Agenda Item 5.3

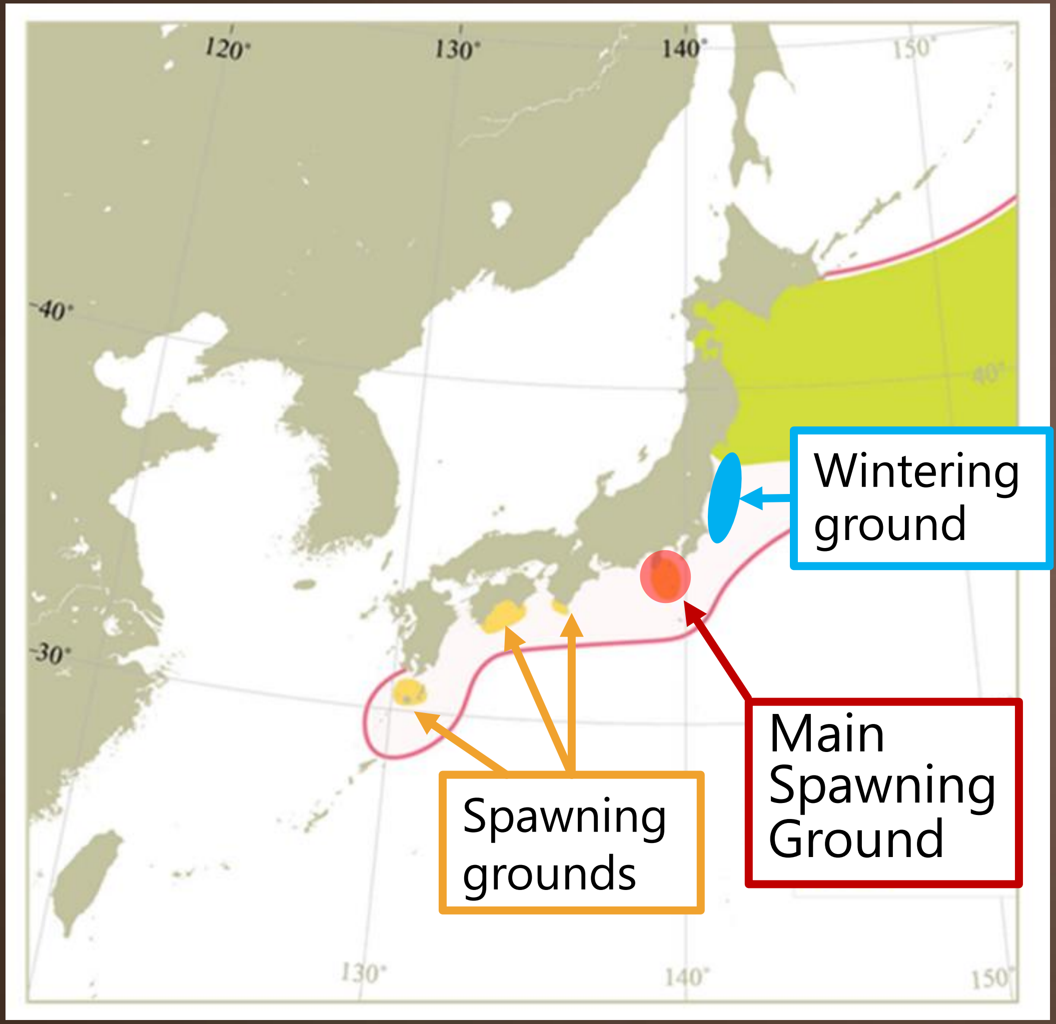
Maturity at age of chub mackerel from China and Japan

NPFC 2024 TWG CMSA8 WP14

AKIHIRO MANABE, RYUJI YUKAMI, MOMOKO ICHINOKAWA, SAYOKO ISU (JPN), HENG ZHANG(CHN)

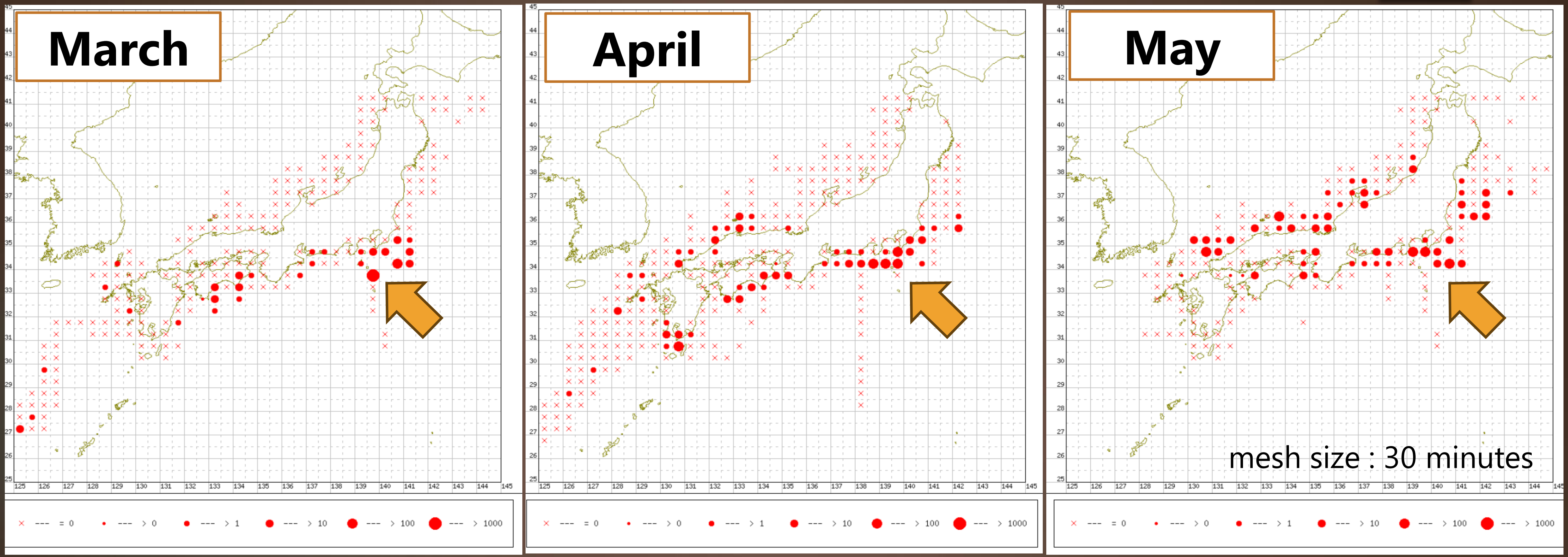
JAN 22 2024, NIIGATA, JAPAN

Basic reproductive biology of CM



- CM distributes widely in the NW Pacific Ocean
- Spawns mainly in Mar-Jun (broadly Q1~Q2)
- Spawning grounds are located in…
  - Shallow (<200m) water above the continental shelf
  - SST 17~19 degrees C
- Main spawning ground is located around the Izu Islands
  - Historically monitored for more over 50 years

Distribution of CM eggs in 2022



- Eggs are observed along the coastal region with Izu Islands as center of gravity
- Considering short egg period (~3 days), some eggs may disperse along the current
- Data suggests spawning of CM takes place in the coastal region of Japan

Submitted data

- China and Japan had submitted maturity at age data
- China submitted quarter and annual MAA
  - Since 2018-2022
- Japan submitted annual MAA
  - Since 1970-2022

- To cope with different initial date of age incrementation, Chinese age data are converted into age starting from 7/1

MAA China

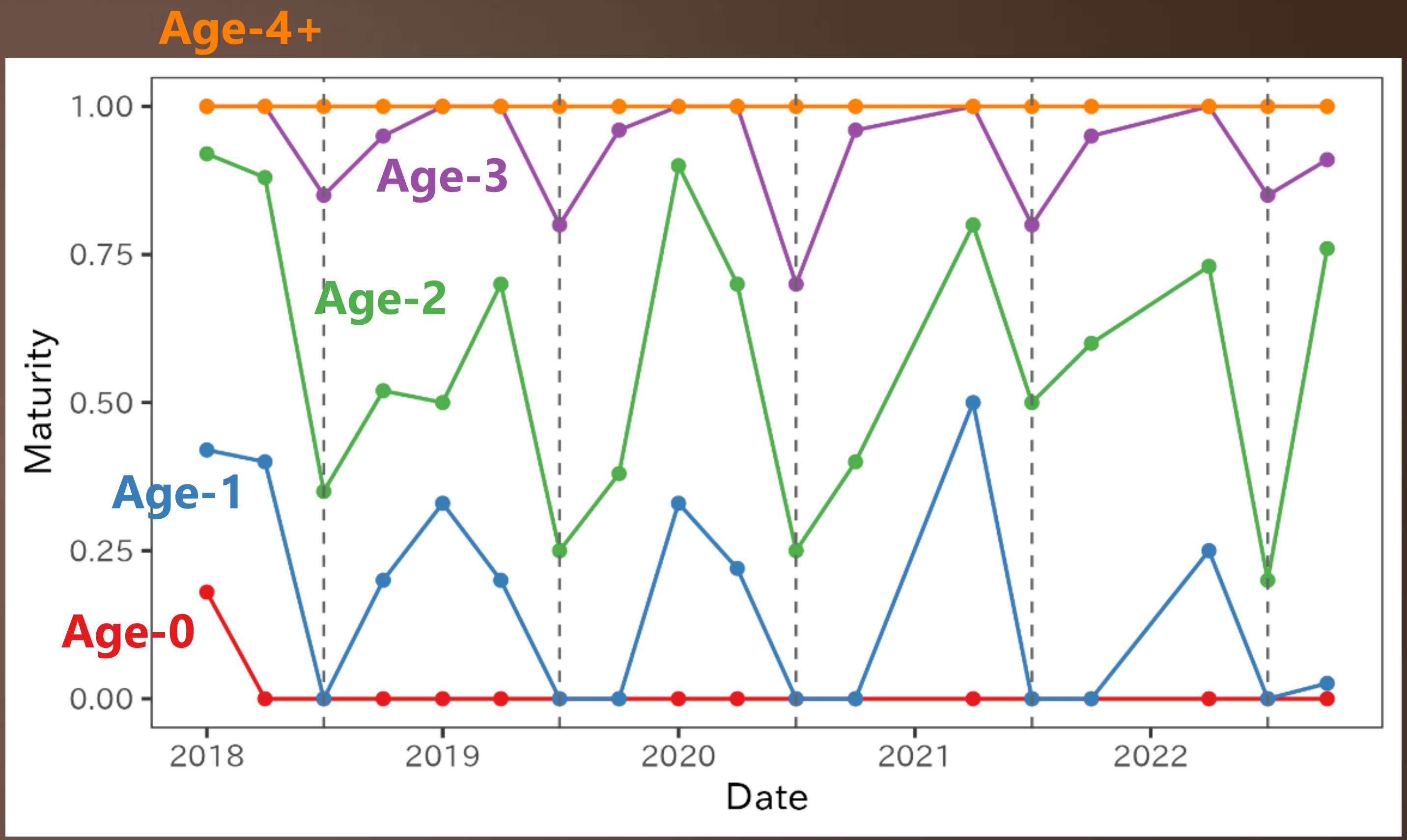
- Maturity status obtained by observing gonads from the catch sample with naked eyes
  - Opaque eggs in the gonad as a key to ID maturity?
- **Age 4 +** are considered as fully matured (MAA = 1)
- Nearly all **age-0** are fully immature (MAA = 0)

Age adjusted quarterly MAA

Year	Fishing year	Quarter	Age-0	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6+
2018	2017	1	0.18	0.42	0.92	1	1	1	1
2018	2017	2	0	0.4	0.88	1	1	1	1
2018	2018	3	0	0	0.35	0.85	1	1	1
2018	2018	4	0	0.2	0.52	0.95	1	1	1
2019	2018	1	0	0.33	0.5	1	1	1	1
2019	2018	2	0	0.2	0.7	1	1	1	1
2019	2019	3	0	0	0.25	0.8	1	1	1
2019	2019	4	0	0	0.38	0.96	1	1	1
2020	2019	1	0	0.33	0.9	1	1	1	1
2020	2019	2	0	0.22	0.7	1	1	1	1
2020	2020	3	0	0	0.25	0.7	1	1	1
2020	2020	4	0	0	0.4	0.96	1	1	1
2021	2020	1	-	-	-	-	-	-	-
2021	2020	2	0	0.5	0.8	1	1	1	1
2021	2021	3	0	0	0.5	0.8	1	1	1
2021	2021	4	0	0	0.6	0.95	1	1	1
2022	2021	1	-	-	-	-	-	-	-
2022	2021	2	0	0.25	0.73	1	1	1	1
2022	2022	3	0	0	0.2	0.85	1	1	1
2022	2022	4	0	0.026	0.76	0.91	1	1	1

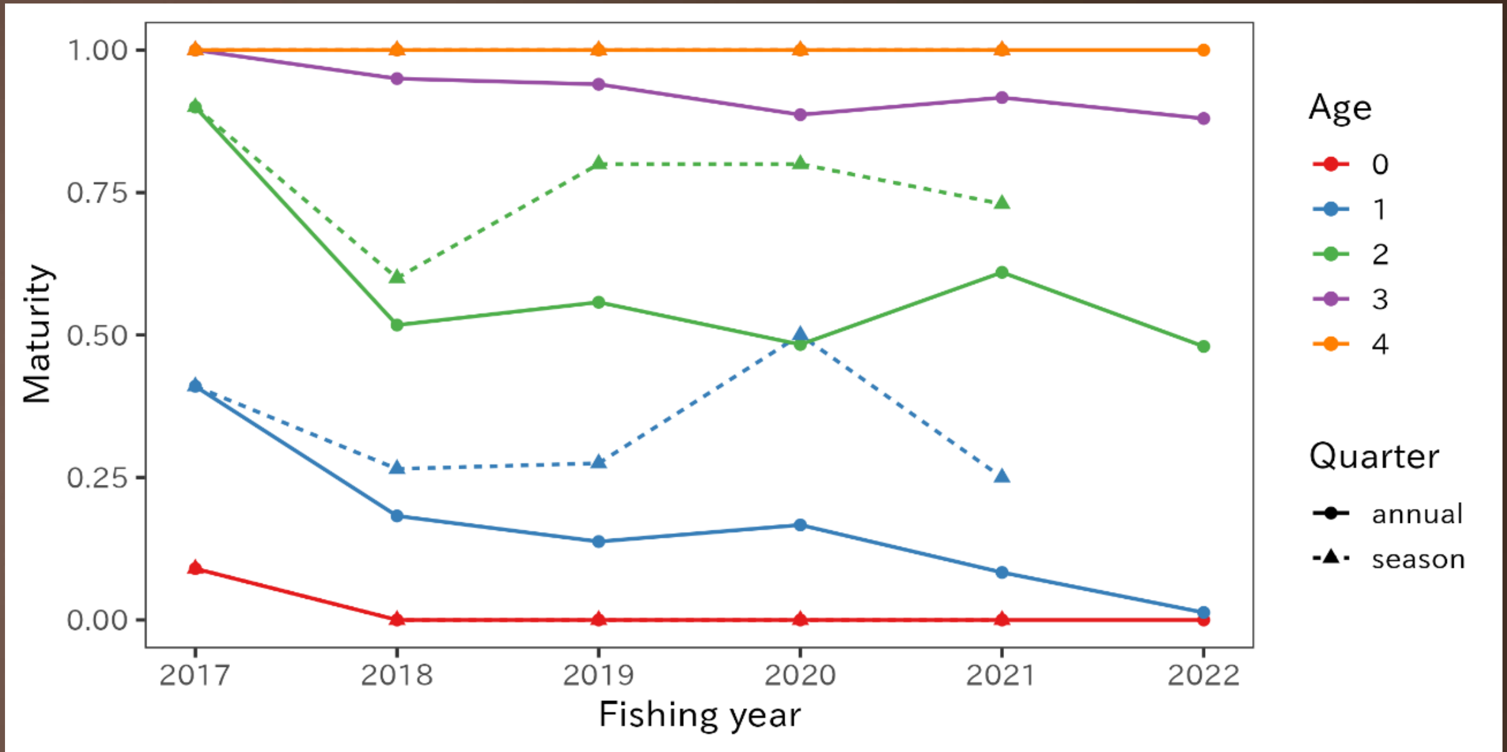
MAA China

- Seasonal fluctuation in MAA
- Higher MAA in Q4-Q2 with a peak in Q1-Q2
  - Showing gonadal development?
  - Spawning season as peak
- Age-2 is partially matured
- Age-3 is almost matured



MAA China

- Annual MAA
- The original submitted data used arithmetic mean of quarterly MAA
- Two scenarios to convert quarterly MAA to fishing year based annual
  - Annual based on fishing year
  - Seasonal (Q1 and Q2 only)
- Seasonal mean showed higher MAA – due to gonadal development



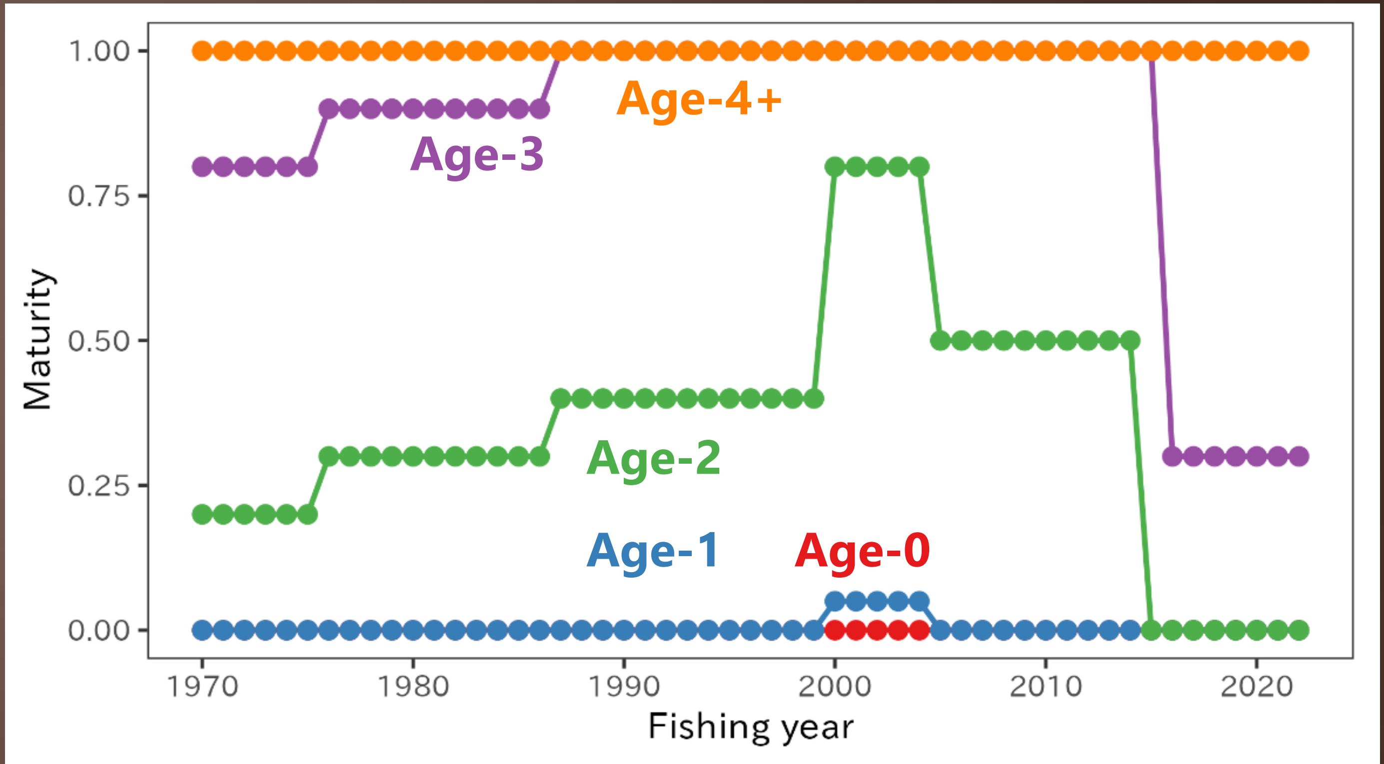
MAA Japan

- Uses gonad index (KG) based maturity to observe reproductive status of CM (Watanabe and Yatsu 2006, Watanabe 2010)
- Based on the data from coastal region during the season, including the main spawning ground
- Recent MAA is very low up to **age-3**
- **Age-4+** are fully matured (same as China)

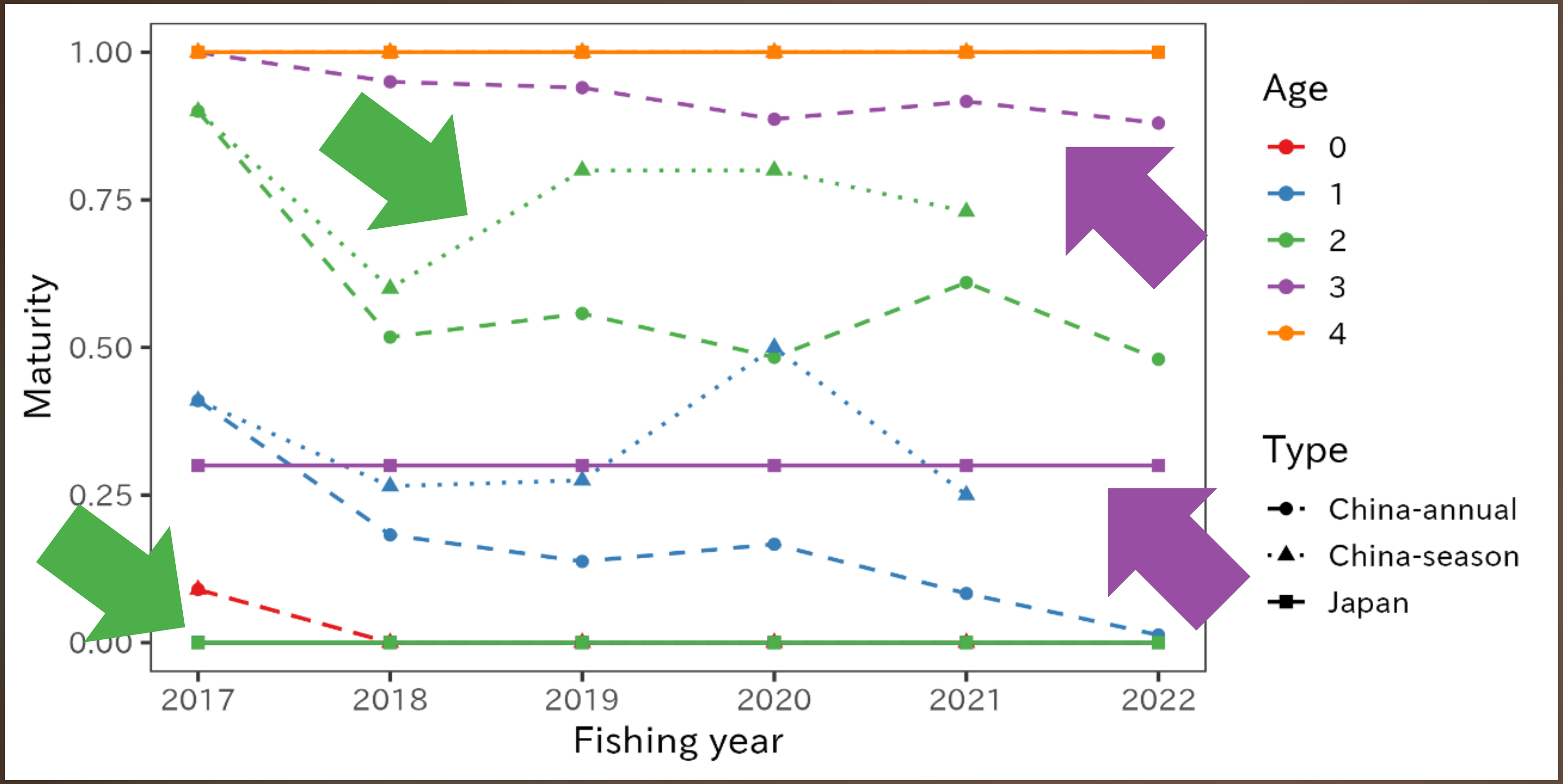
Year	Age-0	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6+
1970-1975	0	0	0.2	0.8	1	1	1
1976-1986	0	0	0.3	0.9	1	1	1
1987-1999	0	0	0.4	1	1	1	1
2000-2004	0	0.05	0.8	1	1	1	1
2005-2014	0	0	0.5	1	1	1	1
2015	0	0	0	1	1	1	1
2016	0	0	0	0.3	1	1	1
2017	0	0	0	0.3	1	1	1
2018	0	0	0	0.3	1	1	1
2019	0	0	0	0.3	1	1	1
2020	0	0	0	0.3	1	1	1
2021	0	0	0	0.3	1	1	1
2022	0	0	0	0.3	1	1	1

MAA Japan

- Age-2 and age-3 show variations
- Density dependent maturity reported in literatures (Watanabe 2010)
- Density dependent effect also affect growth (Kamimura et al. 2021)



Comparing MAA



- Both Chinese and Japanese data show **age-0** as fully immature, **age-4+** as fully matured
- **Age-1~3** are different
- Chinese MAA is significantly higher
- It is difficult to consider that samples from offshore-origin is more matured than spawning-ground-origin

Conclusion

- Maturity at age data for stock assessment is **key parameter to estimate spawning stock biomass**
- Chinese and Japanese data both shared same view on MAA on age-0 and age-4+
- For 1970-2016
  - Japanese MAA is the only source
- For 2017-present
  - The method on empirical observation by eye should be examined for validity
  - How do we interpret the low MAA of age-3 from Japan
  - If to use Chinese data, how do we interpret the quality of data in terms of data continuity
  - Considering catching the phenomena of spawning, Japanese data is better describing the actual spawning event?