Fisheries and Oceans Canada | Pêches et Océans Canada
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Canadian Science Advisory Secretariat
Quebec Region | Science Response 2023/032

UPDATE OF STOCK STATUS INDICATORS FOR QUEBEC NORTH SHORE (DIVISION 4S) HERRING IN 2022

Context

The Fisheries and Aquaculture Management Branch requested scientific advice on the Quebec North Shore (NAFO Division 4S) herring stocks for the 2023 and 2024 fishing seasons. However, the assessment of these stocks, initially scheduled for March 2023, was cancelled to allow for a review of the assessment framework for northern Gulf of St. Lawrence (Divisions 4R and 4S) herring stocks in April 2023. At this meeting, the definition of the assessment unit was reviewed (inclusion of 4Sw with 4R), and the available data for the establishment of a new assessment model were reviewed.

In order to determine whether there had been any changes in the status of the resource that would require adjustments to the management plan for the 2023 and 2024 fishing seasons, the primary status indicators for the two herring spawning stocks in Division 4S were updated in 2022. The next full assessment is scheduled for March 2025.

This Science Response Report results from the regional peer review of February 27, 2023 on the Update of stock status indicators for Quebec North Shore (Division 4S) herring in 2022.

Background

The assessment of Division 4S herring stocks is conducted by examining trends in various fishery-dependent and fishery-independent indicators over the past few years, as described in DFO (2021). The indicators selected to monitor stock status are commercial fishery landings, age composition of the commercial catch, the acoustic survey results from unit area 4Sw in 2021 and 2022, and the cumulative stock productivity index. As a result of the March 2021 assessment, the total allowable catch (TAC) of 4,500 t was maintained for the 2021 and 2022 fishing seasons. Maintaining the TAC was considered appropriate based on the trends and annual values of the different indicators. In 2019 and 2020, commercial catches were composed mainly of new strong year-classes of spring spawners (2017) and fall spawners (2016), which were also strongly represented in the acoustic survey biomass estimates for those years. The abundance of young fish observed in the commercial fishery and the acoustic survey was considered an encouraging sign for the future of these stocks. Although there is a high degree of uncertainty in the acoustic survey results, in 2020 the biomass index for spring spawners reached the highest level observed since the beginning of the series. In contrast, the biomass index for fall spawners remained relatively stable in 2018–2020 with values comparable to those observed at the beginning of the series. The objective of this Science Response is to update the 4S herring stock status indicators for the 2023 and 2024 fishing seasons based on the best available data.

Description of the fishery

As of January 23, 2023, preliminary landings of herring totalled 670 t and 3,812 t in 2021 and 2022, respectively (Figure 1). Almost all landings of herring (> 98%) occurred in the eastern end

of 4Sw, between Vieux-Fort and Blanc-Sablon (Figure 1). The purse seine fishery accounted for the majority of landings, i.e. 97%, while the trap and gillnets fisheries represented 1.7% and 1.1% of landings respectively (Figure 2).

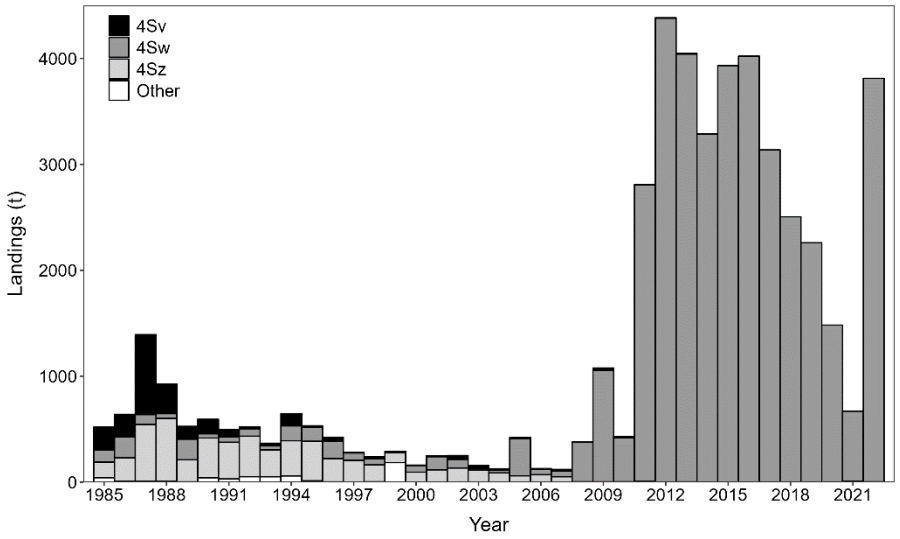

Figure 1. Herring cumulative commercial landings (tons) in the unit areas on the Quebec North Shore (NAFO Division 4S) from 1985 to 2022.

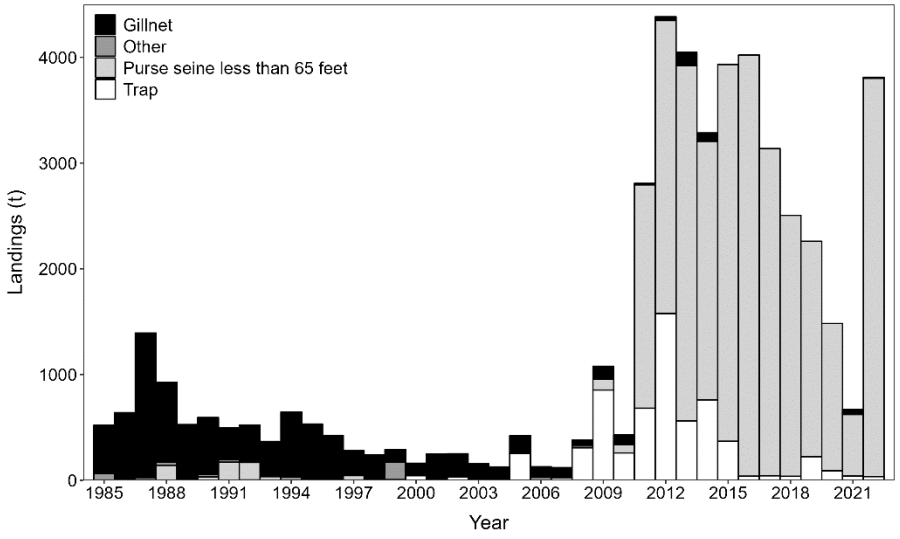

Figure 2. Herring cumulative commercial landings (tons) by fishing gear on the Quebec North Shore (NAFO Division 4S) from 1985 to 2022. Rarely used types of fishing gear have been grouped under "other" and include shrimp trawl, midwater trawl, bottom trawl, bar seine, beach seine, purse seine, longline, jigger, weir and handline.

Analysis and Response

Indicators of stock status

Commercial catch-at-age composition

The annual proportion of spring spawners observed in catches has seen a substantial decline since 2008 (Figure 3). Between 1985 and 2007, spring spawners accounted for an average of 65% of commercial herring landings. Since 2008, they have accounted for only 8% of landings on average. This change coincides with the shift of fishing effort from the western area (where fishing activities are mostly carried out in spring) towards the eastern end of Division 4S (where activities take place mainly during summer and fall (Figure 1)). However, the proportion of spring spawners observed in catches increased since 2020, reaching 37% in 2022 (Figure 3).

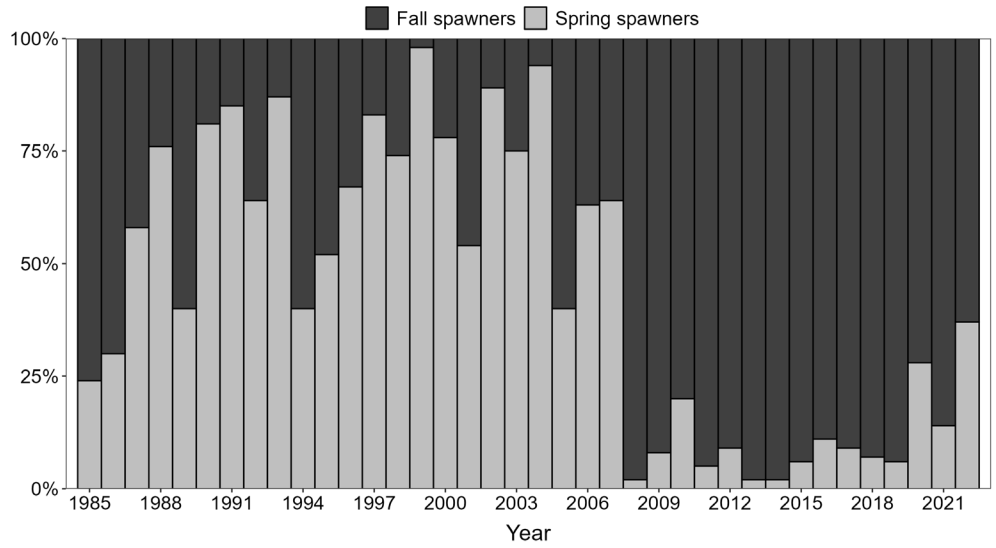

Figure 3. Annual proportion of spring and fall spawners in Quebec North Shore herring commercial catches (NAFO Division 4S) from 1985 to 2022.

The age composition of the commercial catch of herring generally allows the dominant cohorts to be tracked from 3–4 years of age onwards (Figure 4). In the spring spawners, the most recent year-classes are those of 2013 (age 8 in 2021 and age 9 in 2022) and 2017 (age 4 in 2021 and age 5 in 2022). In the fall spawners, the last relatively abundant year-classes were observed in 2000 and 2008 (age 11^{+} in 2021 and 2022). A new dominant year-class (2016) was also observed in 2020 in the fall spawners (Figure 4). Although this cohort was relatively abundant in 2020 (19.6%) and 2022 (22.7%), it was absent from the commercial catch in 2021.

Catches of spring-spawning herring in 2021 were primarily composed of fish from the 2013 cohort (30.4%) and the 2014 cohort (28.1%), while in 2022, landings were predominantly composed of fish from the 2017 cohort (64.8%). For fall-spawning herring, landings in 2021 and 2022 were predominantly composed of fish aged 6 years and over. These age groups accounted for 100% and 91.3% of all fall spawners caught in 2021 and 2022, respectively.

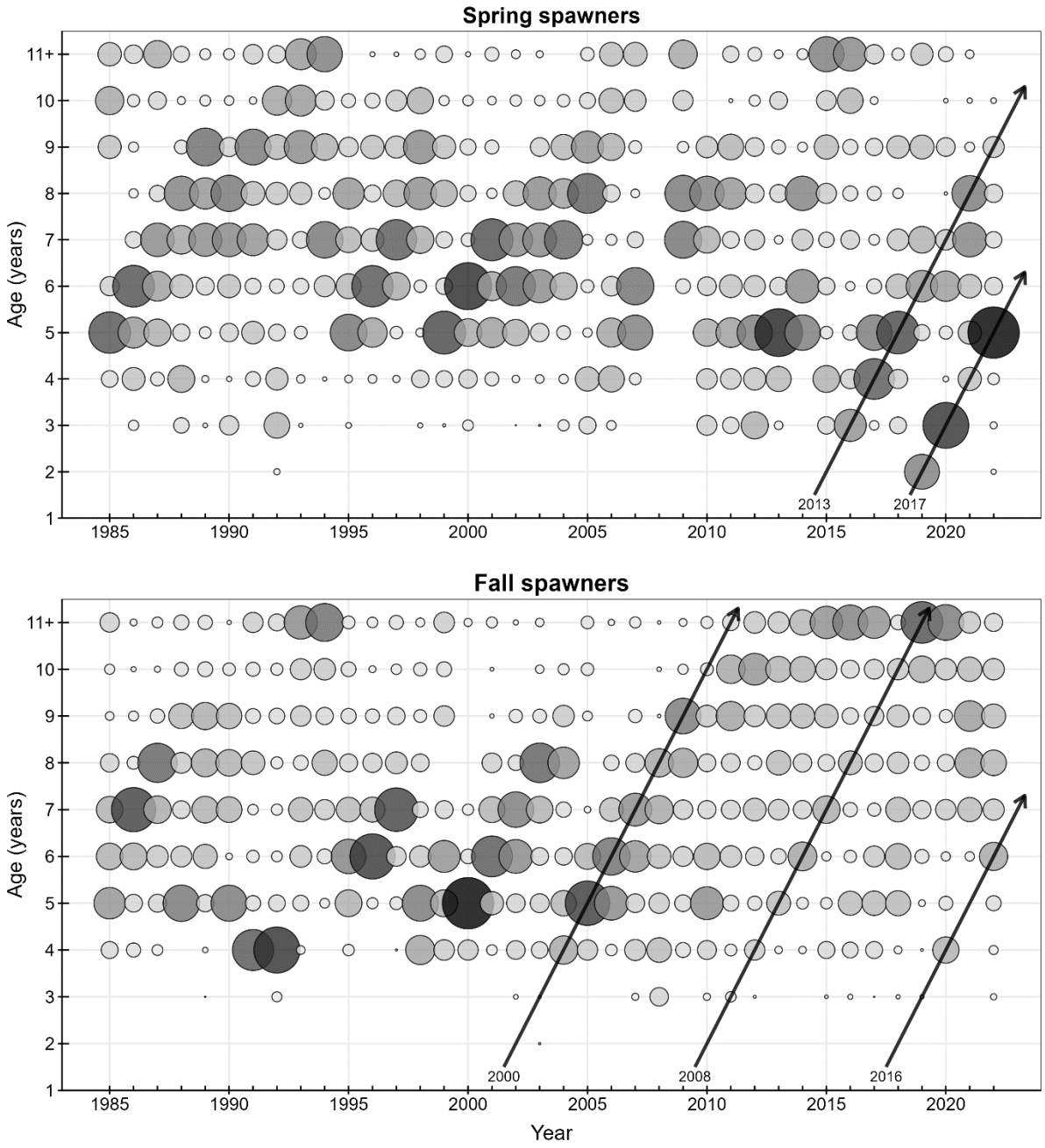

Figure 4. Annual catch-at-age composition (%) of herring, spring (upper panel) and fall (bottom panel) spawners, on the North Shore of Quebec (NAFO Division 4S) from 1985 to 2022. The size of the circles is proportional to the relative frequency (%) by year-class. The most recent dominant year-classes are indicated with arrows.

Acoustic survey

Fall acoustic surveys were carried out across the coastal area of unit area 4Sw between 2009 and 2022. The objective of these surveys was to estimate the abundance of spring and fall spawning herring as they gather near the coast to feed before beginning their migration to overwintering areas.

In 2021, the biomass estimated from the acoustic survey was 7,962 t for spring spawners and 10,270 t for fall spawners, while in 2022 the biomass estimate was 3,049 t for spring spawners and 7,048 t for fall spawners (Figure 5). Because the survey covers only a small portion of the stock's range, these values are considered to represent minimum estimates of the amount of fish available at the time of the survey. However, changes in survey coverage and catchability limit our ability to compare values from year to year and interpret long-term trends in biomass.

The proportion of spring spawners in the acoustic survey has increased significantly in recent years, from an average of 8.4% for 2009–2018 to an average of 63.3% for 2019–2022. The biomass estimates of spring-spawning herring from the acoustic surveys in 2021 and 2022 were dominated by the 2017 cohort (2021: 85.7%; 2022: 88.1%). The biomass estimates of fall spawners from the acoustic survey in 2021 were primarily composed of fish from the 2016 cohort (53.3%), and to a lesser extent, young fish from the 2019 cohort (25.7%). In 2022, the biomass estimates of fall spawners were primarily composed of fish aged 5–8 (76.9%), with the 2016 cohort alone accounting for 36.8%.

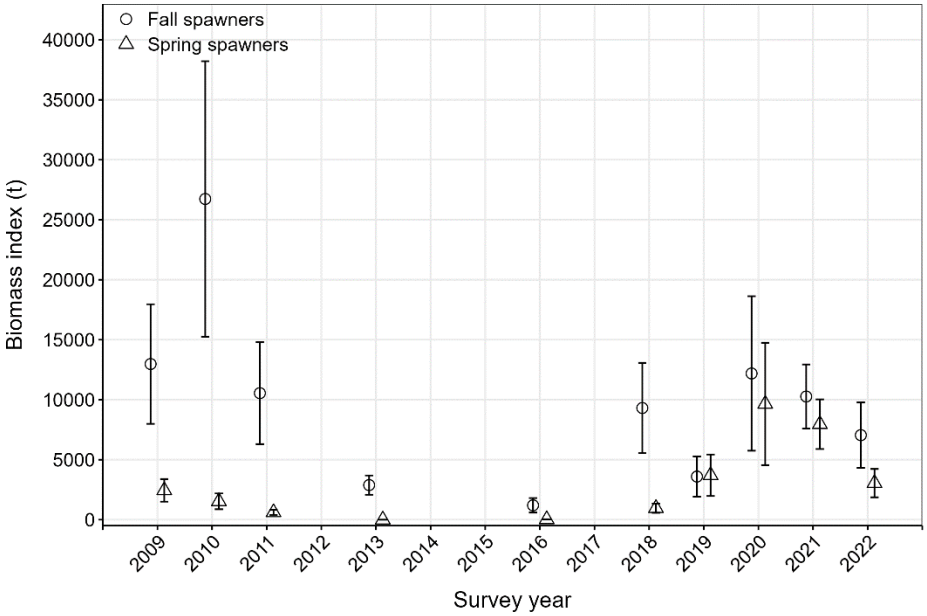

Figure 5. Acoustic survey biomass index (tons, with standard error) of the spring and fall herring spawners in unit area 4Sw from 2009 to 2022.

Cumulative stock productivity index

A cumulative index combining three stock productivity parameters has been developed to integrate available information and to describe temporal patterns in the productivity of the two herring spawning stocks on Quebec's North Shore. Three indicators were included: recruitment index (proportion of fish aged 3–5 in the catch, lagged by 3 years), average total length at age 6, and relative condition index. Each indicator was transformed into standardized anomalies by subtracting the series mean and dividing by the series standard deviation. The productivity index was defined as the sum of the annual standardized anomalies.

In the 1980s, anomalies in the cumulative stock productivity index of both spawning stocks were predominantly positive (Figure 6). Following a period of negative anomalies from 1995 to 2001, the productivity of the spring spawning stock fluctuated between positive and negative anomalies between 2002 et 2020 (Figure 6A). For fall spawners, the stock productivity varied

between positive and negative anomalies in the 1990s and 2000s, and has remained largely negative since 2009 (Figure 6B). In 2021 and 2022, length at age 6 and condition of herring in both spawning groups were below the long-term averages.

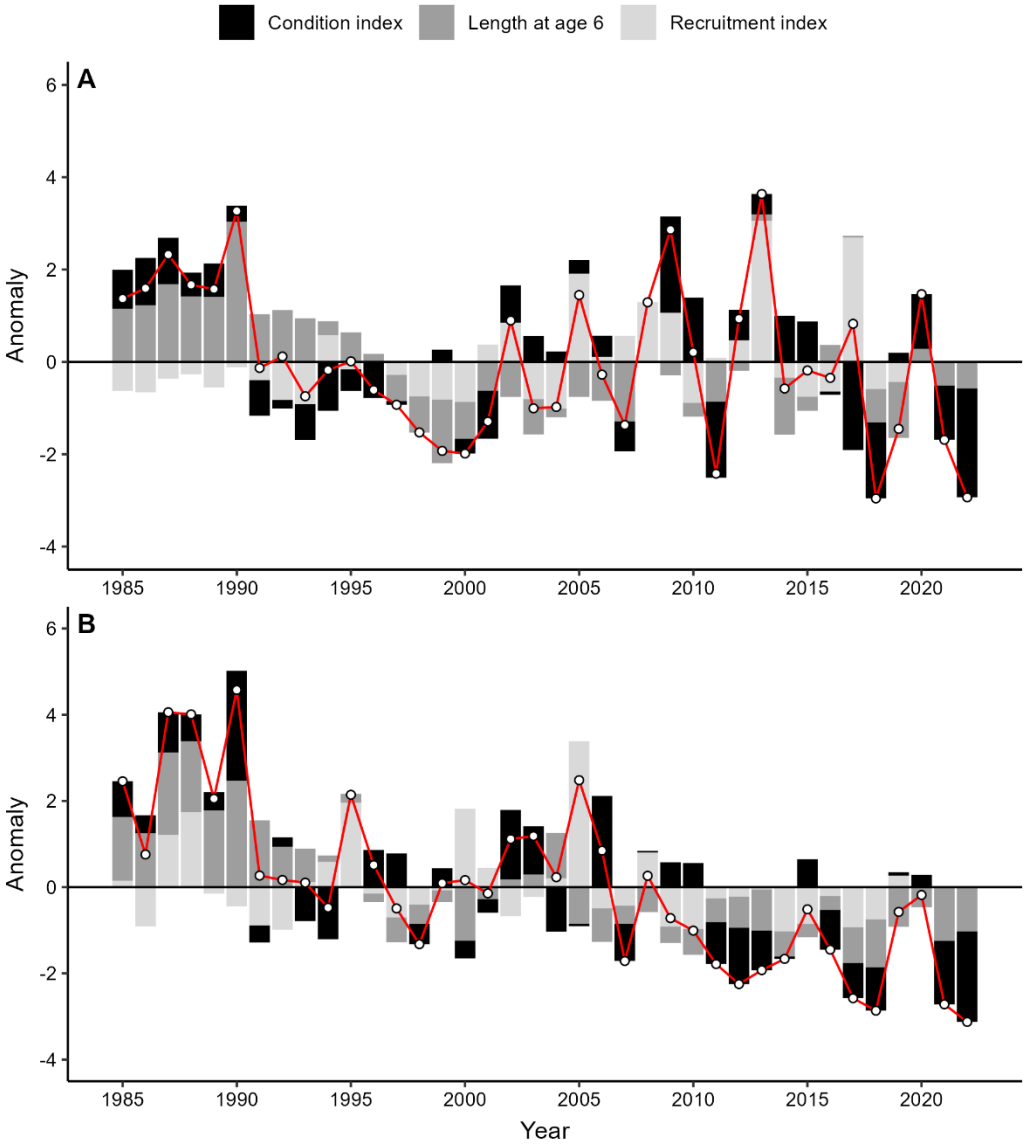

Figure 6. Cumulative stock productivity index (red line) based on the sum of annual standardized anomalies of key stock productivity indicators (relative condition index, average total length at age 6 and recruitment index) of spring (A) and fall (B) herring spawning stocks on Quebec's North Shore (NAFO Division 4S) from 1985 to 2022. The recruitment index is available through 2019 only.

Conclusions

Catch-at-age in the commercial fishery makes it possible to follow the progression of cohorts up to age 11+ for both herring spawning stocks, indicating low overall mortality. Strong cohorts were observed among the spring spawners (2017) and fall spawners (2016) and made up a significant portion of the commercial catch and acoustic survey biomass estimates in 2021 and 2022. Catch-at-age was also dominated by older individuals (age 6+) for fall spawners, which

accounted for the majority of landings. The dominance of older year-classes in the commercial catch suggests that the stock is not overfished. There are signs of recent increases for the spring-spawning stock, which has made up a larger proportion of the commercial catch and acoustic survey biomass since 2019.

The update of the main indicators for monitoring the stock status of Quebec North Shore herring in 2022 does not present a major change from the previous assessment. Therefore, the conclusion of the most recent Advisory Report remains appropriate: “Evidence available up to 2022 (age composition of the commercial catch and the acoustic survey) indicates that current catch levels are not expected to pose a significant short-term risk to herring stocks in 4S.”

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Sources of Information

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