

Abstract

The study provides a comprehensive analysis of the Elasmobranchii class, which includes sharks, rays, and skates, within the Gujarat maritime zone, aiming to fill information gaps and offer updated insights on their taxonomy, diversity, population dynamics, and post-harvest utilization. Data were collected from fishing harbors along the Gujarat coast from 2021 to 2023. A total of 48 elasmobranch species were recorded, belonging to 6 orders, 16 families, and 29 genera. This includes 22 shark species from 3 orders, 7 families, and 12 genera; 8 skate species from 2 orders, 5 families, and 6 genera; and 18 ray species from 1 order, 4 families, and 11 genera. Notably, six species were recorded for the first time along the Gujarat coast: *Glyphis gangeticus*, *Sphyrna zygaena*, *Alopias superciliosus*, *Pastinachus ater*, *Himantura undulata*, and *Urogymnus granulatus*. Phylogenetic analysis using the COI gene revealed significant genetic relationships among elasmobranchs. For instance, *Isurus oxyrinchus* was identified as having a distinct evolutionary position, while *Galeocerdo cuvier* and *Sphyrna lewini* showed a close genetic relationship. DNA barcoding has been instrumental in identifying cryptic species and aiding conservation efforts by highlighting species at risk of extinction. The study employed YOLO v2, a deep learning model, to enhance species identification accuracy. Performance metrics such as accuracy, sensitivity, specificity, and F1 score were all above 0.7, demonstrating the model's effectiveness in monitoring marine biodiversity. This approach significantly improves the efficiency and accuracy of species cataloging, which is crucial for conservation strategies. Various diversity indices were calculated, revealing seasonal variations. The Shannon-Wiener Diversity Index was the highest in spring (2.74), followed by autumn (2.15), winter (1.91), and summer (1.29). Dominance (D) values were the lowest in spring (0.121), indicating high diversity, with the highest dominance in summer (0.426). Simpson's Index of Diversity (1-D) was the highest in spring (0.87), indicating even species distribution. The Margalef Richness Index was the highest in spring (5.523) and the lowest in summer (1.961). The Evenness Index showed the most even distribution in spring (0.36). Length-based stock assessment methods using the FiSATII program estimated the following for the silky shark (*Carcharhinus falciformis*): Asymptotic Length (L_{∞}) at 326.55 cm TL, Growth Coefficient (K) at 0.13/year, Total Mortality (Z) at 0.45, Natural Mortality (M) at 0.22, and Fishing Mortality (F) at 0.23. The exploitation ratio (E) was calculated at 0.51, indicating overexploitation. The

recruitment pattern showed continuous recruitment with peaks in June and July. Virtual population analysis (VPA) indicated an increasing fishing mortality rate for larger size groups. Surveys conducted at various fishing harbors provided insights into the utilization and trade of elasmobranch products. Profitability was generally low due to market and regulatory challenges, though some traders profit from exporting ray fish. Most fishermen did not consume elasmobranch meat due to taste preferences; products are often salted, dried, and sold domestically. The shark fin trade is illegal locally; shark liver oil is used for boat varnishing. Low-quality fish are sold to the fish meal industry. Interviews with 64 respondents (48 fishermen and 16 traders) revealed that fishermen aged 21-65 (mean 41) had 1-50 years of experience (mean 21.5), while traders aged 32-65 (mean 32) had 10-40 years of experience (mean 22.25). Various gears were used, with gillnets and hook & line for sharks and trawl nets for rays. Peak fishing seasons were in September-October and February-March, with reduced activity in July-August due to a seasonal ban. Fishermen and traders were aware of regulations and noted a significant decline in elasmobranch populations due to overfishing and increased fishing efforts, alongside misconceptions and limited awareness of regulations. The study highlights the urgent need for enhanced monitoring, better management practices, and collaboration to ensure the sustainable utilization and conservation of elasmobranch populations. Continued research and effective policy implementation are crucial for maintaining marine biodiversity and ecosystem health in the Gujarat maritime zone.

Keywords: Elasmobranch Taxonomy, Shark and Batoids, YOLO, Elasmobranch diversity indices