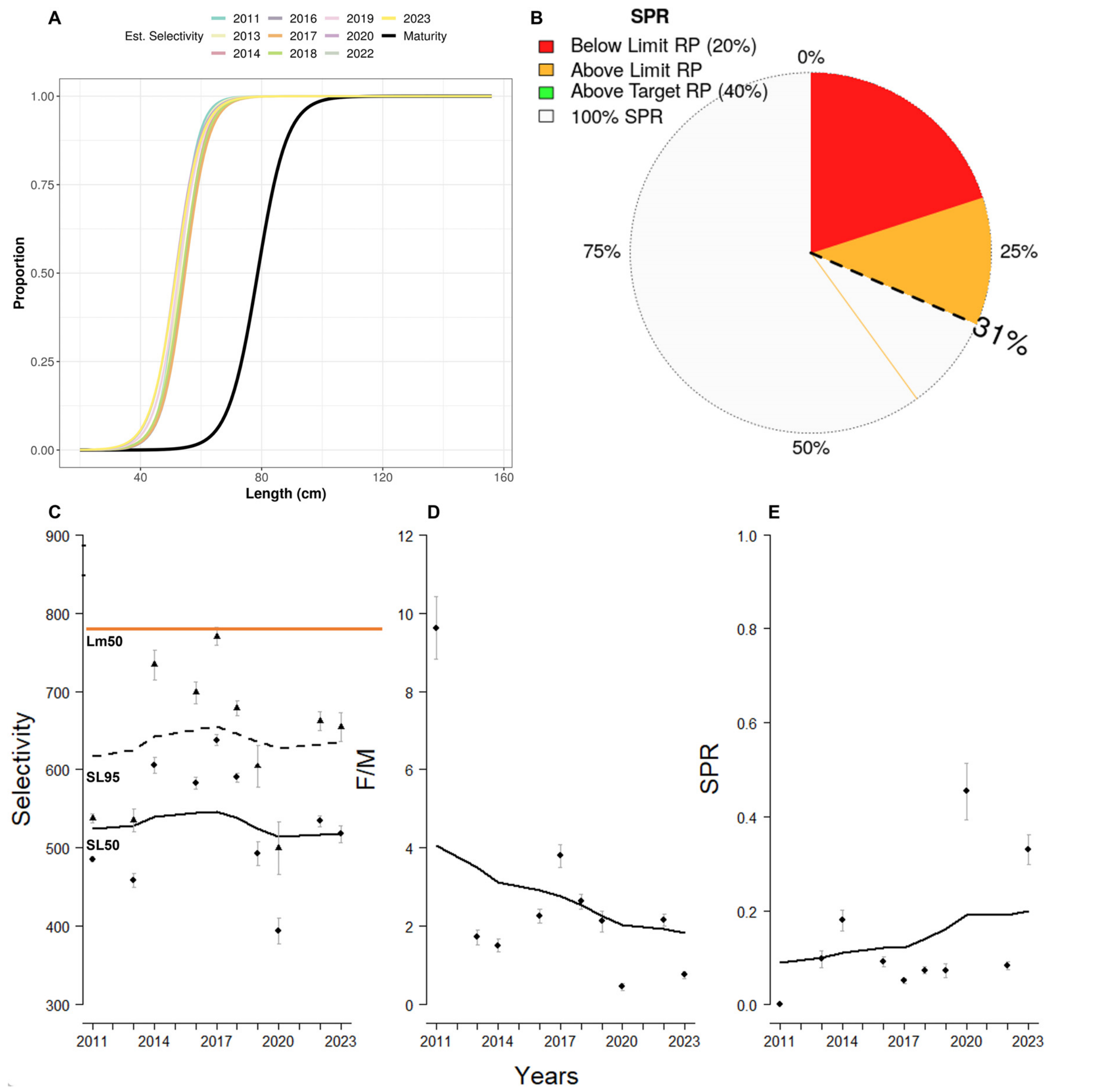

FIGURE 5
Outputs of the LBSPR model showing **(A)** maturity and selectivity curve from the fitted model when $L_{m50\%}$ = 78.7 cm and $L_{95\%}$ = 93 cm for all study years, **(B)** SPR for the last year of assessment (dotted line) according to reference point (RP), time series changes in **(C)** the distribution of mean selectivity parameters $SL_{50\%}$ (solid black line) and $SL_{95\%}$ (dotted line) across Lm_{50} (red solid line), **(D)** fishing mortality to natural mortality (F/M), and **(E)** SPR% with their standard deviations.

reached recently despite low landings. Similarly, the LBB models indicated ratios suggesting the fishing of undersized fish, with larger fish still present and a high proportion of juveniles. The F/M ratio has decreased, while B/B_0 has increased, reaching a sustainable level. The final year values indicated ongoing overfishing. In line with the LBB results, the LBSPR model found selectivity parameters lower than the maturity length, indicating targeting of undersized fish, and consistently low SPR values. The F/M ratio was generally higher, decreasing recently but still suggesting overfishing. The ban on gillnets, implemented as a regulatory measure in response to declining trends and overexploited status (EAD, 2023), has significantly impacted the fishery of *S. commerson*. It has proven highly effective by preventing the capture of small, immature individuals due to the highly selective nature of gillnets. Following the ban, there has been a notable increase in the size-based values such as the proportion of mature fish (P_{mat}), optimal-sized fish (P_{opt}), and mega-spawners (P_{mega}). Concurrently, fishing mortality (F) has decreased, and biomass indicators have gradually increased, reaching sustainable levels in 2023. These positive changes highlight the importance of such regulatory measures in promoting the recovery of overfished stocks. The LIME model showed a relatively stable recruitment, with SPR values below the target reference point but recently above the limit reference point. The annual mean length of the catch varied, averaging a higher length. However, LIME SPR results are remarkably higher than the other two methods, also indicating SPR values that were above limit

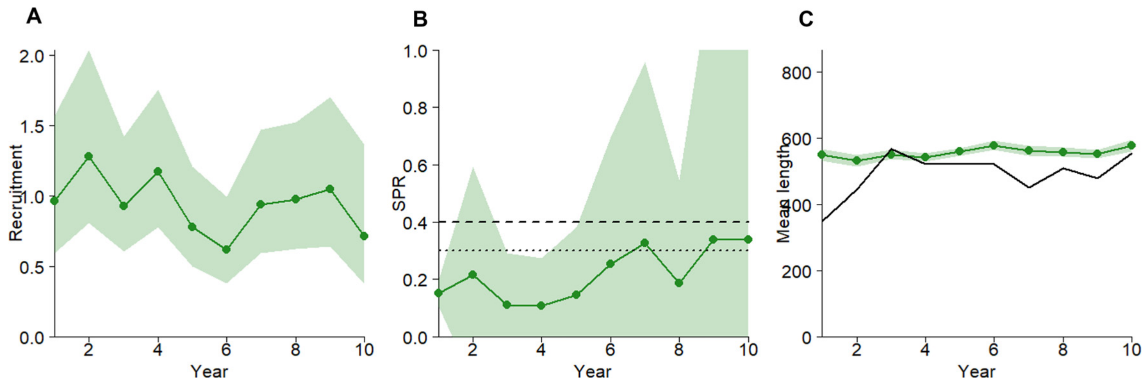

FIGURE 6
Outputs of the LIME model showing changes in time **(A)** recruitment, **(B)** SPR, and **(C)** mean length for *S. commerson* in Abu Dhabi waters between 2011 and 2023.

reference points of 20% in several years, still presenting more stable variation years. Although species-specific stock assessment of *S. commerson* in the study region is limited, our results are compatible with the findings of previous studies—for example, catch-based stock reduction analysis (SRA) in the Oman Sea and generalized depletion models in Saudi waters have reported the overfishing and biomass depletion of *S. commerson* stock (Al-Shehhi et al., 2021; Roa-Ureta, 2015). Additionally, fisheries biology studies determined high exploitation rates and the capture of fish below L_{m50} (Dudley et al., 1992; Grandcourt et al., 2005; McIlwain et al., 2005; Shojaei et al., 2007; Grandcourt, 2013; Alrashada, 2022).

Length-based methods, while useful for rapid assessments in data-limited fisheries, have inherent limitations, and the robustness of these methods under varying data conditions is a critical area of consideration. They assume equilibrium conditions, such as consistent mortality rates (Z, M, F) and stable recruitment over time, which are often violated due to variable recruitment influenced by stochastic ocean conditions and changing fishing pressures (Thorson et al., 2014; Szuwalski et al., 2015). Detecting these violations is challenging, as the mean length might remain constant despite underlying variability (Gedamke and Hoenig, 2006; Nadon et al., 2015; Rudd and Thorson, 2018). The effectiveness of length-based methods varies with life histories of species and the quality of priors used (Pons et al., 2019)—for example, the LBI method is sensitive to uncertainties in life history parameters, particularly in stocks where M/K ratios or asymptotic lengths ($L\infty$) are challenging to estimate precisely (Chong et al., 2020). When parameter estimates deviate, LBI indicators can exhibit significant biases, underscoring the necessity for cross-validation with other models when the parameters are uncertain (Pennino et al., 2022). The LBB model, on the other hand, can be customized with specific priors like L_{inf} and M/K to enhance its reliability (Froese et al., 2018; 2019). Accurate priors are essential to reduce uncertainty in stock status

TABLE 2 Traffic light indicator table for the study period (2011–2023) of *S. commerson* stocks assessed in UAE waters.

Indicator	L_c/ Lm_{50} (LBI)	P_{mega} (LBI)	L_{mean}/ L_{opt} (LBB)	L_{mean}/ LF=M (LBB)	F/ M (LBB)	F/ M (LBSPR)	B/ B0 (LBB)	SPR (LBSPR)	SPR (LIME)
Criteria	>1	~0.3	>1	≥1	≤1	≤1	>0.4 (>0.2)	>0.4 (>0.2)	>0.4 (>0.2)
2011	0.01	0.00	0.52	0.63	57.40	9.62	0.00	0.00	0.15
2013	0.11	0.08	0.61	0.75	4.13	1.72	0.05	0.10	0.22
2014	0.18	0.12	0.74	0.90	4.16	1.51	0.08	0.18	0.11
2016	0.10	0.06	0.69	0.84	4.80	2.26	0.06	0.09	0.11
2017	0.09	0.05	0.69	0.84	3.59	3.80	0.09	0.05	0.15
2018	0.11	0.06	0.69	0.84	3.36	2.63	0.09	0.07	0.25
2019	0.06	0.04	0.62	0.75	3.22	2.13	0.08	0.07	0.33
2020	0.20	0.17	0.68	0.83	0.36	0.45	0.59	0.45	0.19
2022	0.09	0.07	0.65	0.79	2.84	2.16	0.10	0.08	0.34
2023	0.24	0.17	0.72	0.88	0.48	0.76	0.50	0.33	0.34

The colors indicate whether the estimated values by LBI, LBB, LBSPR, and LIME models are below (red) or above the criteria (green) and the limit reference point (yellow) in each year.

estimates (Babcock et al., 2013; Mannini et al., 2020). The LBSPR model, which assesses stock reproductive capacity, considers an SPR of 40% as sustainable for most species (Hordyk et al., 2015). It is highly effective to estimate spawning potential ratios but is also vulnerable to assumptions about length selectivity and maturity, which may introduce additional bias if unaccounted recruitment variability is present (Hordyk et al., 2015; Medeiros-Leal et al., 2023). However, it requires accurate length data to reflect the exploited stock and avoid bias by not assuming a stock–recruitment relationship (Prince et al., 2015). The LIME model can underestimate SPR due to dome-shaped selectivity and the presence of a high frequency of small fish (Pons et al., 2019; Medeiros-Leal et al., 2023). Moreover, length frequency data from small-scale fisheries can be biased due to mixed gear selectivity, complicating assessments (Wolff et al., 2015). Although LIME tends to require robust length frequency data for precise estimates (Rudd and Thorson, 2018), its non-equilibrium approach allows it to model recruitment fluctuations and fishing pressures over time (Pons et al., 2019). Therefore, comparing results from different models helps identify their biases and improve stock status estimates (Rosenberg et al., 2018; Pons et al., 2020). Studies indicate that an ensemble of length-based models may better capture the dynamics of data-limited stocks, particularly when applied as a weight-of-evidence framework (Pons et al., 2020; Froese et al., 2018). None of the four length-based models of LBI, LBB, LBSPR, and LIME can independently determine the exact exploitation levels due to data constraints, but their combined application offers a valuable tool to interpret stock trends and management needs—for example, the combination of LBB and LBSPR can provide insights into biomass and reproductive potential simultaneously, offering a clearer picture of stock sustainability. Although all of these methods may struggle with providing absolute biomass estimates, they can clearly reveal exploitation patterns by indicating the fishing pressure on specific size groups, such as juveniles or mature adults. This insight enables fisheries managers to prioritize regulatory interventions by targeting size classes most impacted by overfishing, thereby addressing pressing conservation concerns (Chong et al., 2020; Pons et al., 2019). This multi-method approach has shown promise in regions with high ecological and economic variability, where contrasting model outcomes informed critical management adjustments (Cousido-Rocha et al., 2022). Specifically, the convergence of findings across methods, such as the indication of overfishing in *S. commerson* stocks, suggests that implementing multiple models enhances the robustness of management recommendations, including the enforcement of minimum size limits or reductions in fishing efforts or restriction of certain fishing methods. This strategy has proven effective in other studies (Medeiros-Leal et al., 2023; Pennino et al., 2022), and it is highly recommended in cases where limited data restrict conventional stock assessment methods.

Given the highly migratory and homogenous nature of this species across the Arabian Gulf and Gulf of Oman, a strategic regional approach to the assessment and management of this species is necessary (Darvishi et al., 2011; Kaymaram et al., 2013). Continuous data collection using life history parameters and joint studies addressing migration between the northern and southern coasts are recommended for effective management. The results of this study emphasize the need of focused discussions among stakeholders on the different methodologies and the status of the fisheries. By recognizing the limitations and strengths of each stock model, more reliable and comprehensive assessments can be achieved. Our findings should stimulate a regional strategy for the sustainable management of *S. commerson*, ensuring its continued contribution to Abu Dhabi's economy and culture.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: Raw data belongs to Emirate of Abu Dhabi. Requests to access these datasets should be directed DP.

Ethics statement

Ethical approval was not required for the study involving animals in accordance with the local legislation and institutional requirements because the samples were purchased from commercial fish markets and were already dead.

Author contributions

MA: Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft. MD: Conceptualization, Investigation, Methodology, Validation, Writing – review & editing. FF: Conceptualization, Supervision, Writing – review & editing. WH: Conceptualization, Supervision, Writing – review & editing. AH: Conceptualization, Supervision, Writing – review & editing. SM: Conceptualization, Writing – review & editing. GS: Conceptualization, Supervision, Writing – review & editing. ND: Formal Analysis, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. DP: Conceptualization, Data curation, Funding acquisition, Project administration, Resources, Supervision, 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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