Improving Accessibility in Quarto Documents:

Application to U.S. Stock Assessment Reports

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Table of contents

List of Figures

List of Tables

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1 Introduction

The earliest catches of Petrale sole are reported in 1876 in California and 1884 in Oregon. Petrale sole were lightly exploited during the early 1900s, but new gear technology in the 1930s allowed trawling on new grounds and the fishery expanded to greater depths and to Oregon and Washington waters, resulting in larger landings. The Petrale sole catches further increased during World War II in response to increased demands. Also, during the "vitamin A rush" in the late 1930s and 1940s it was found that Petrale sole has high levels, which contributed to increased catches of this species as well. By the 1950s, the fishery was well developed with the stock showing declines in biomass and catches (Figures i and ii). Also in the 1950s, winter spawning grounds at deeper depths with dense concentrations of Petrale sole were discovered, and catches increased accordingly. The rate of decline in spawning biomass accelerated through the 1970s reaching minimums estimated to be generally around or below 10% of the unexploited levels during the 1980s through the early 2000s (Figure iii). Recent annual catches between 1981–2022 range between 803 and 3060 mt per year and the most recent landings are shown in Table i. Petrale sole are a desirable market species and discarding has historically been low (less than 5.1%), with most of the discarding due to small sizes.

There is little information regarding the stock structure of Petrale sole off the U.S. West Coast. No genetic research has been undertaken for Petrale sole and there is no other published research indicating separate stocks of Petrale sole within U.S. waters. Tagging studies show adult Petrale sole can move as much as 500 km, having the ability to be highly migratory with the possibility for homing ability (Alverson and Chatwin 1957). Juveniles show little coastwide or bathymetric movement while studies suggest that adults generally move inshore and northward onto the continental shelf during the spring and summer to feeding grounds and offshore and southward during the fall and winter to deep water spawning grounds (Horton 1989; Love 1996). Adult Petrale sole can tolerate a wide range of bottom temperatures (Perry, Stocker, and Fargo 1994).

The NWFSC has updated the assessment for Petrale sole along the U.S. West Coast to help identify any concerns for management and aid in management decisions.

2 Data

Data comprise the foundational components of stock assessment models. The decision to include or exclude particular data sources in an assessment model depends on many factors. These factors often include, but are not limited to, the way in which data were collected (e.g., measurement method and consistency); the spatial and temporal coverage of the data; the quantity of data available per desired sampling unit; the representativeness of the data to inform the modeled processes of importance; timing of when the data were provided; limitations imposed by the Terms of Reference; and the presence of an avenue for the inclusion of the data in the assessment model. Attributes associated with a data source can change through time, as can the applicability of the data source when different modeling approaches are explored (e.g., stock structure or time-varying processes). Therefore, the specific data sources included or excluded from this assessment should not necessarily constrain the selection of data sources applicable to future stock assessments for Petrale sole. Even if a data source is not directly used in the stock assessment they can provide valuable insights into biology, fishery behavior, or localized dynamics.Data comprise the foundational components of stock assessment models. The decision to include or exclude particular data sources in an assessment model depends on many factors. These factors often include, but are not limited to, the way in which data were collected (e.g., measurement method and consistency); the spatial and temporal coverage of the data; the quantity of data available per desired sampling unit; the representativeness of the data to inform the modeled processes of importance; timing of when the data were provided; limitations imposed by the Terms of Reference; and the presence of an avenue for the inclusion of the data in the assessment model. Included is a reference to Section 1. Attributes associated with a data source can change through time, as can the applicability of the data source when different modeling approaches are explored (e.g., stock structure or time-varying processes). Therefore, the specific data sources included or excluded from this assessment should not necessarily constrain the selection of data sources applicable to future stock assessments for Petrale sole. Even if a data source is not directly used in the stock assessment they can provide valuable insights into biology, fishery behavior, or localized dynamics.

Since 2011, trawl fisheries have been managed with catch shares under a system of annual individual fishing quotas (IFQs) for the shoreside sector (i.e., vessels delivering to shoreside processors) and harvest cooperatives for the at-sea hake sectors (catcher-processors who catch and process hake at sea; and Motherships, factory processors that take delivery of hake from catcher vessels at sea). Constant monitoring of catch using observers or electronic monitoring (EM) is required to participate in the trawl catch share fishery.

3 Results

The model fits the (s-wcgbt) index very well, including a decline from 2005 to 2009 followed by a rapid increase to a plateau in 2013–2017 and a gradual decline to the most recent observations (fig-spawn_bio). The observations that fit the least well are 2018 and 2019, which were lower than the years before and after. The absence of a 2020 survey due to the COVID-19 pandemic makes it difficult to determine if those two years were just outliers or if there was some unexplained population dynamics leading to a reduction in available biomass for those years.

When an extra standard deviation parameter was estimated for the (s-wcgbt), the value was minimal, indicating that the index fits well enough to not require additional tuning. These findings can have major implications to management (See Section 4).

The terminal year (2023) spawning biomass reference point was valued at 5.51571 when fishing was occurring at 0.179929. This changed drastically over the period of 178 years (management and monitoring beginning in 1845).

4 Discussion

5 Impact to Management

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5.1 Considerations

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6 References

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7 Figures

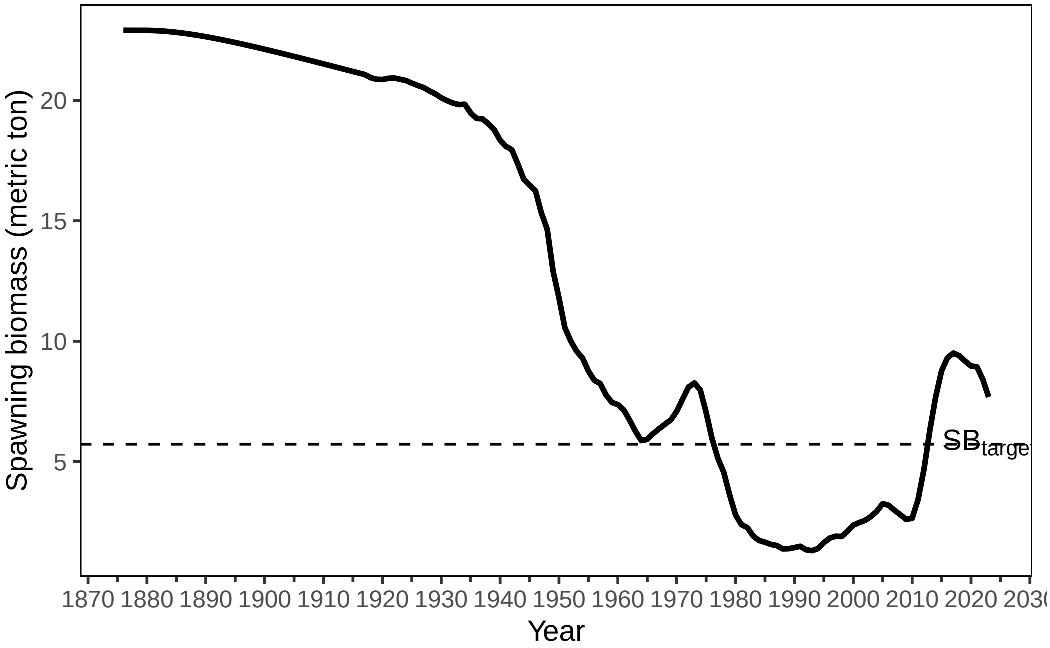

Figure 1: This is a great caption explaining a trend of spawning biomass of Petrale sole in 2023 test in-line code 0.179929 .