Direct observations of the trans-boundary movement of walleye pollock in the northwestern Bering Sea

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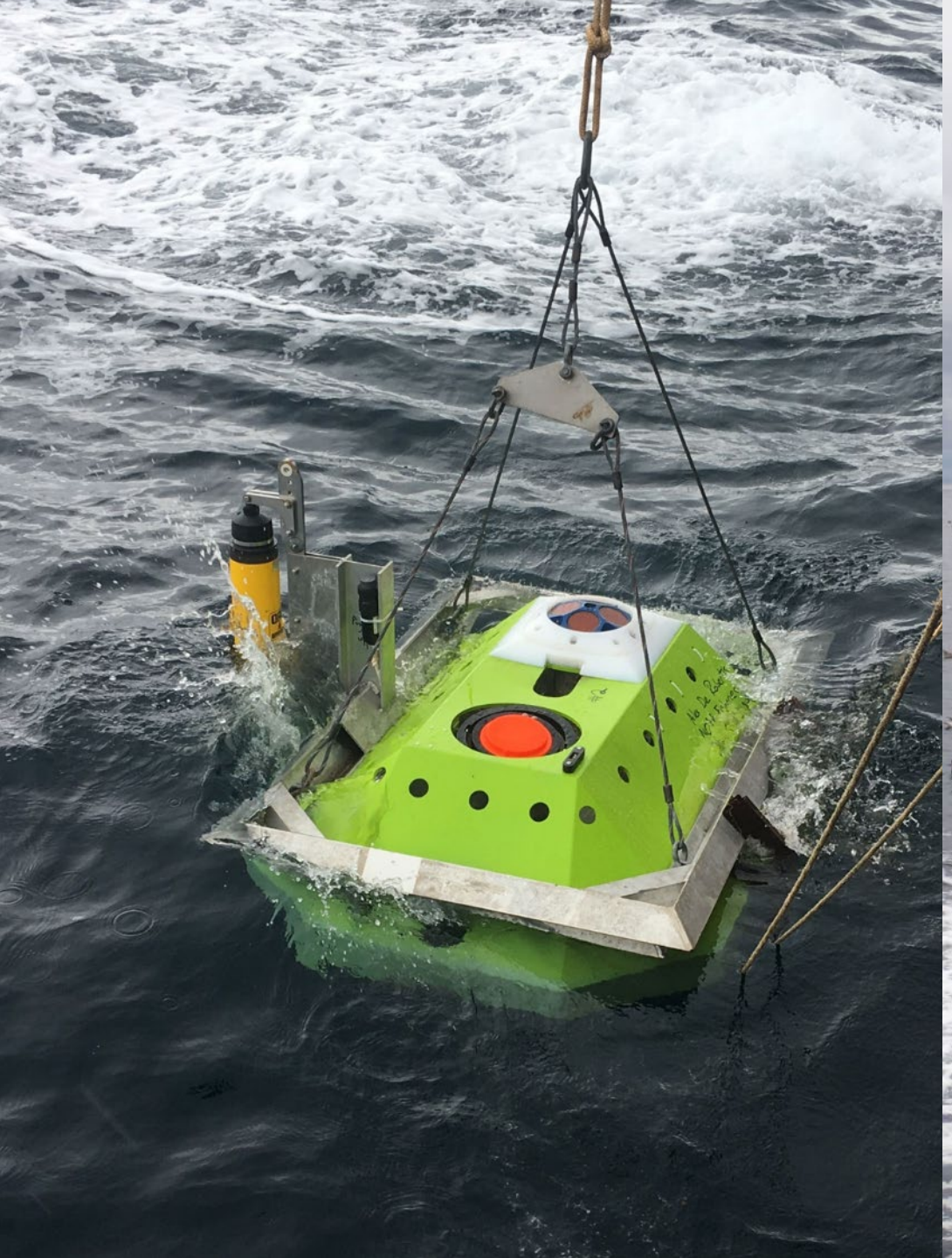
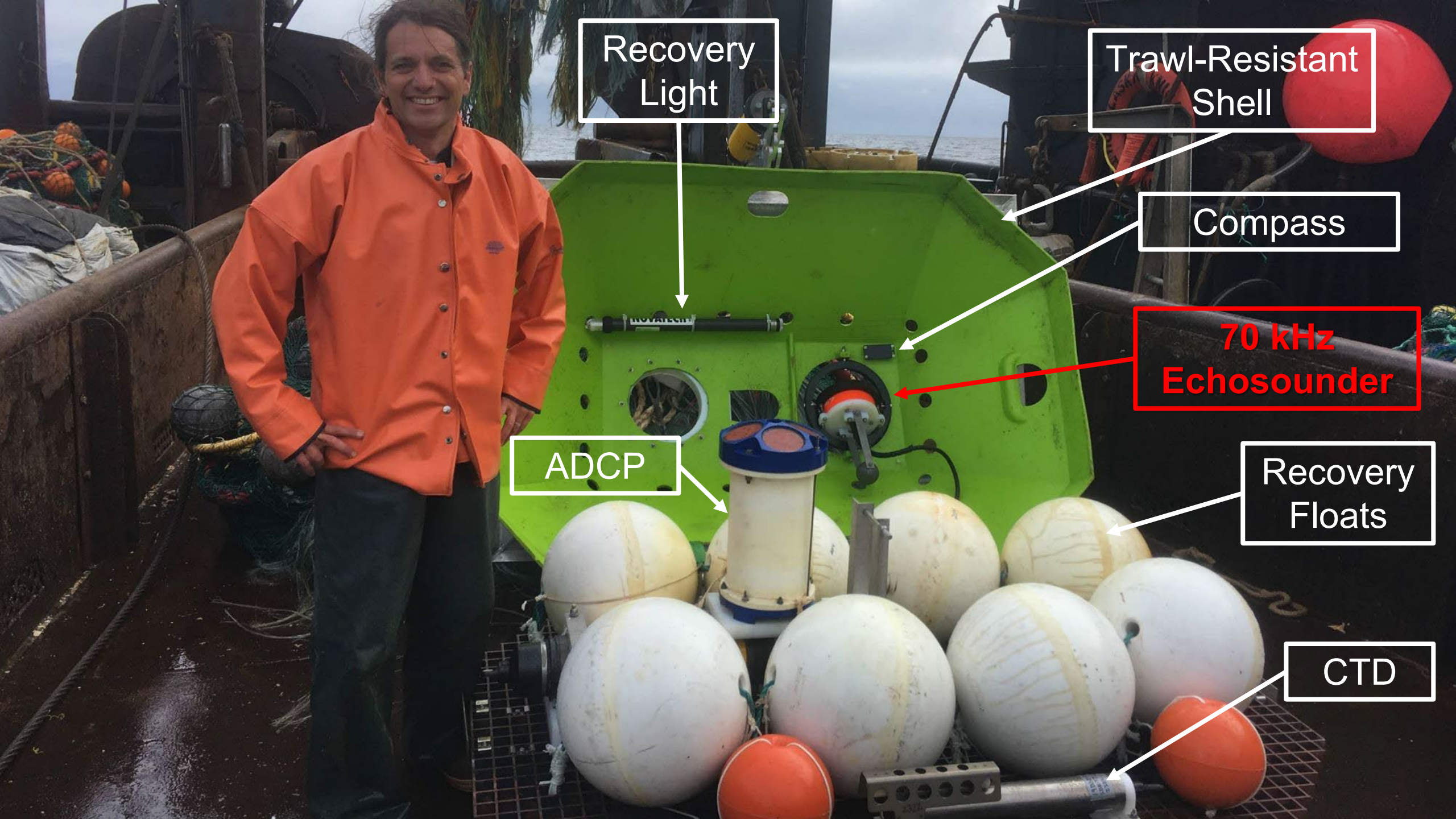
Motivating Questions

What are the seasonal dynamics of pollock in the NW Bering Sea?

- What are the seasonal trends in abundance?
- Are there seasonal trends in the direction pollock are moving?
- How do these patterns relate to environmental conditions?

Can we measure pollock movements between U.S. and Russian waters?



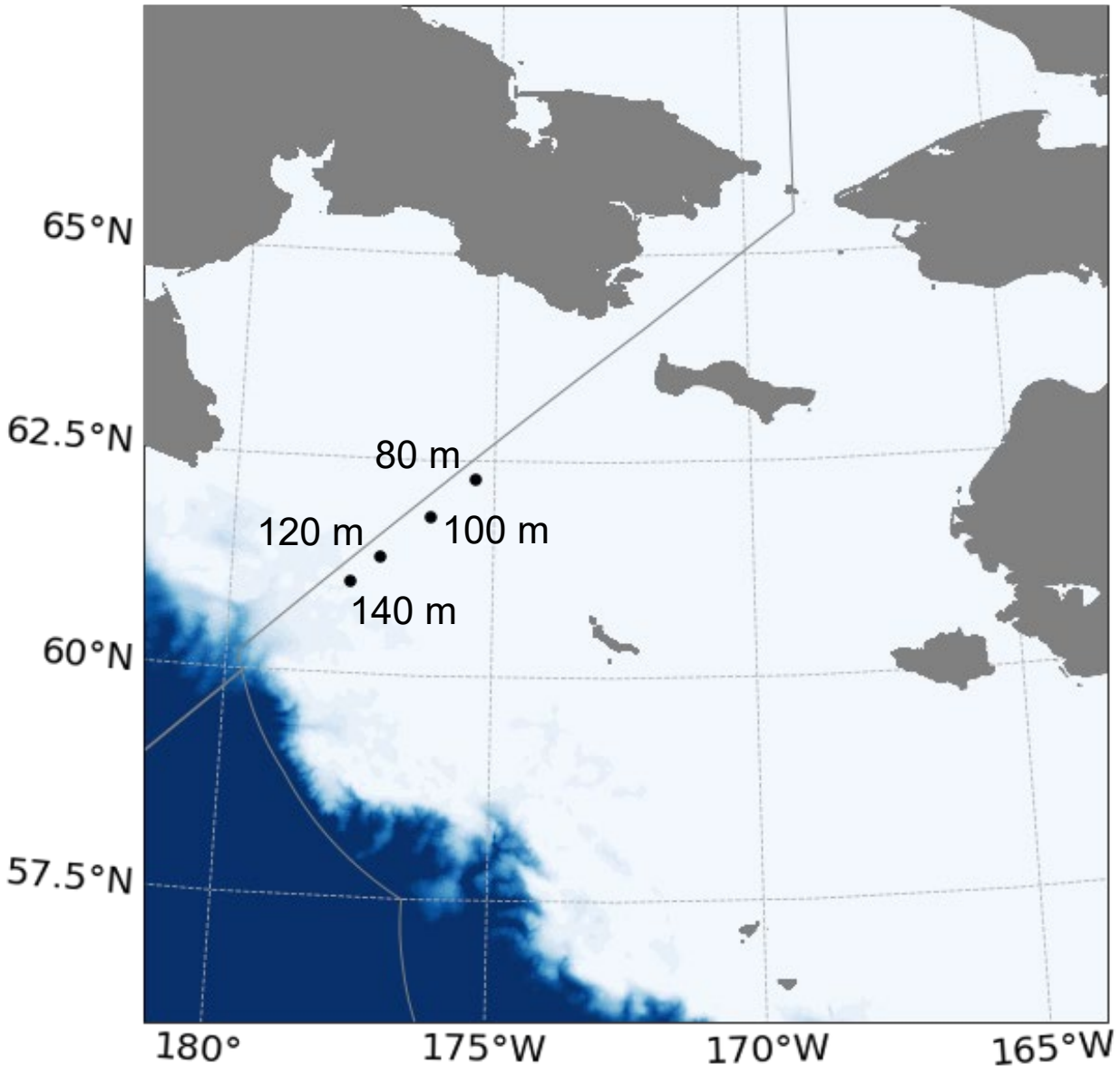

Recovery Light
Trawl-Resistant Shell
Compass
70 kHz Echosounder
ADCP
Recovery Floats
CTD

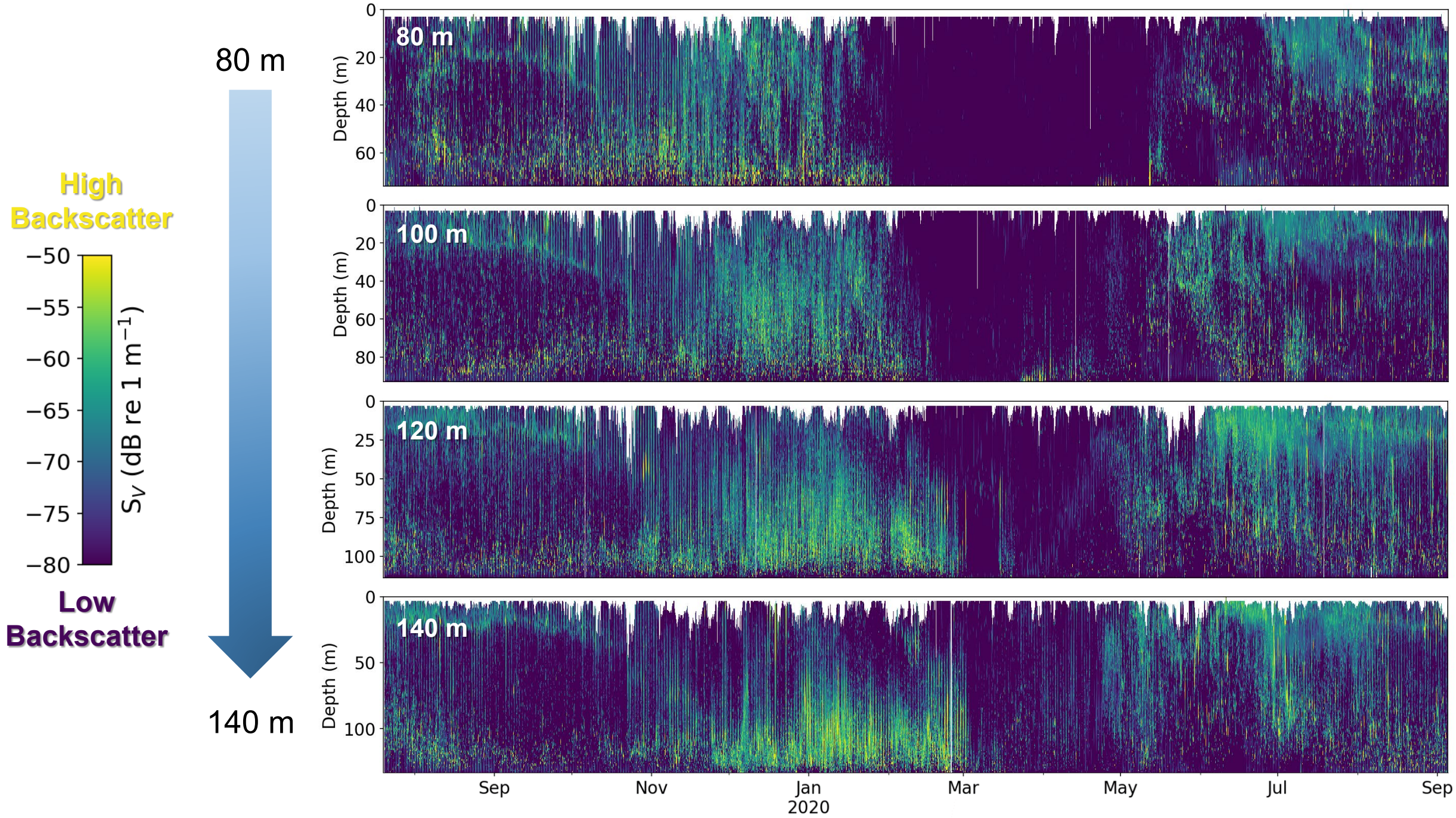
Four moorings 10 nmi from the U.S.-Russia maritime border

Depths of 80, 100, 120, and 140 meters

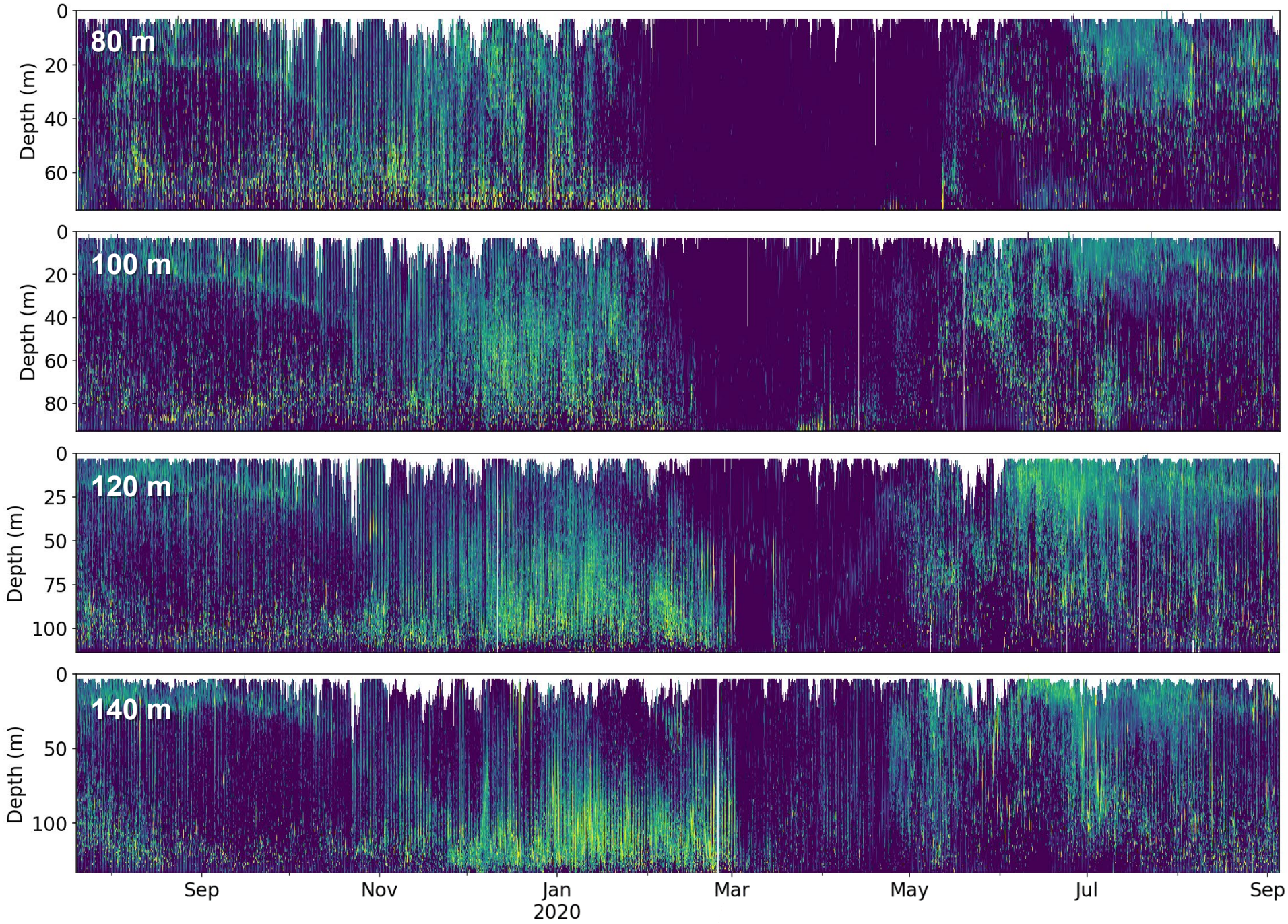
Deployed in July 2019

Recovered in August 2020




High Backscatter
−50
−55
−60
−65
−70
−75
−80
S_V (dB re 1 m^{-1})
Low Backscatter
80 m
140 m
80 m
100 m
120 m
140 m
Depth (m)
0
20
40
60
80
100
25
50
75
Sep
Nov
Jan
2020
Mar
May
Jul
Sep

Seasonal patterns were consistent across all four sites



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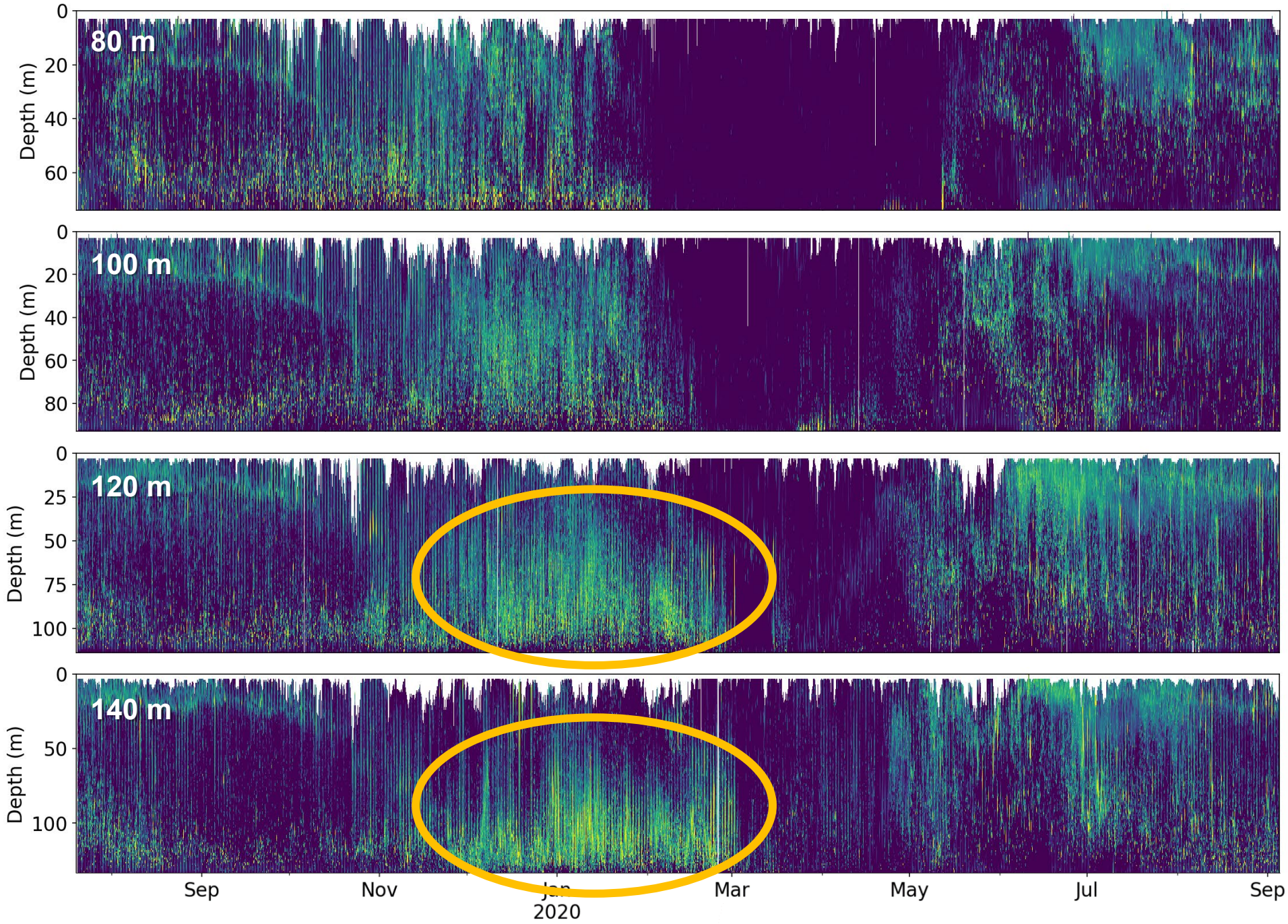
Peak fish abundance occurred from Dec – Feb

Backscatter was highest at the 120 and 140 m sites during winter



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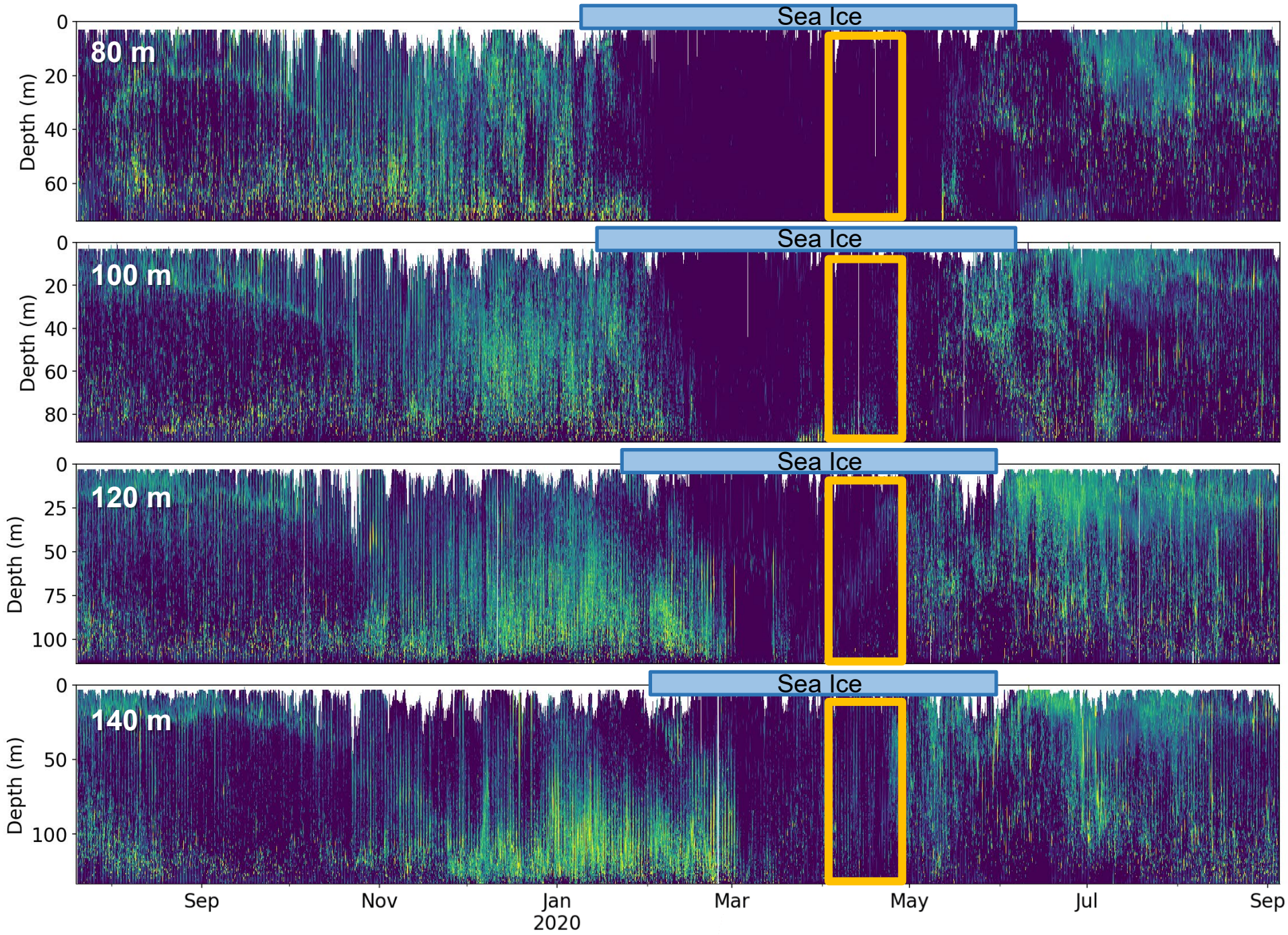

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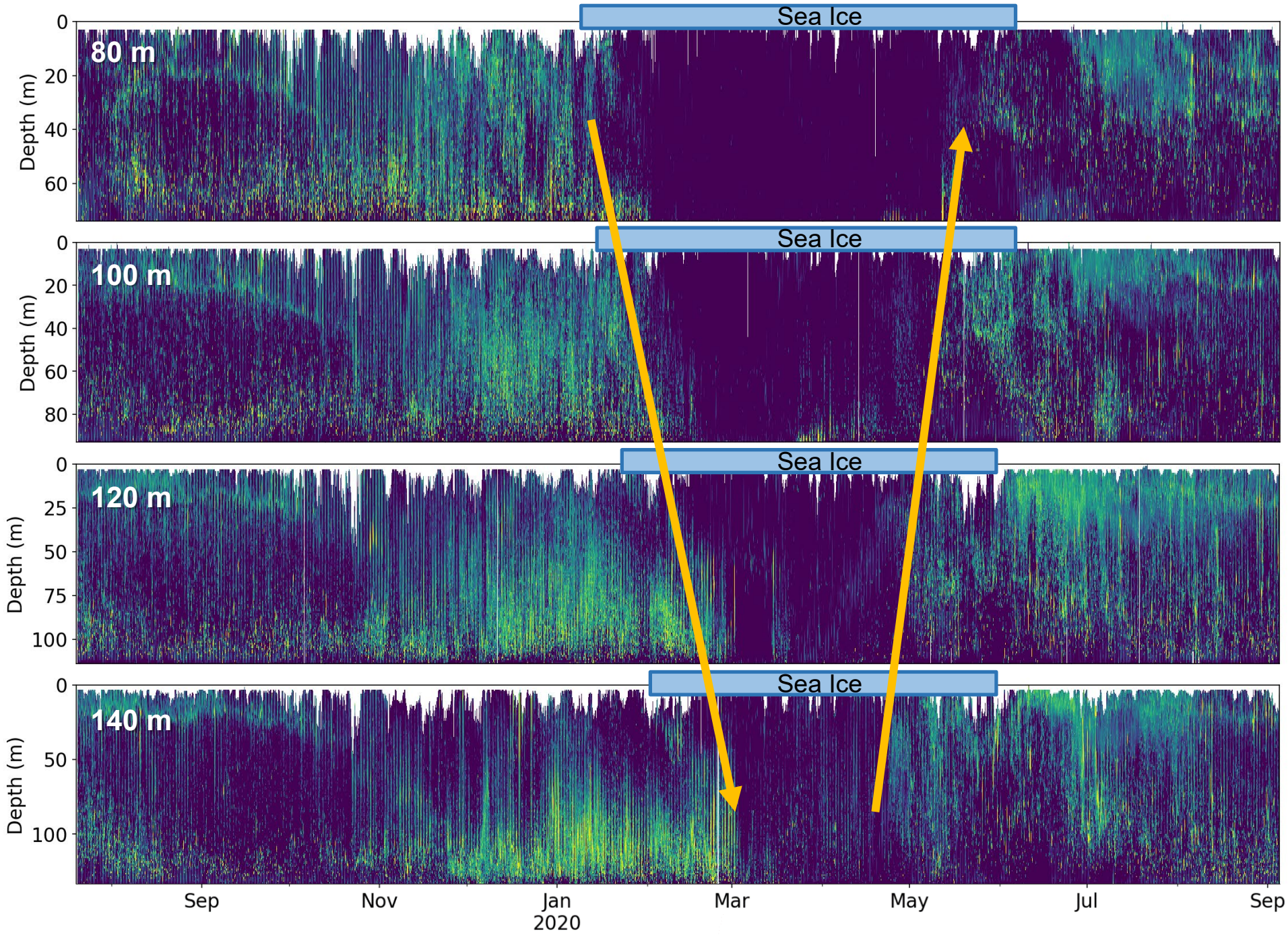
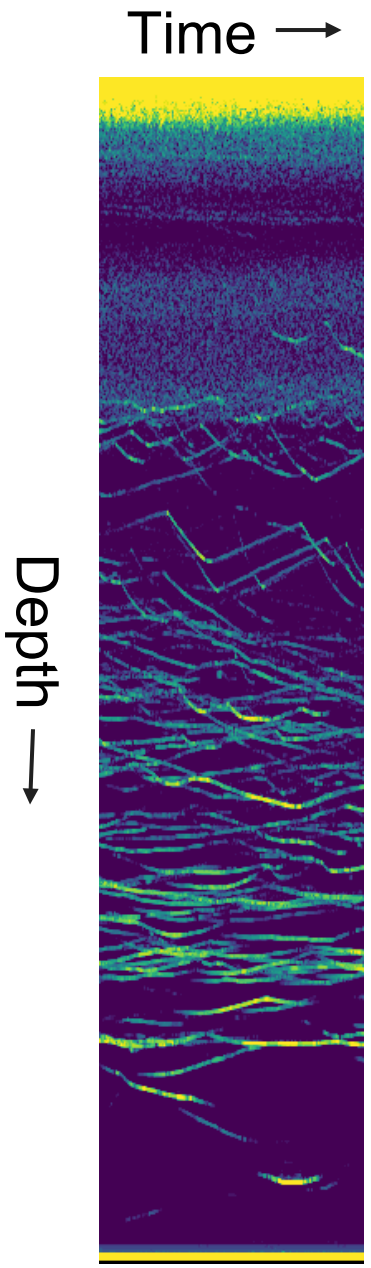


Tracking individual fishes



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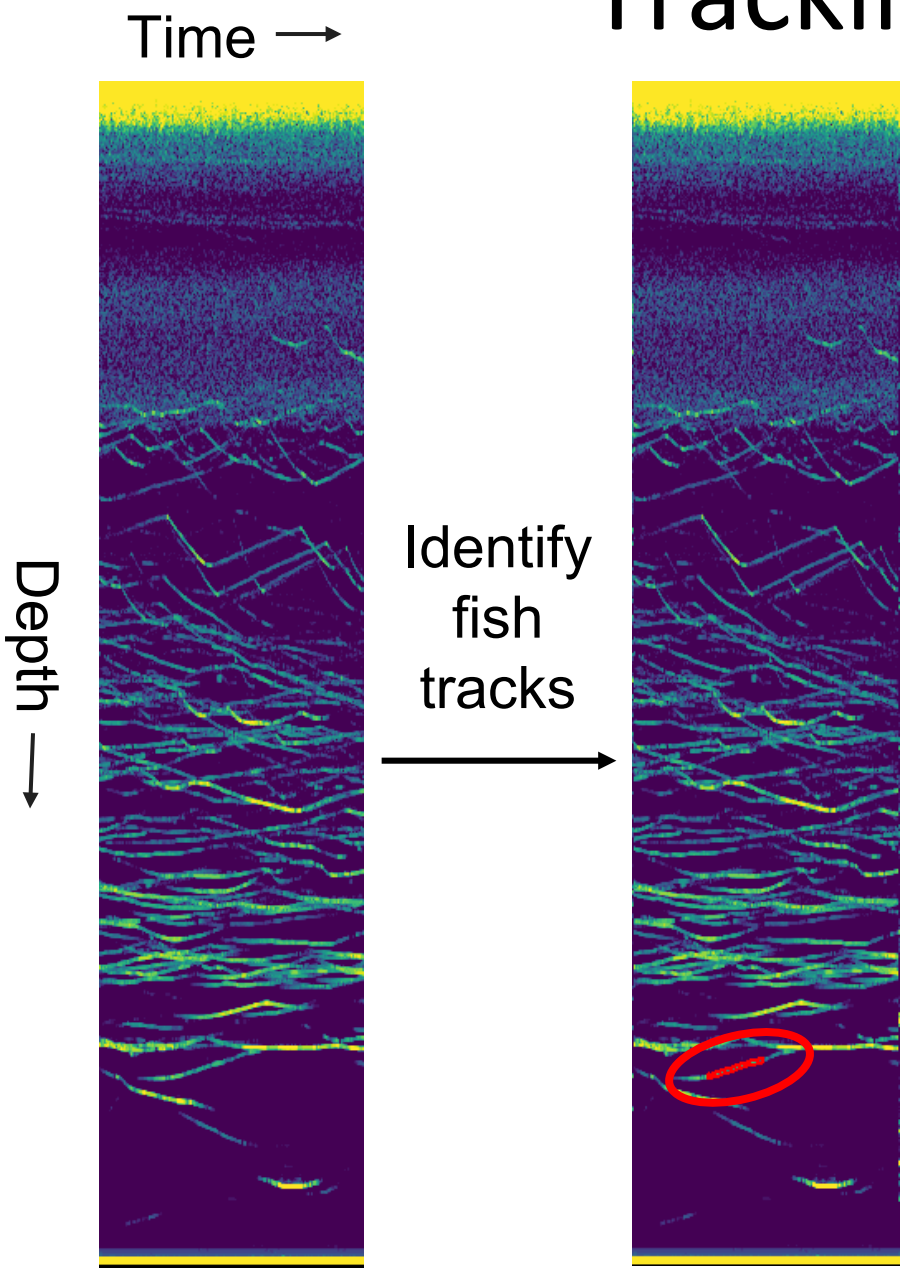
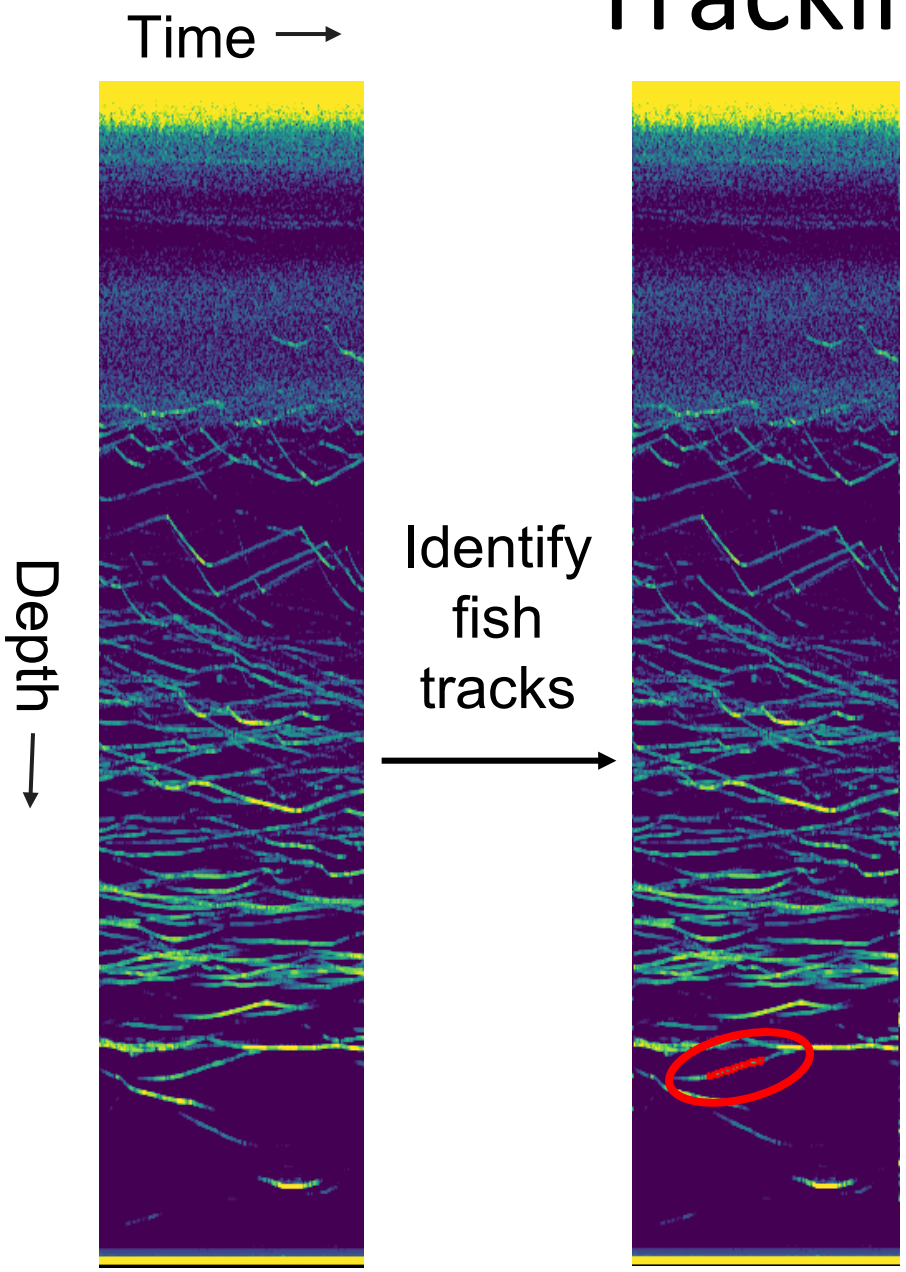
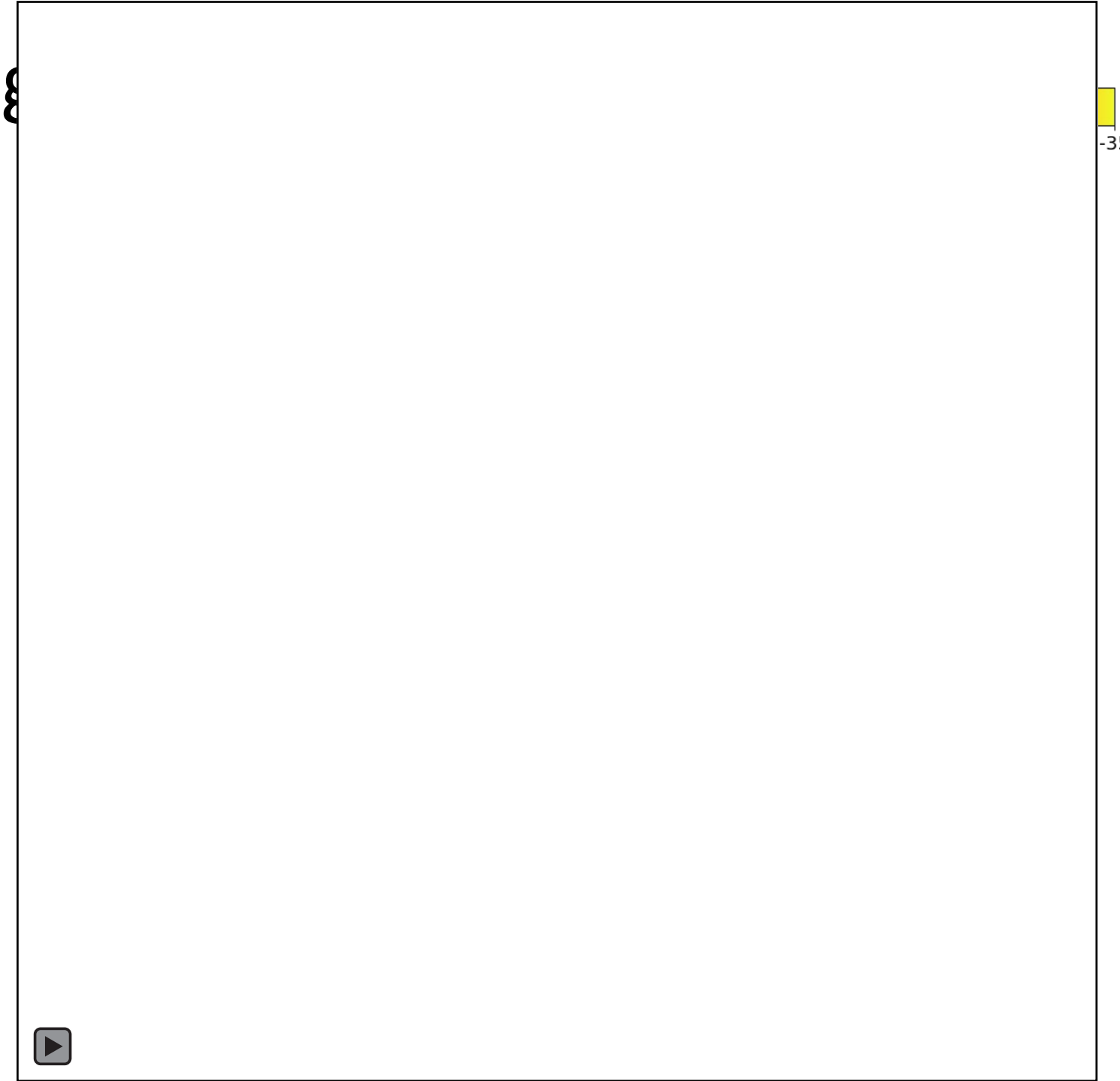
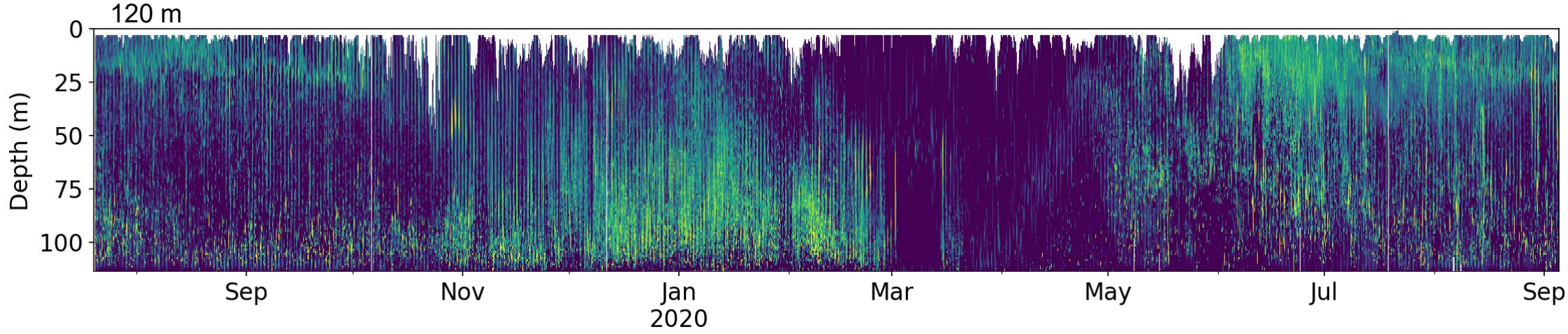


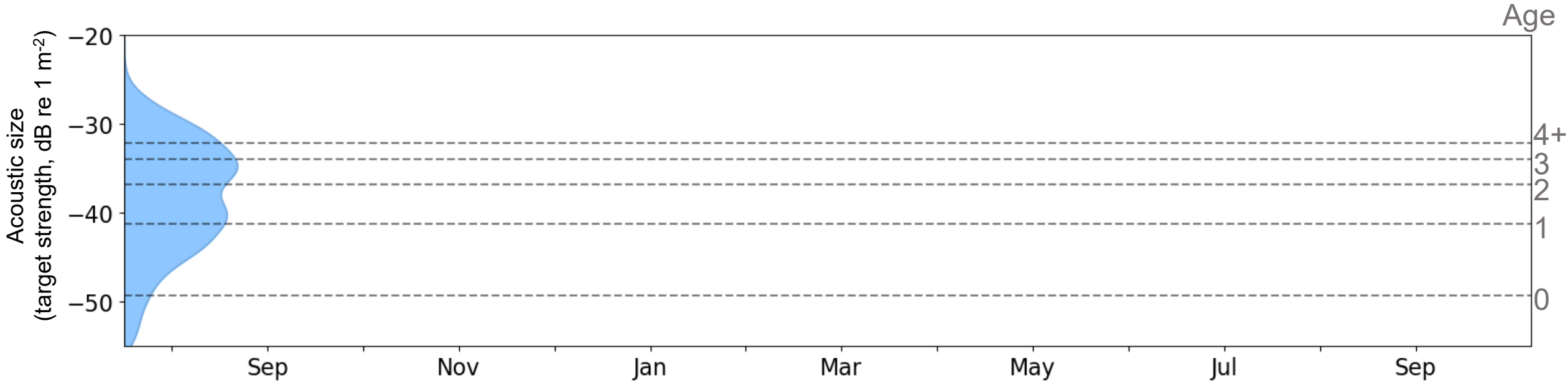
Tracking





Seasonal variability in fish size





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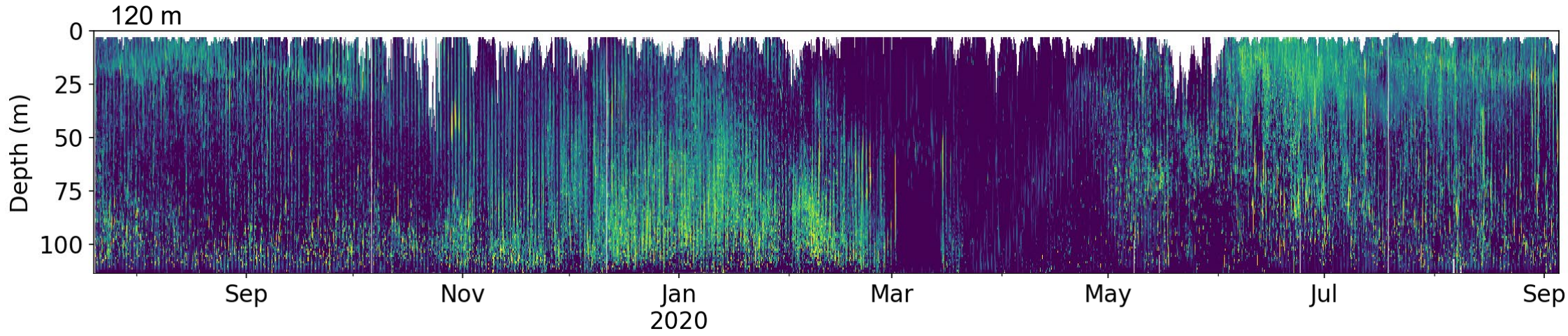

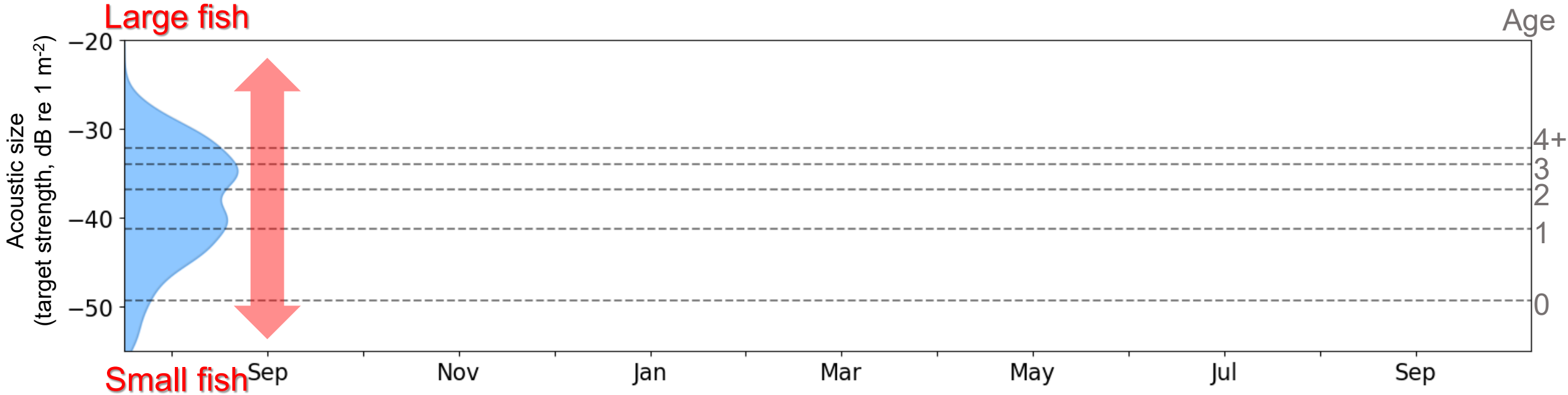

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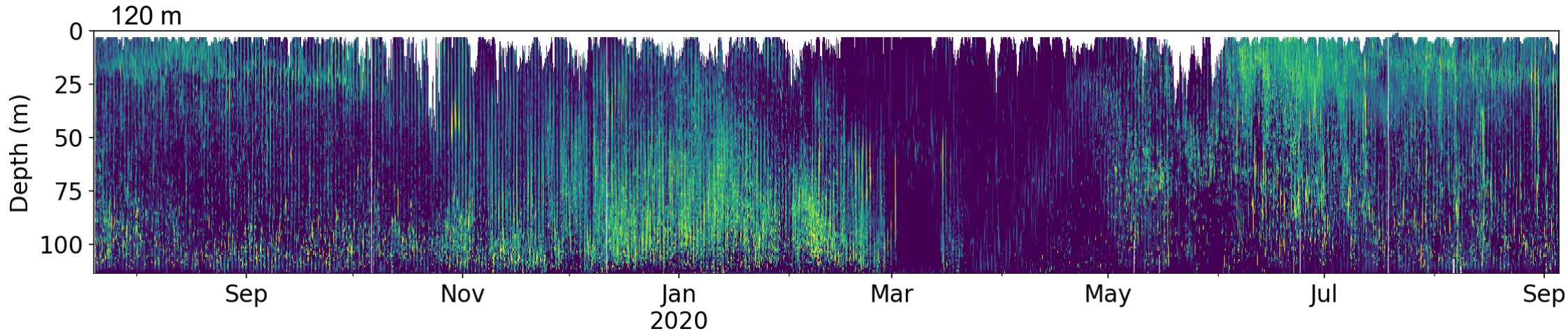

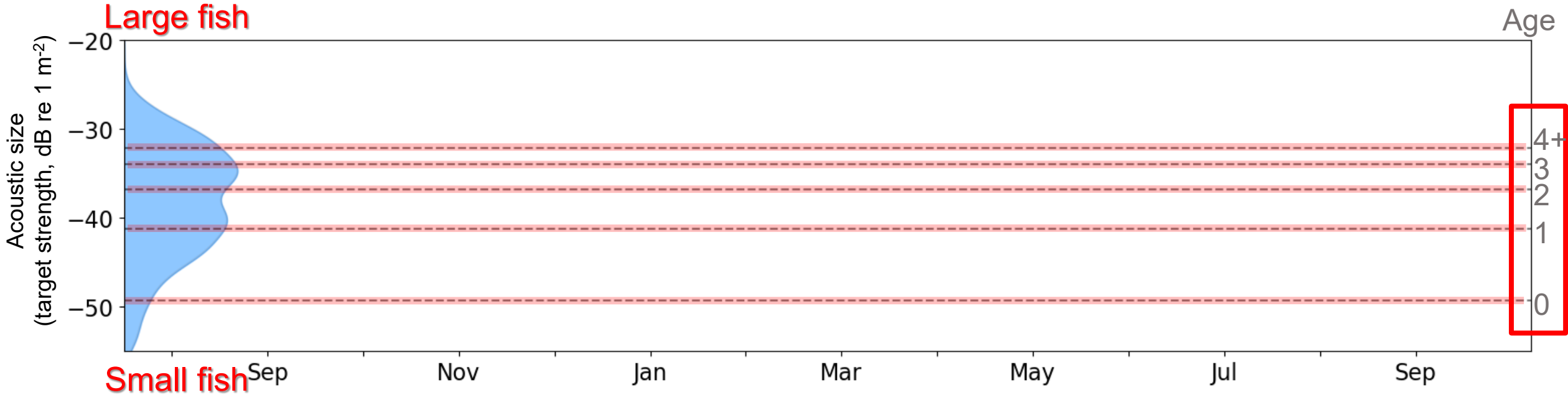

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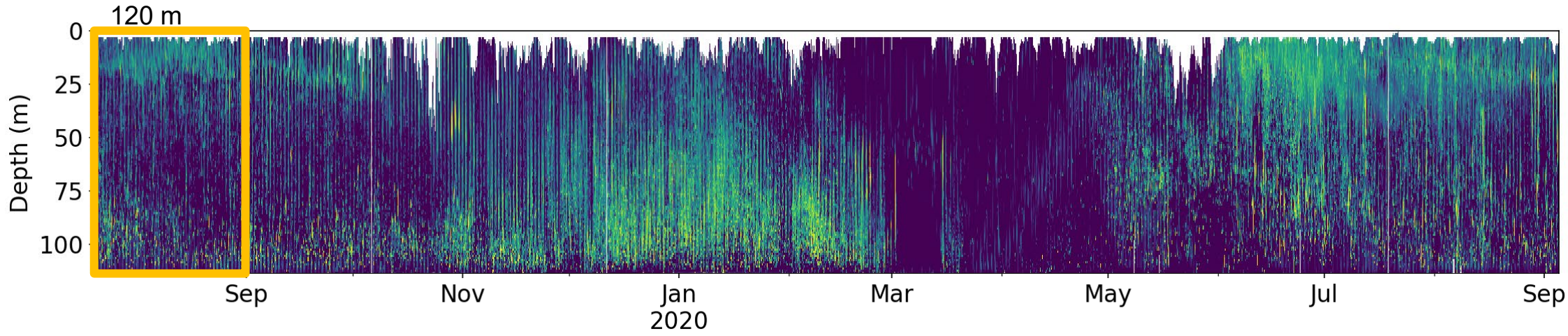

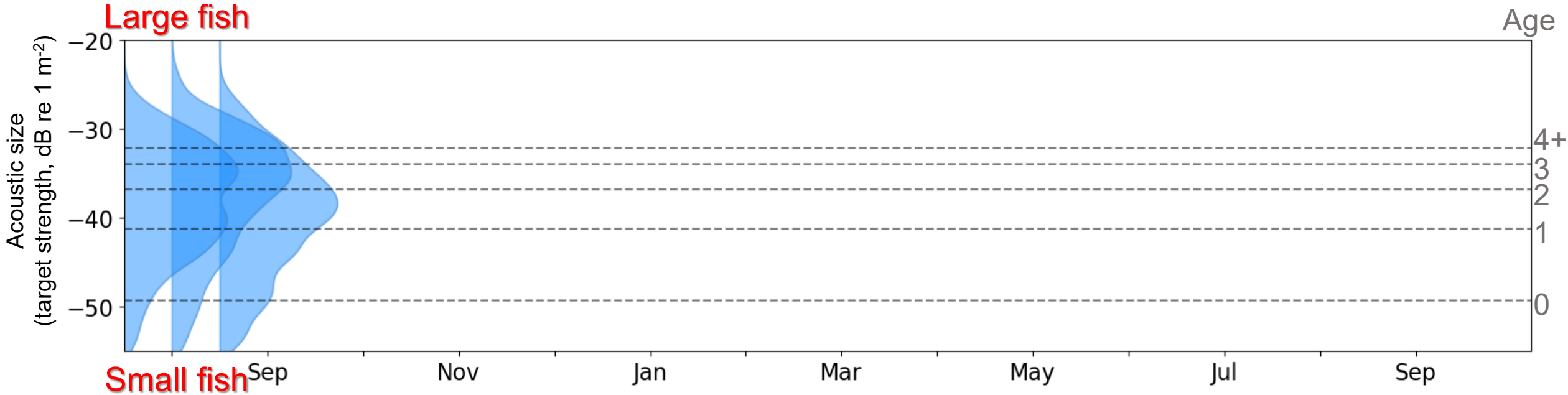

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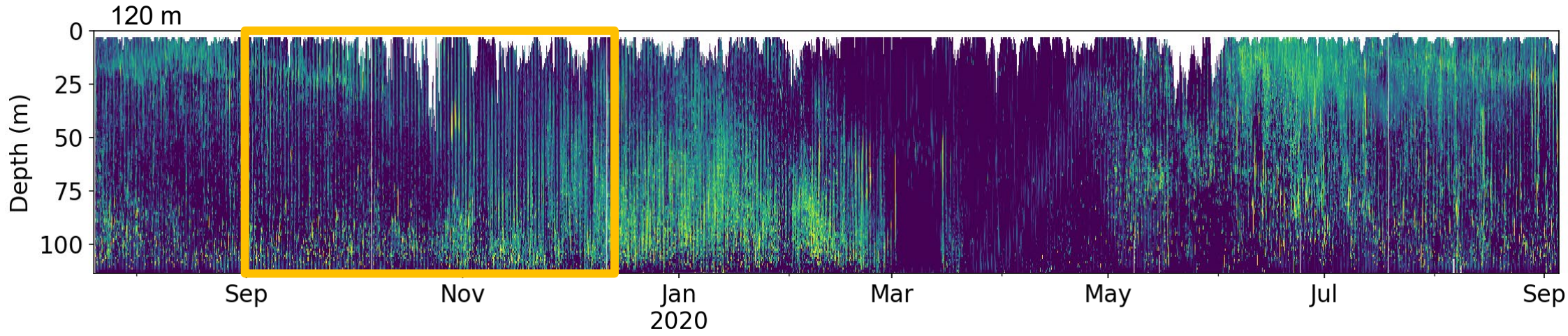

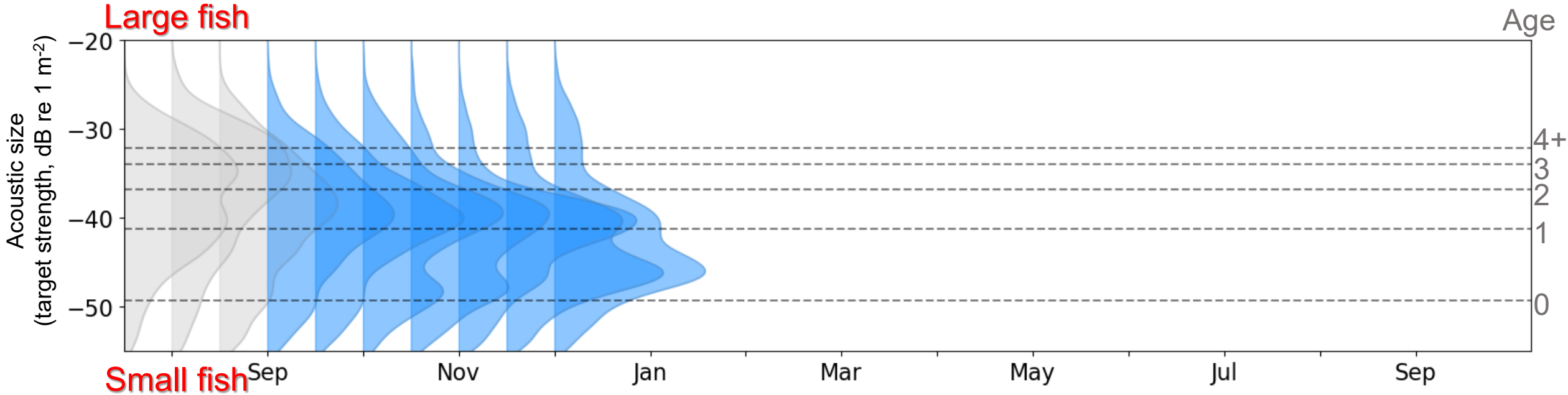

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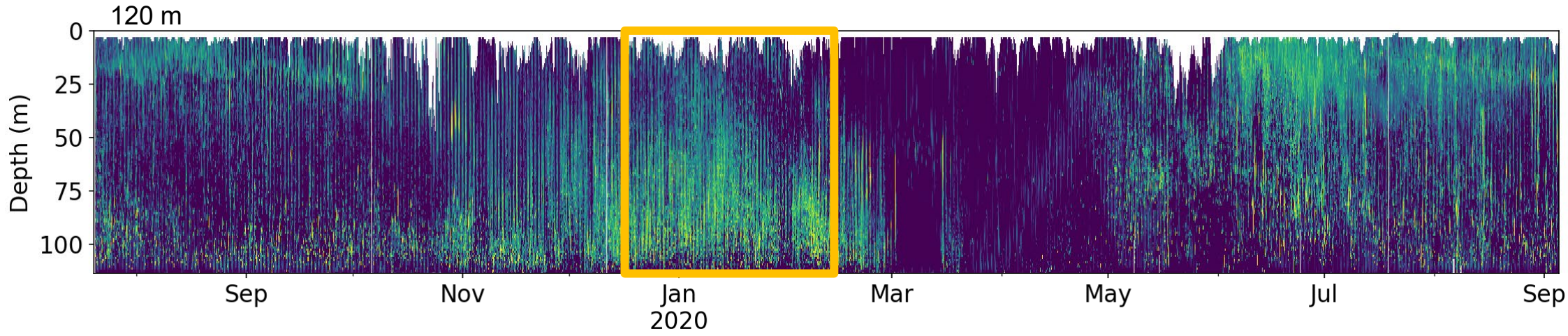

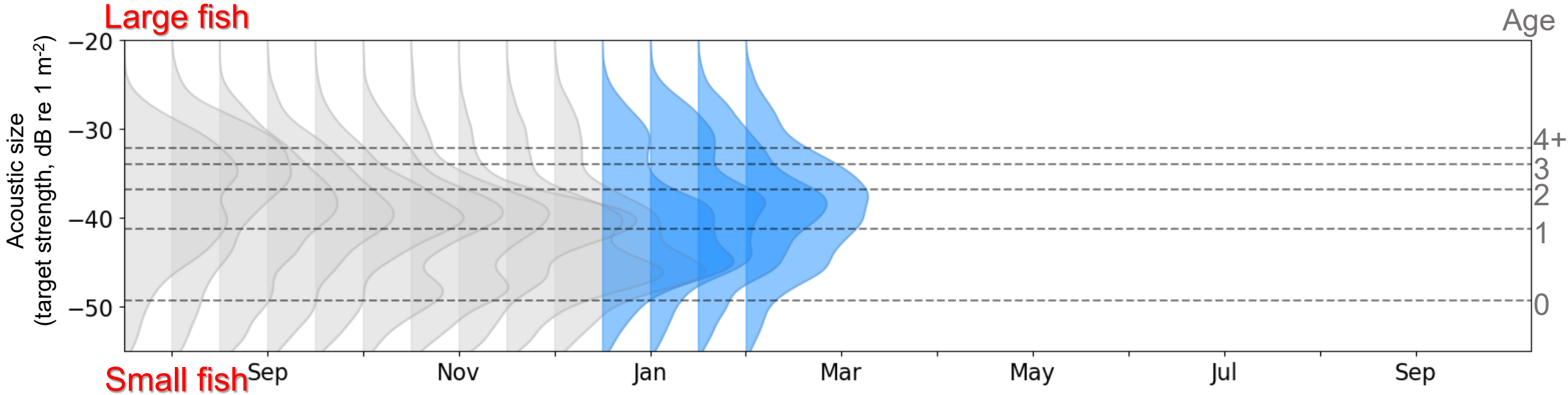

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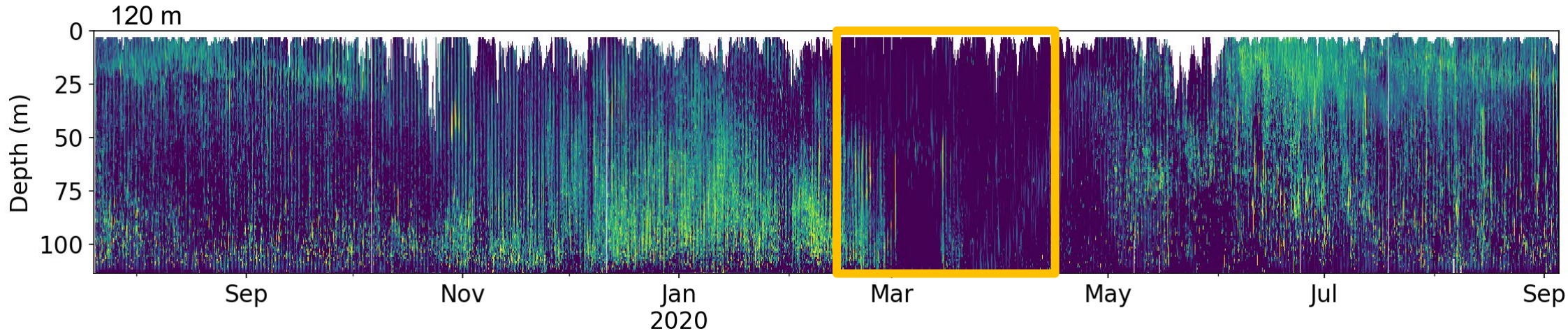

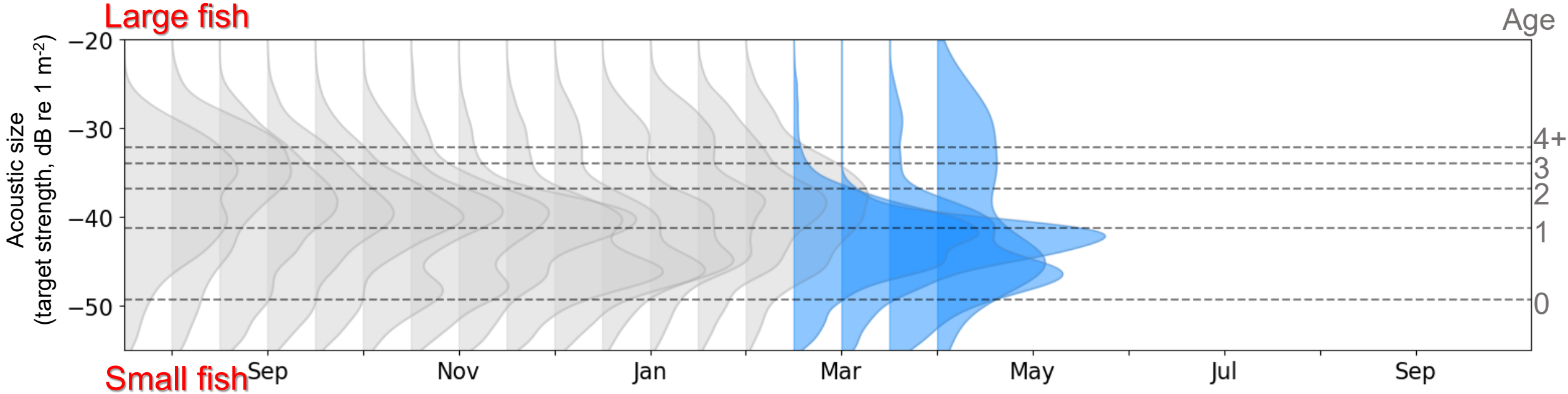

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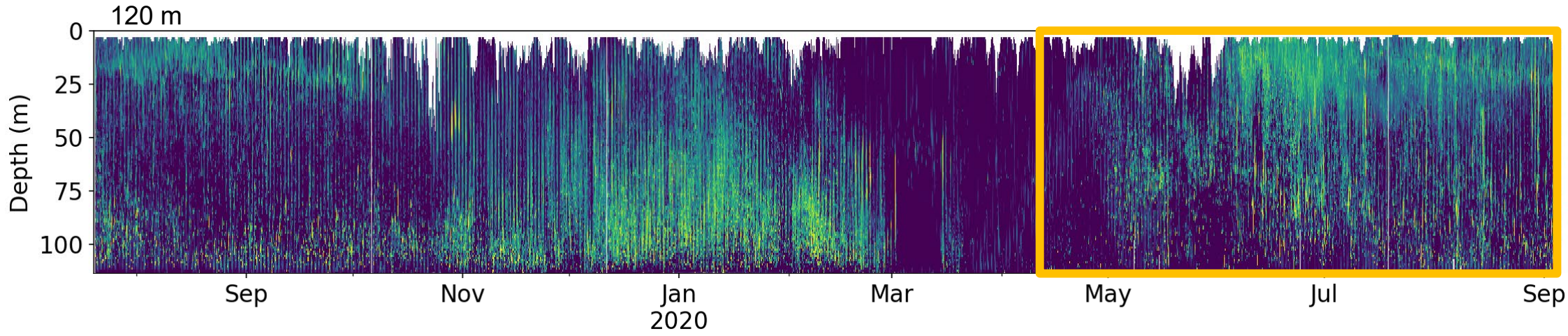
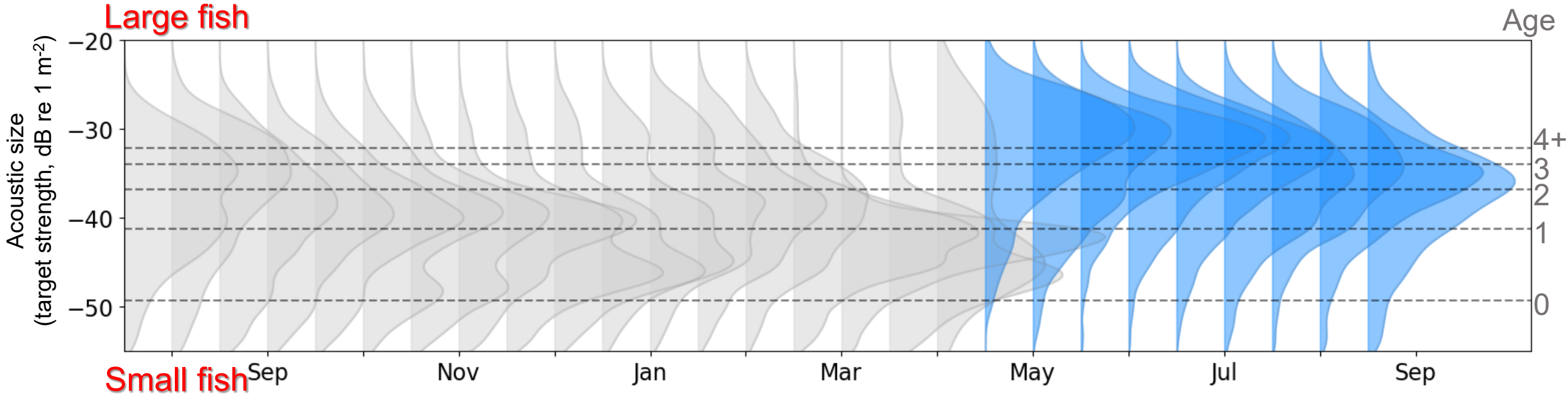
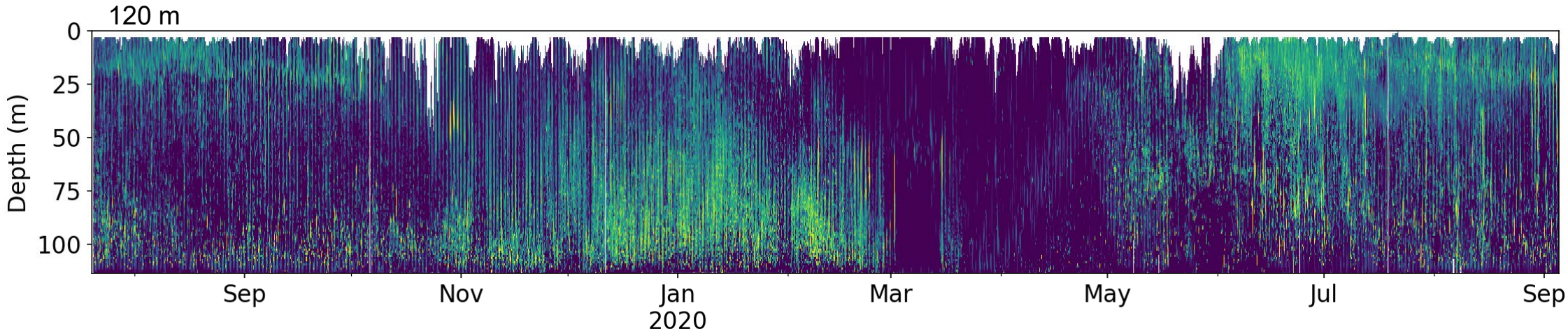
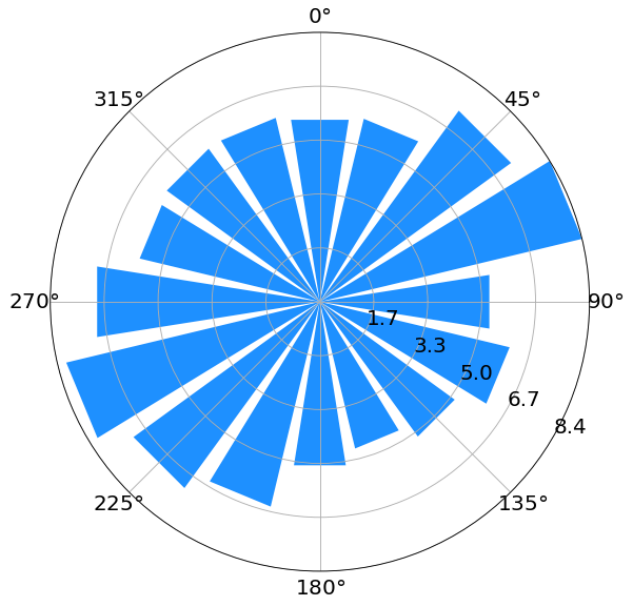
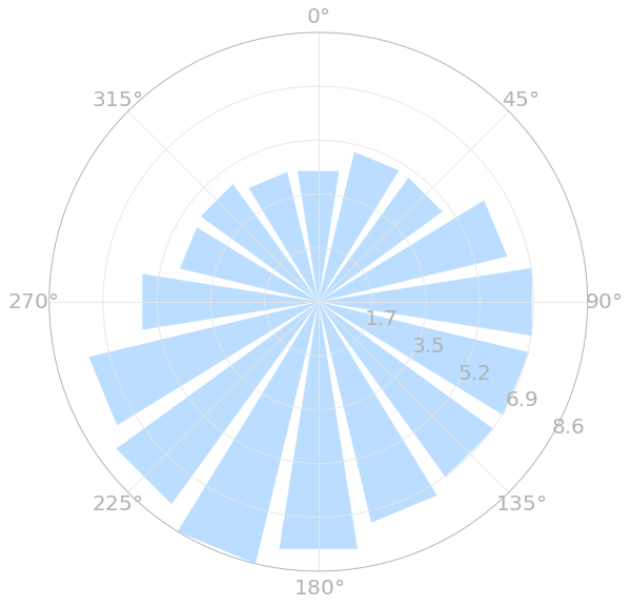


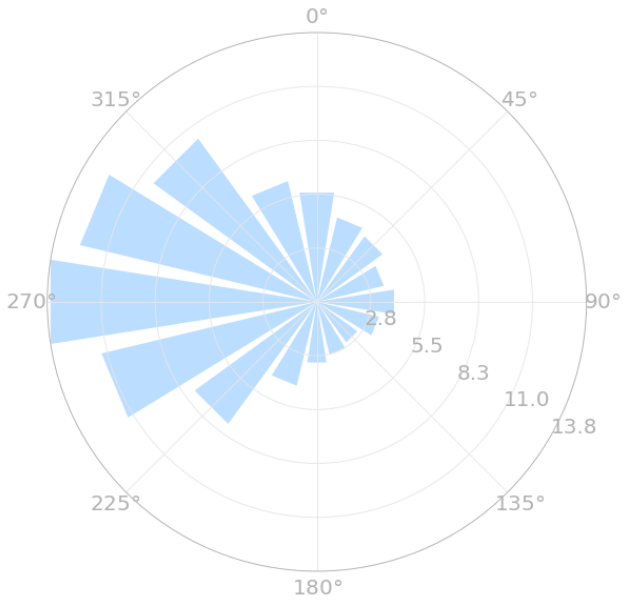


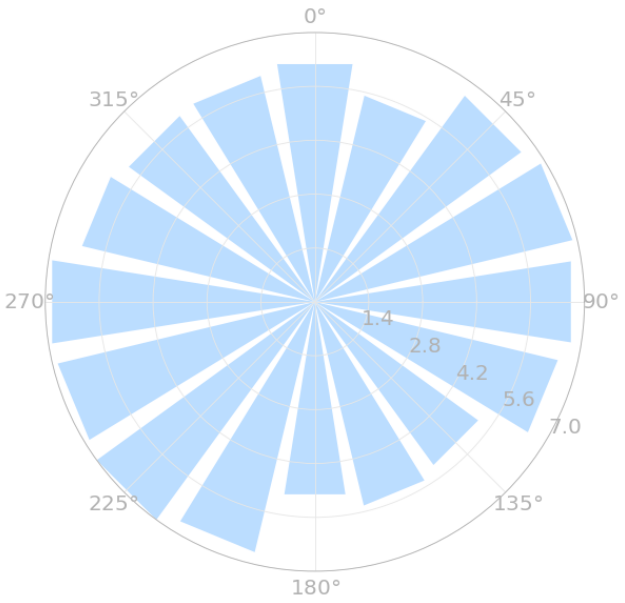
Seasonal patterns in fish movement











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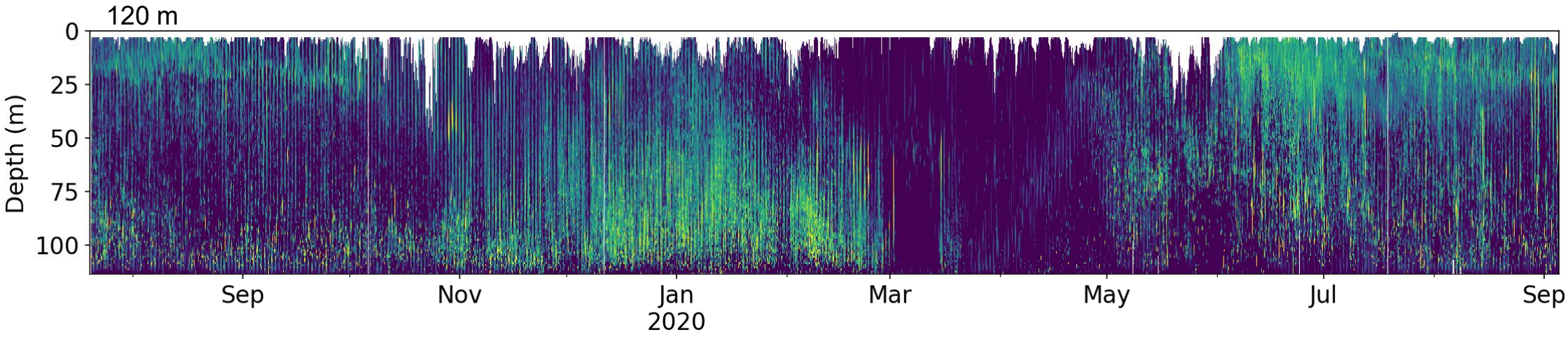

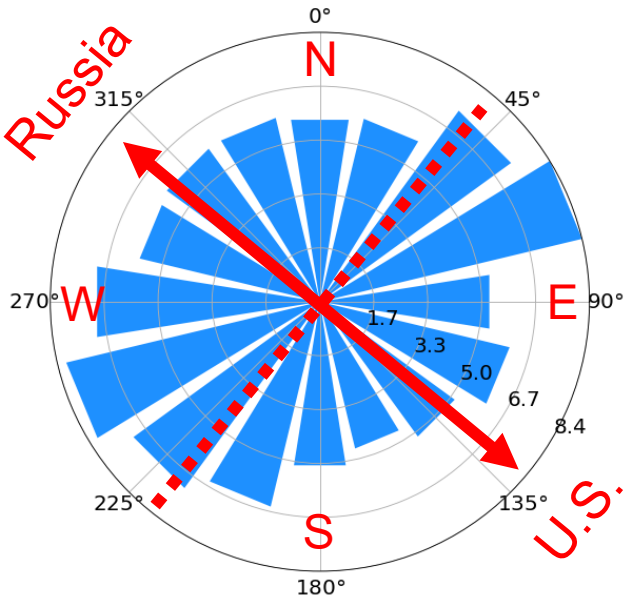

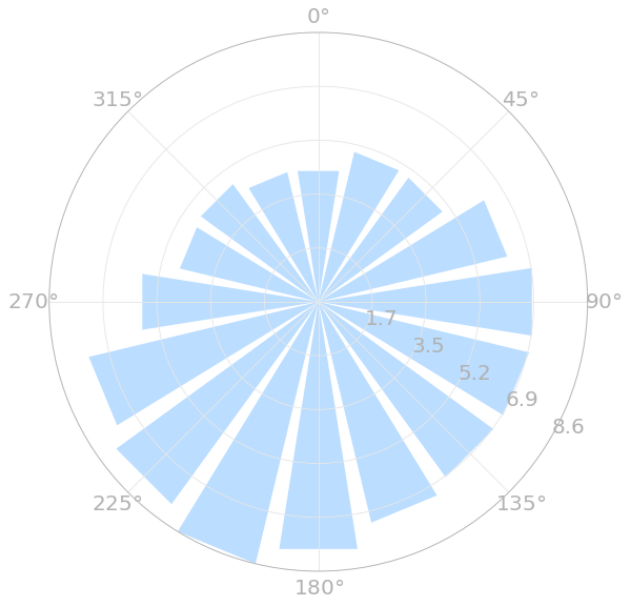

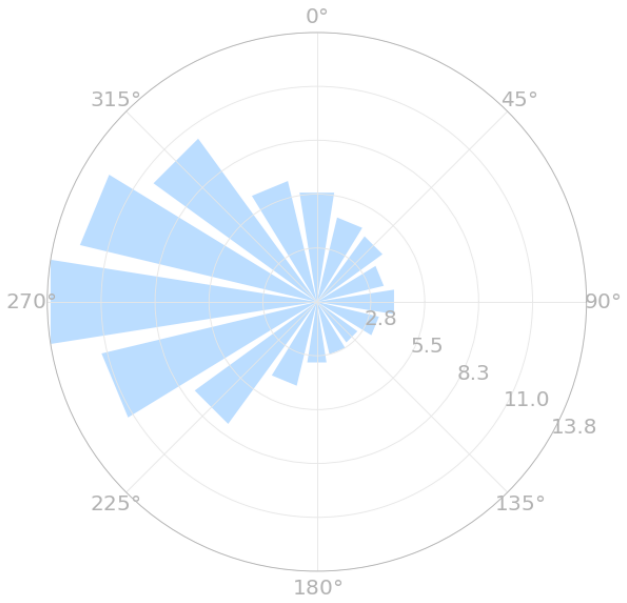

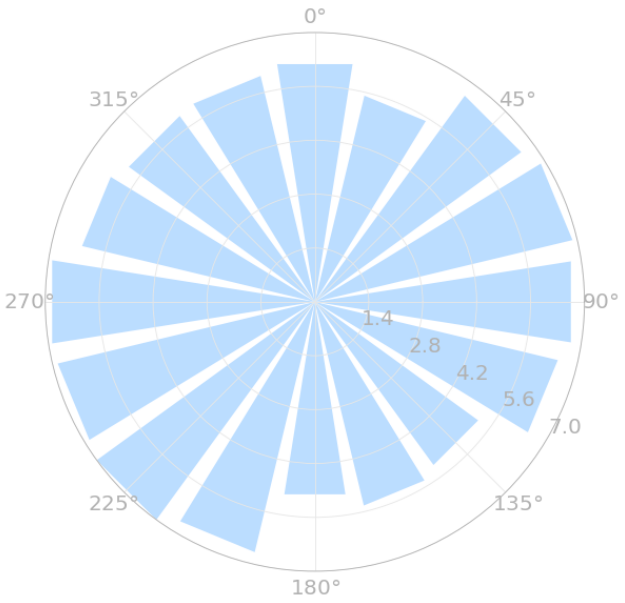

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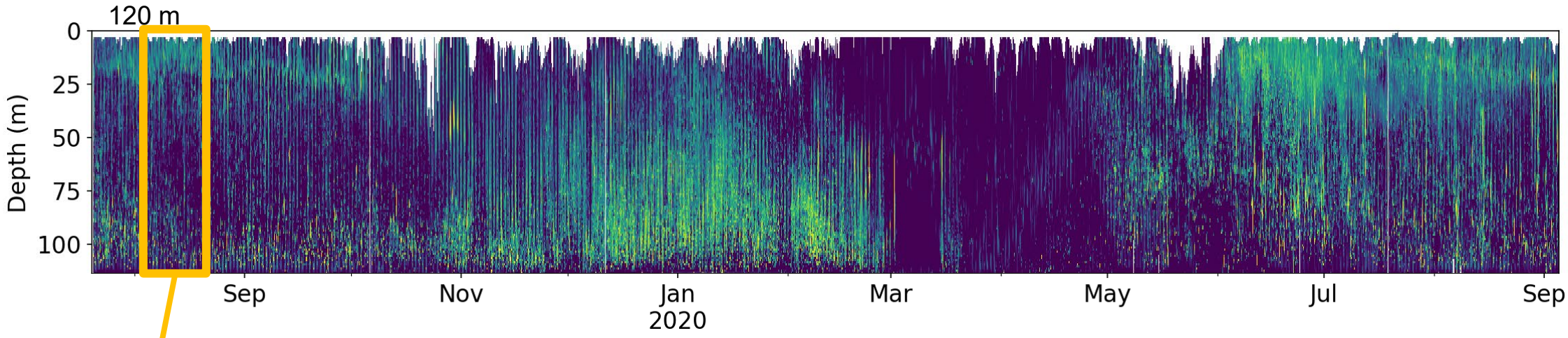

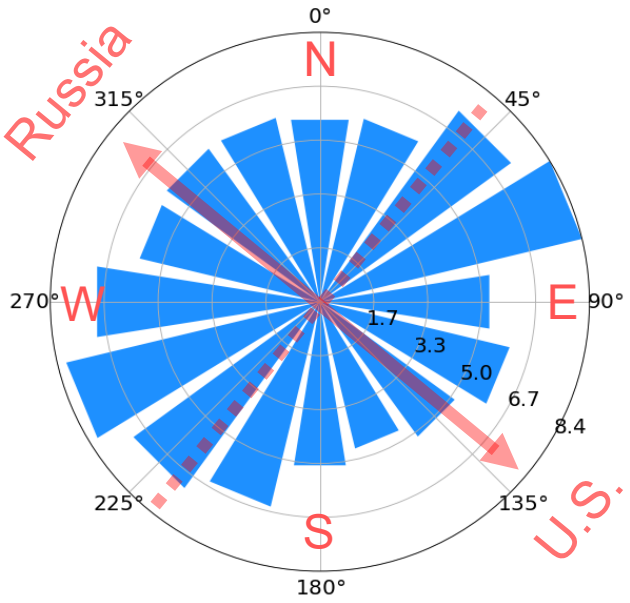

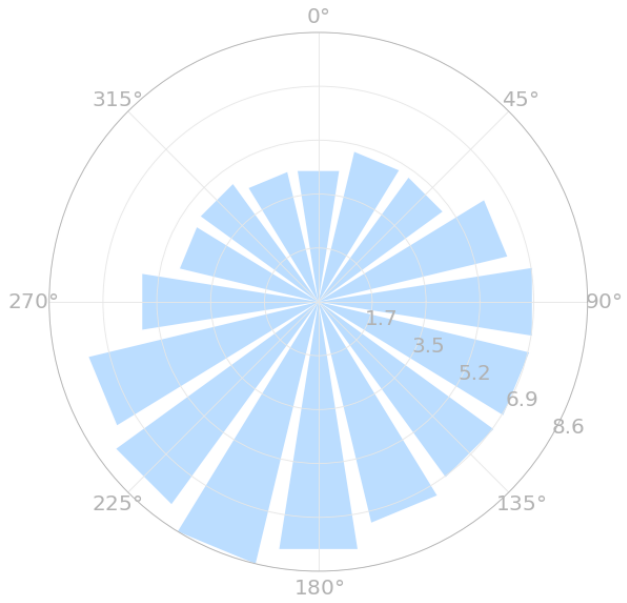

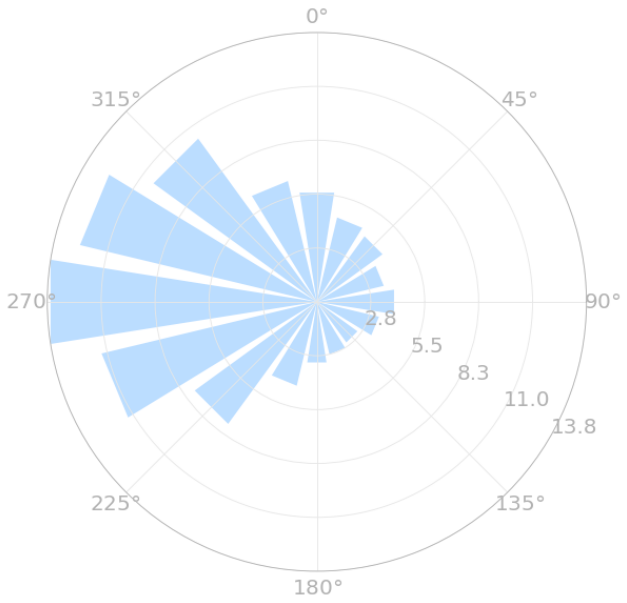

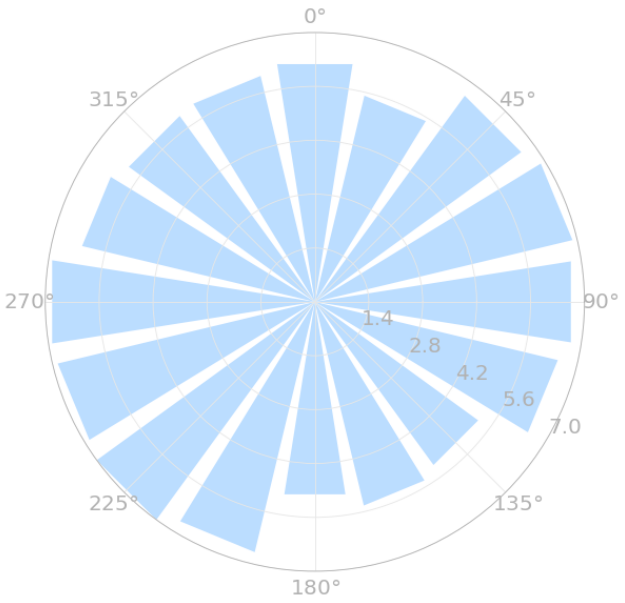

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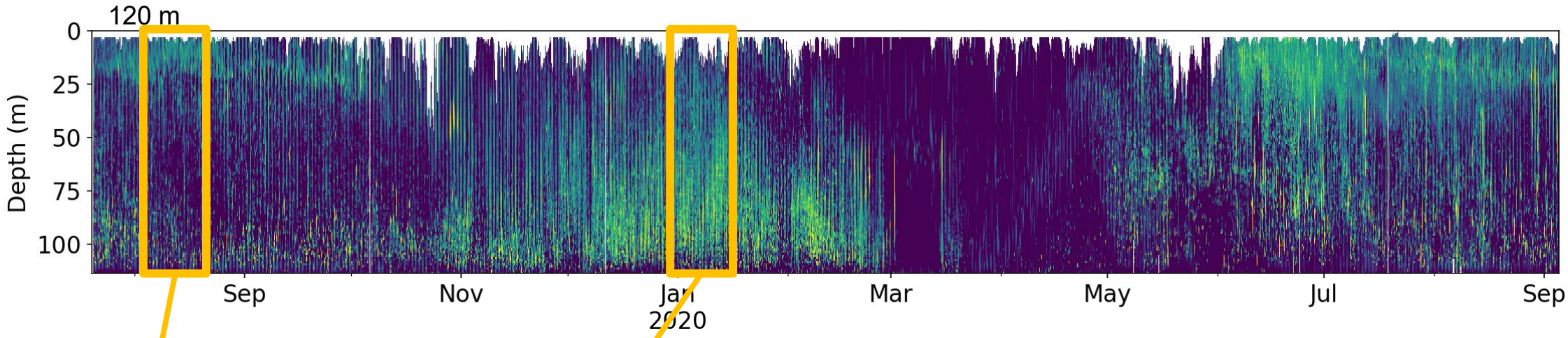

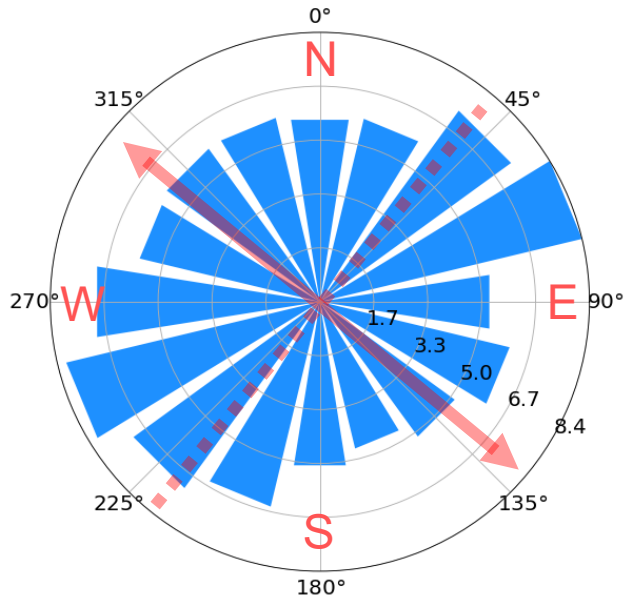

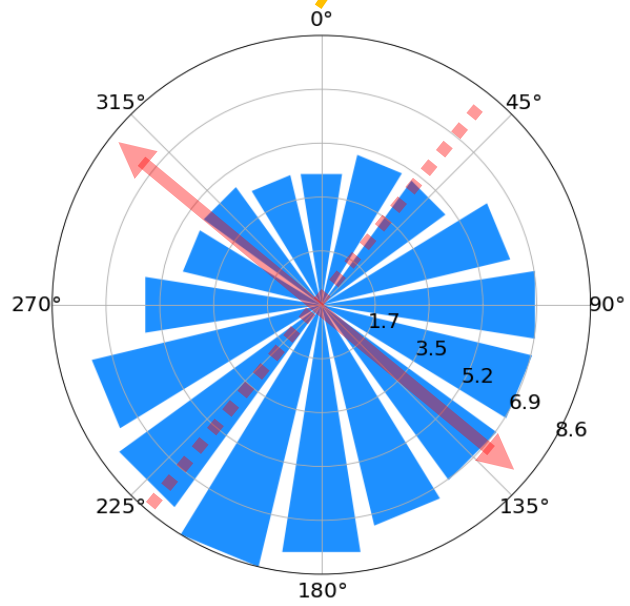

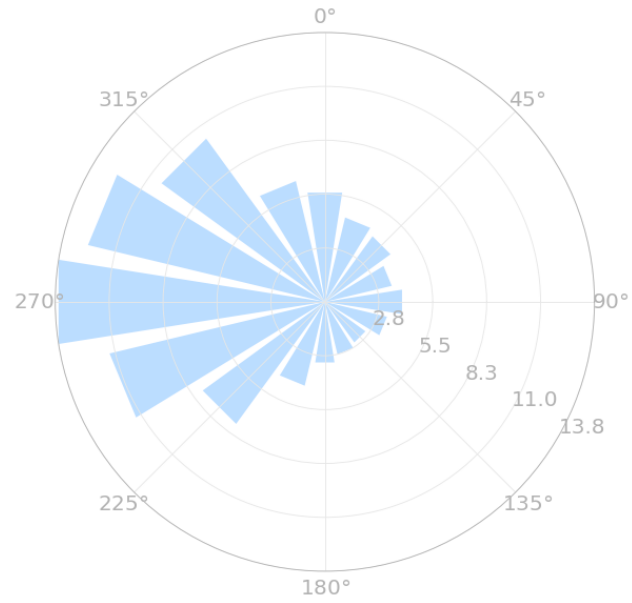

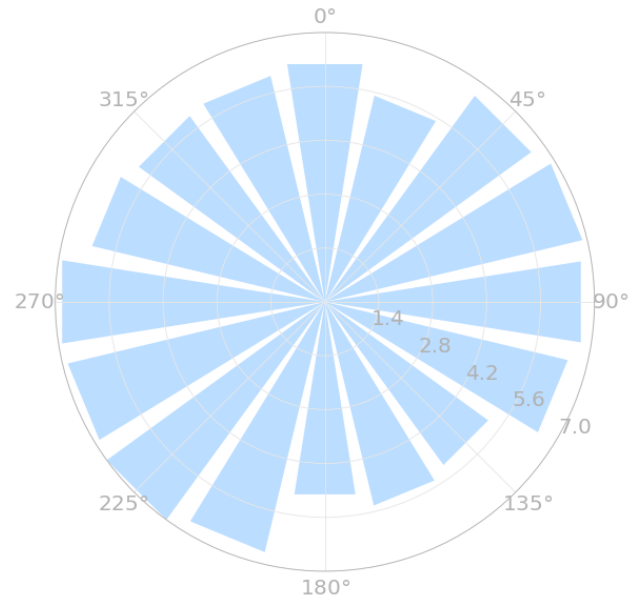

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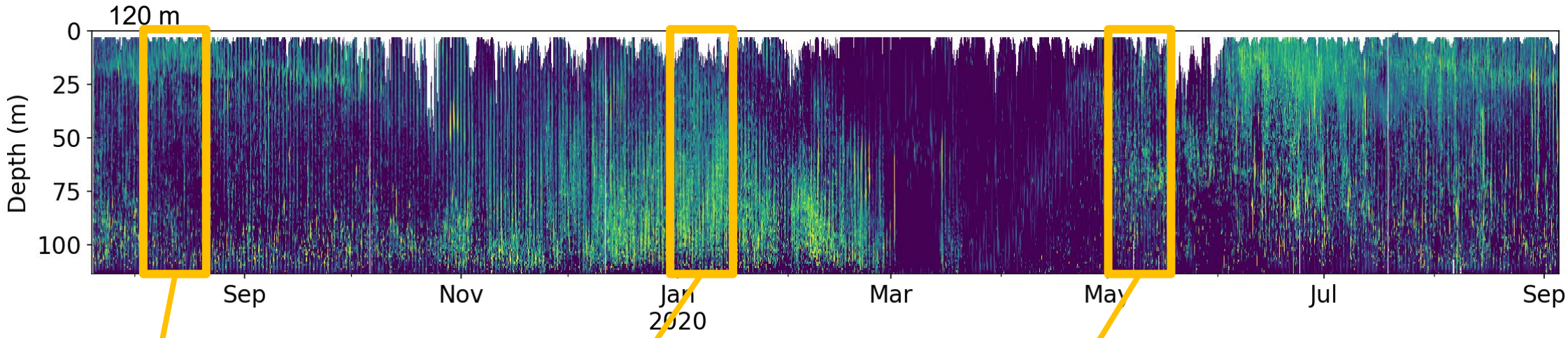

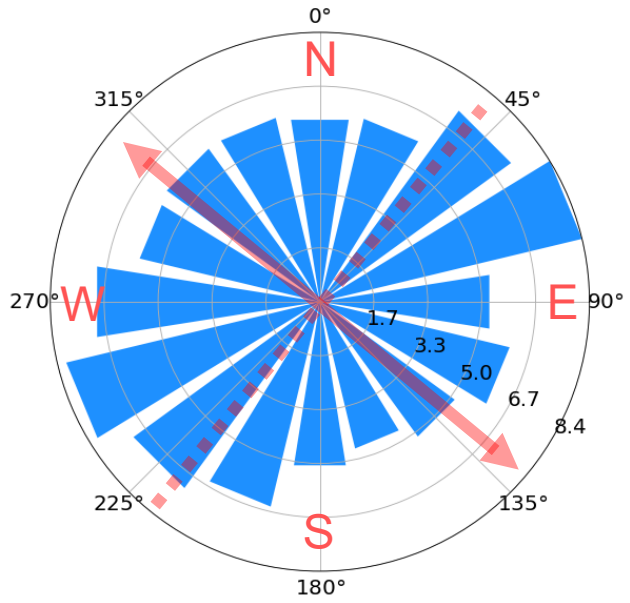

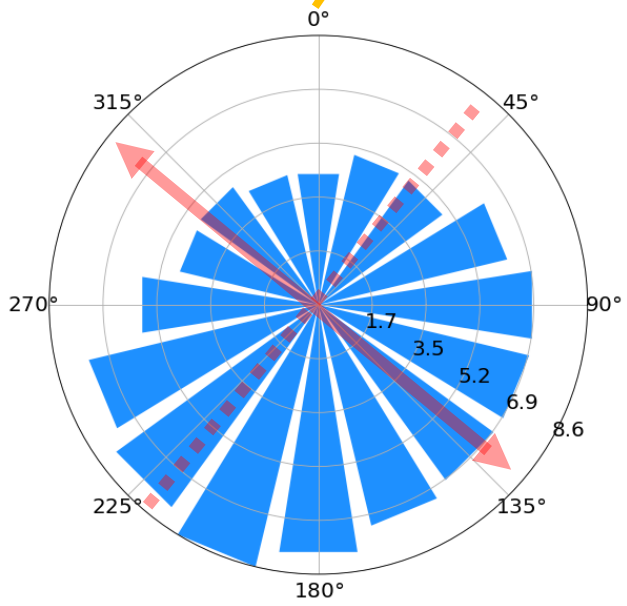

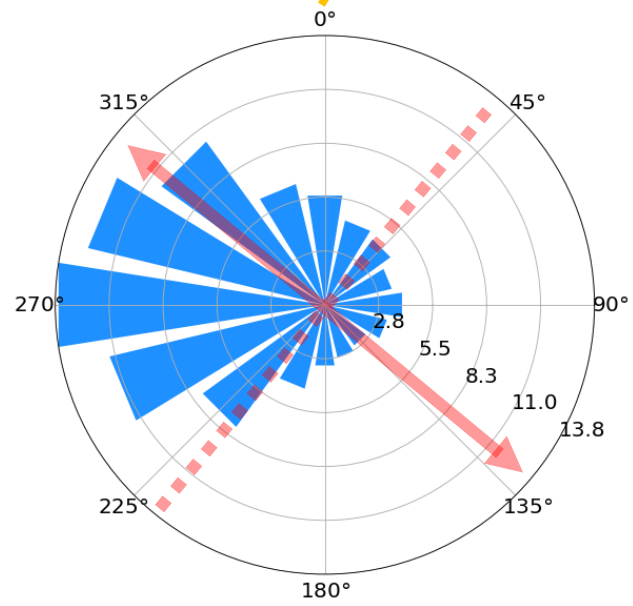

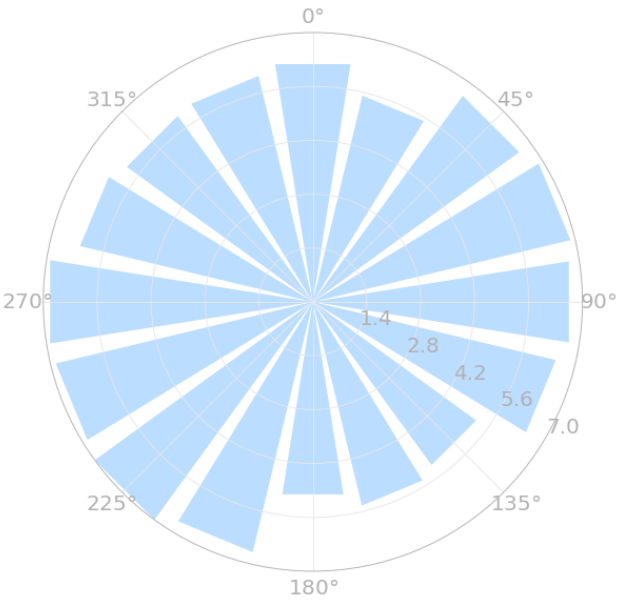

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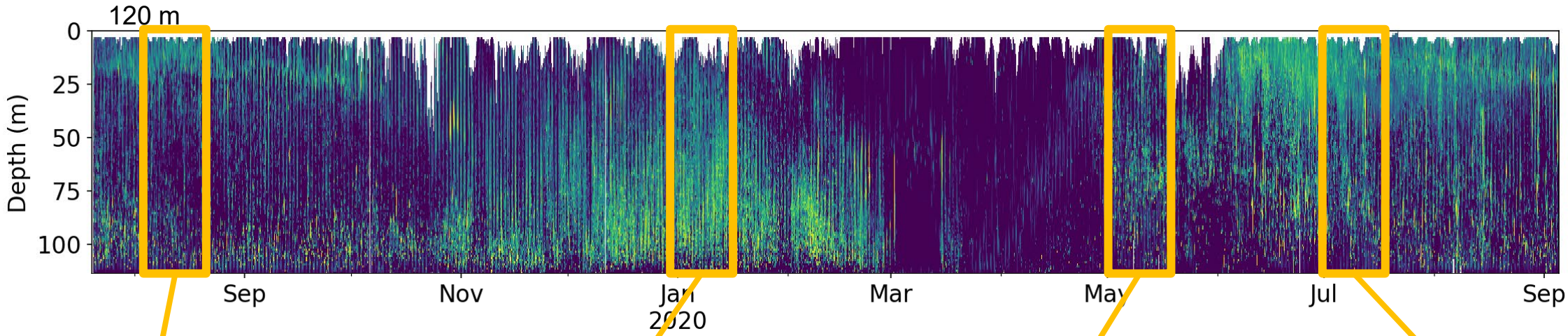
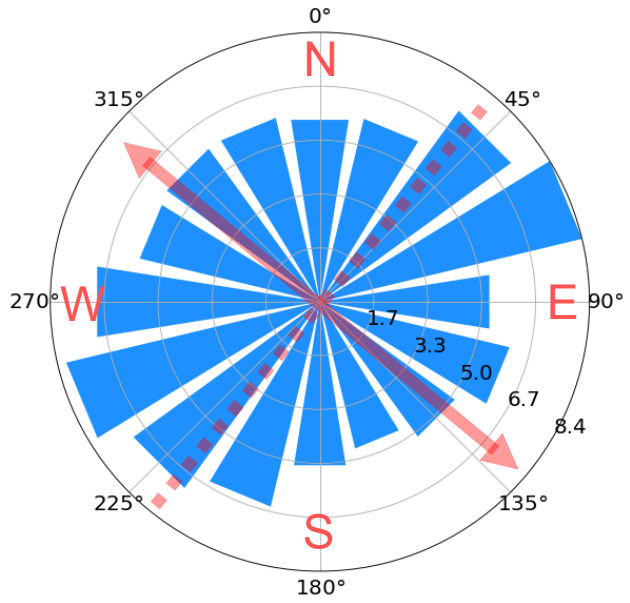
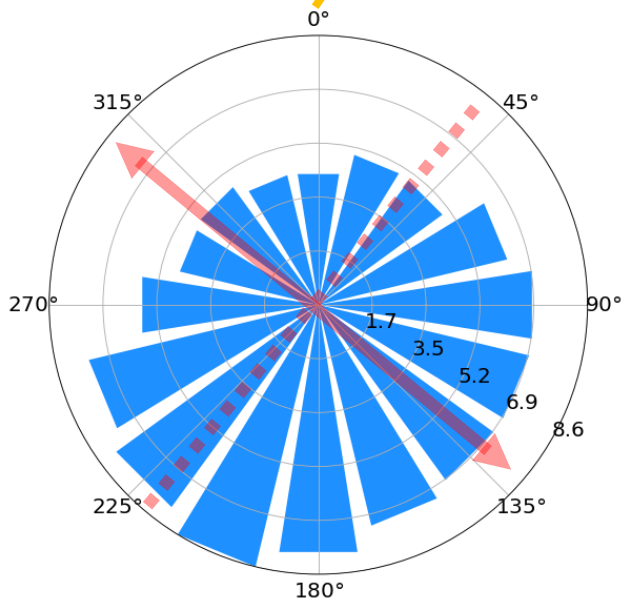
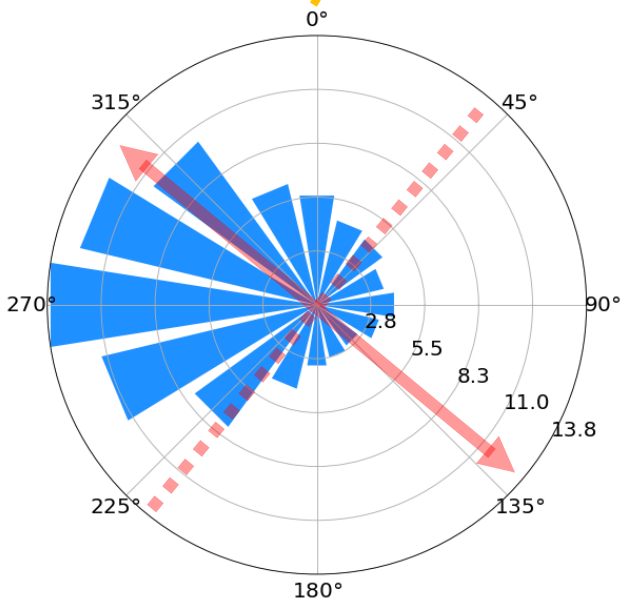
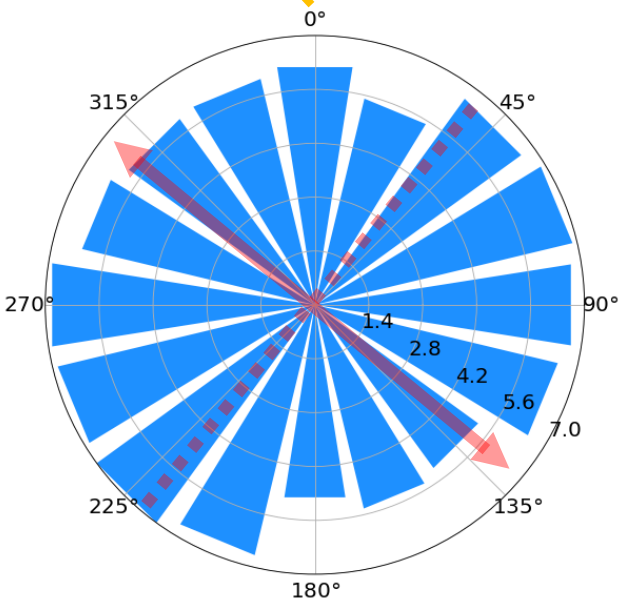






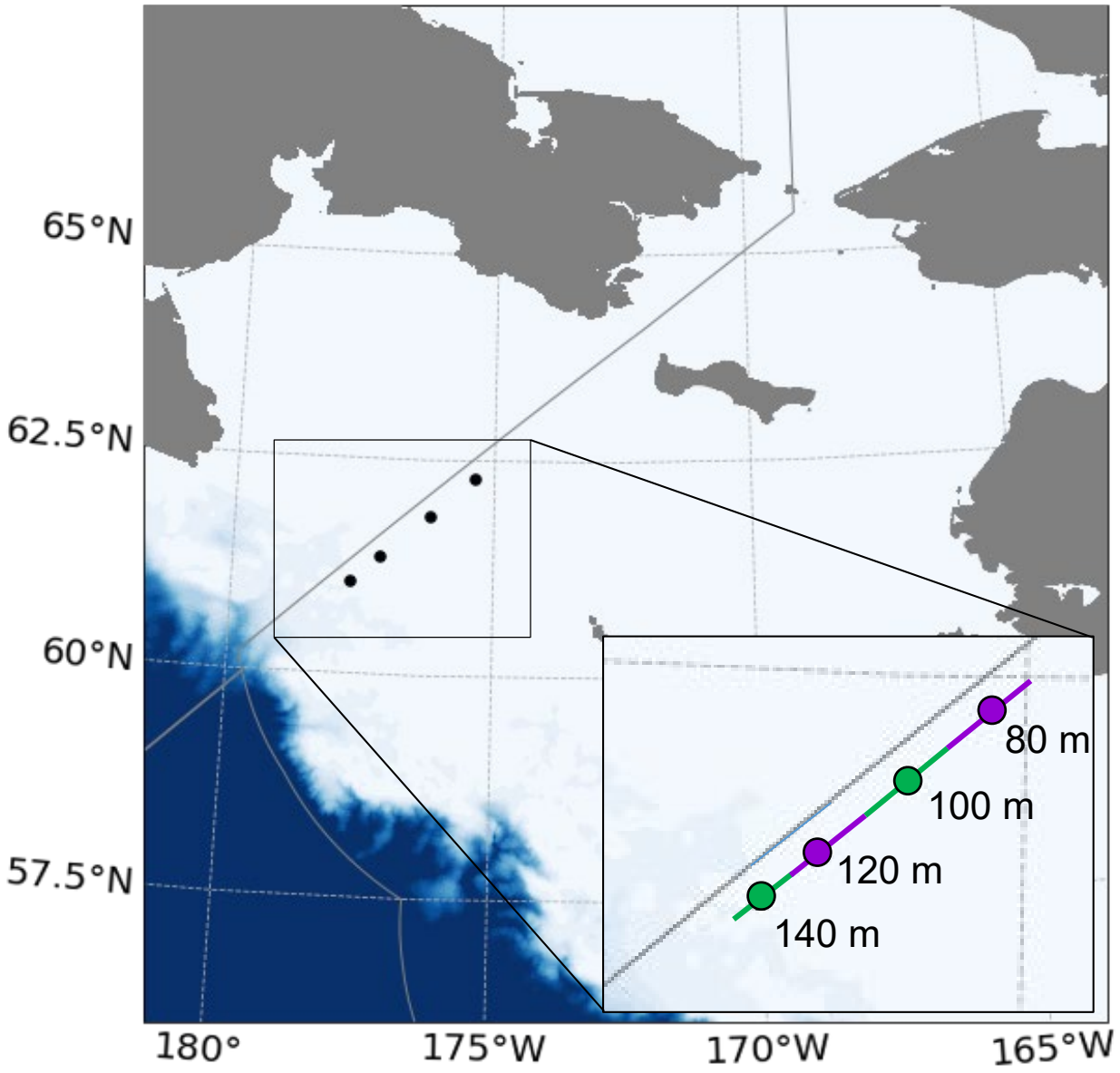




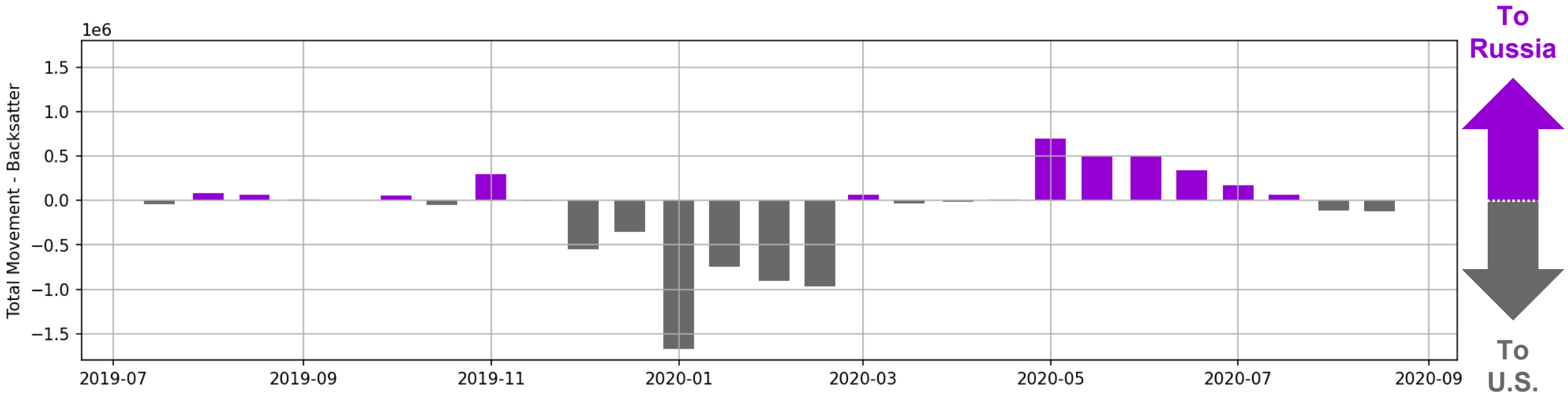
Estimating population movement across the mooring line

Observations from each mooring are extrapolated to estimate total movement across a line

Fish Speed towards Russia
×
Backscatter



Seasonal patterns in population movement



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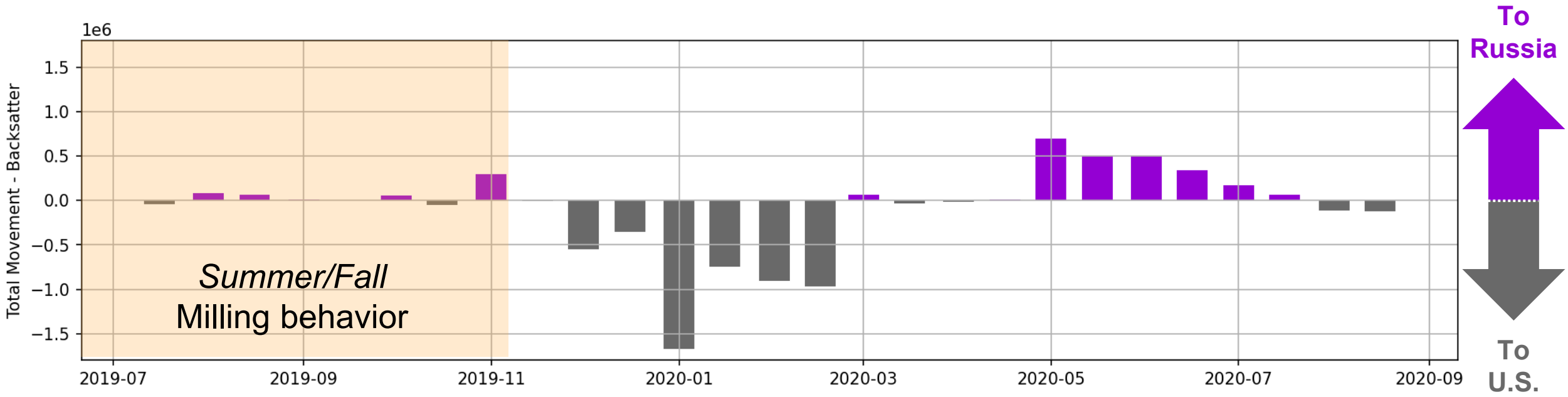
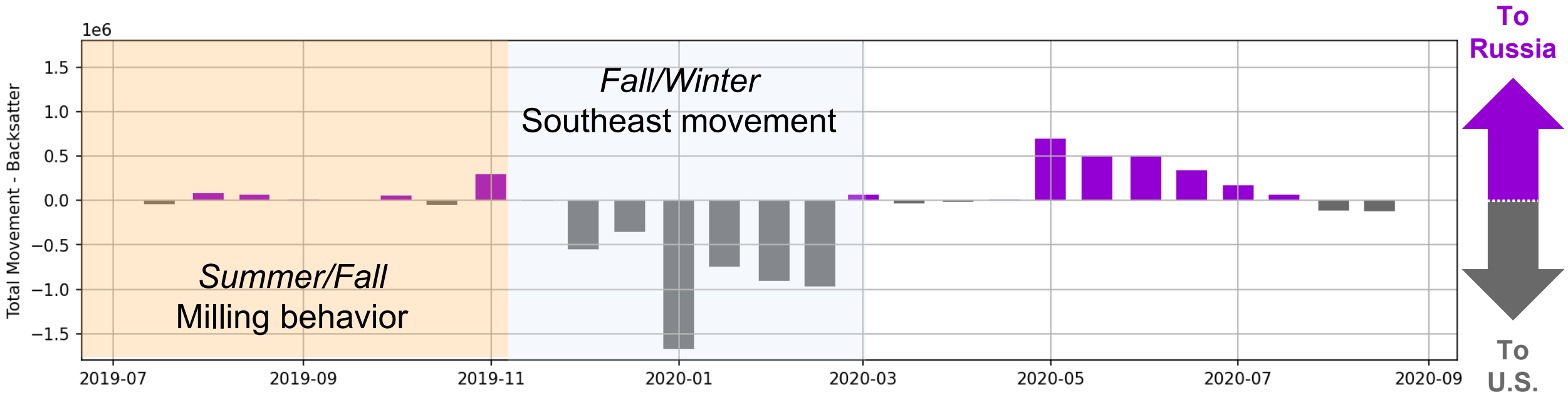


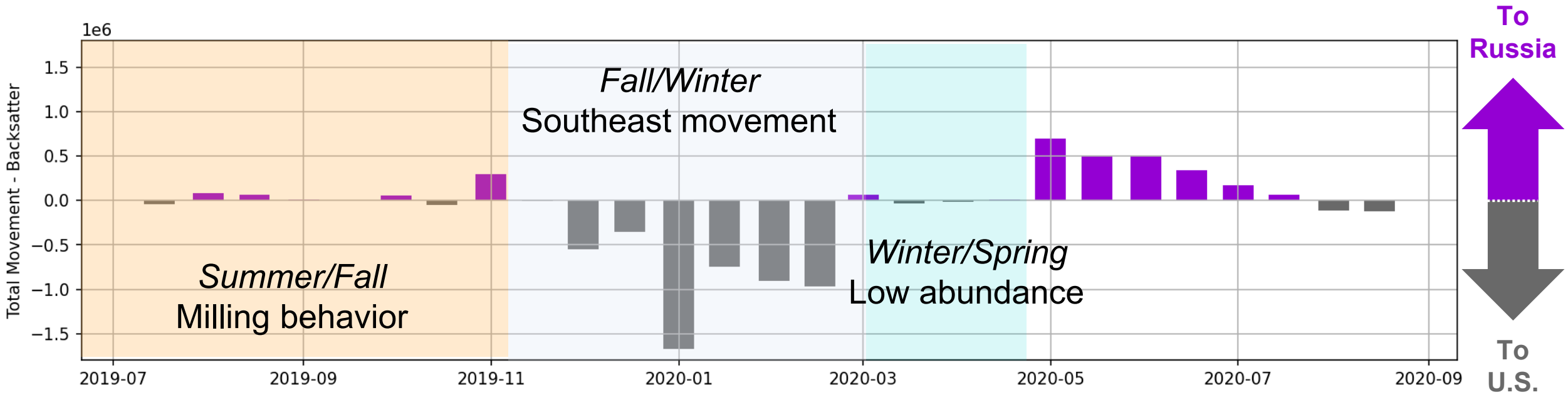
Period	Abundance	Behavior	Movement
Summer/Fall	Medium-High	Low	Low

Seasonal patterns in population movement



Period	Abundance	Behavior	Movement
Summer/Fall	Medium-High	Low	Low
Fall/Winter	High	High – Down slope	High – Into U.S.

Seasonal patterns in population movement



Period	Abundance	Behavior	Movement
Summer/Fall	Medium-High	Low	Low
Fall/Winter	High	High – Down slope	High – Into U.S.
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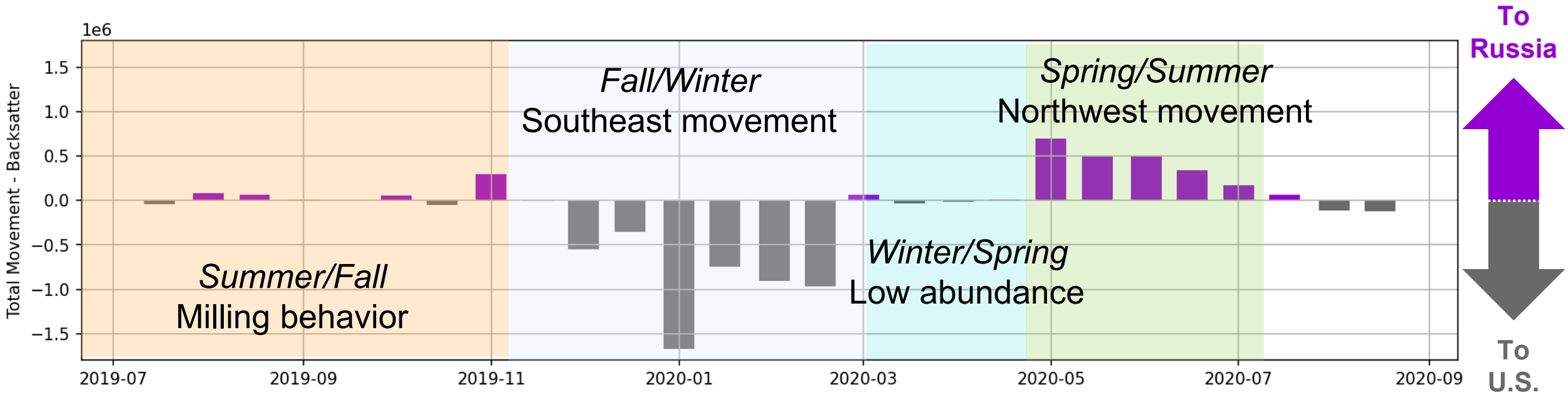
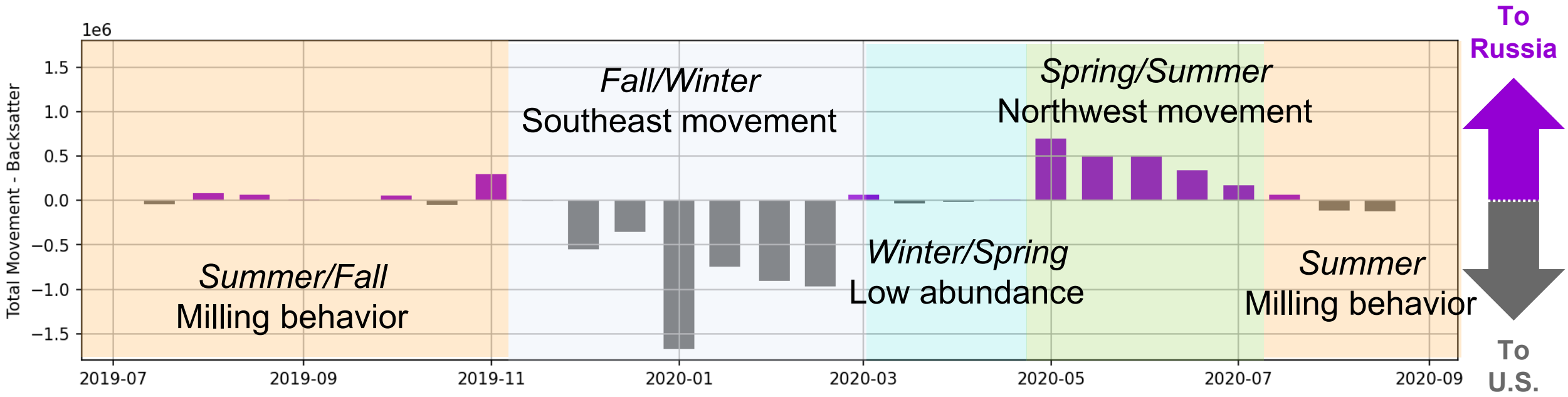
Seasonal patterns in population movement



Period	Abundance	Behavior	Movement
Summer/Fall	Medium-High	Low	Low
Fall/Winter	High	High – Down slope	High – Into U.S.
Winter/Spring	Low	Low	Low
Spring/Summer	Medium-High	High - West	High – Into Russia

Seasonal patterns in population movement



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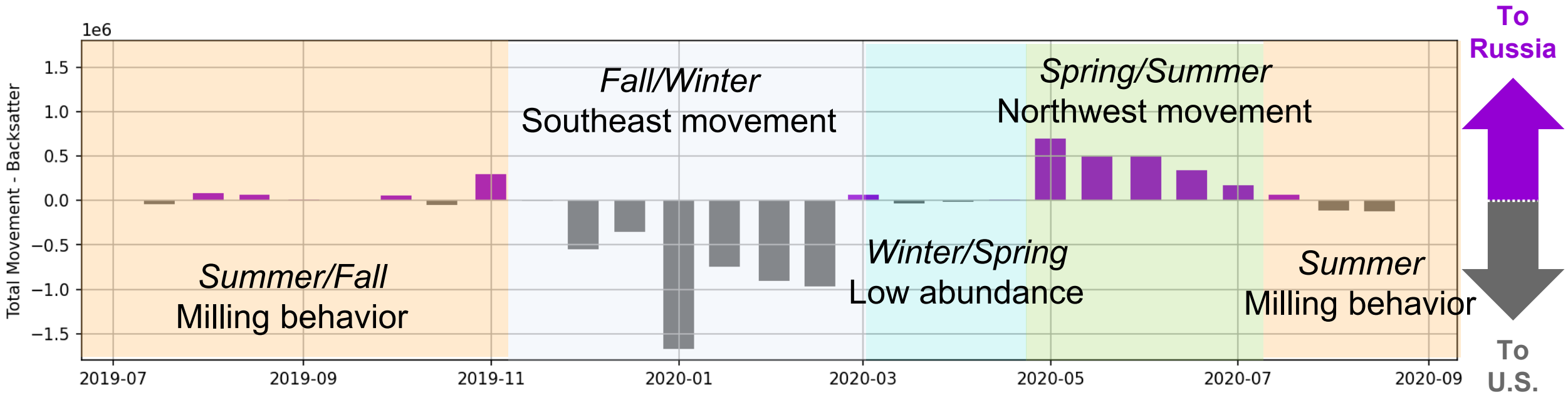
Seasonal patterns in population movement



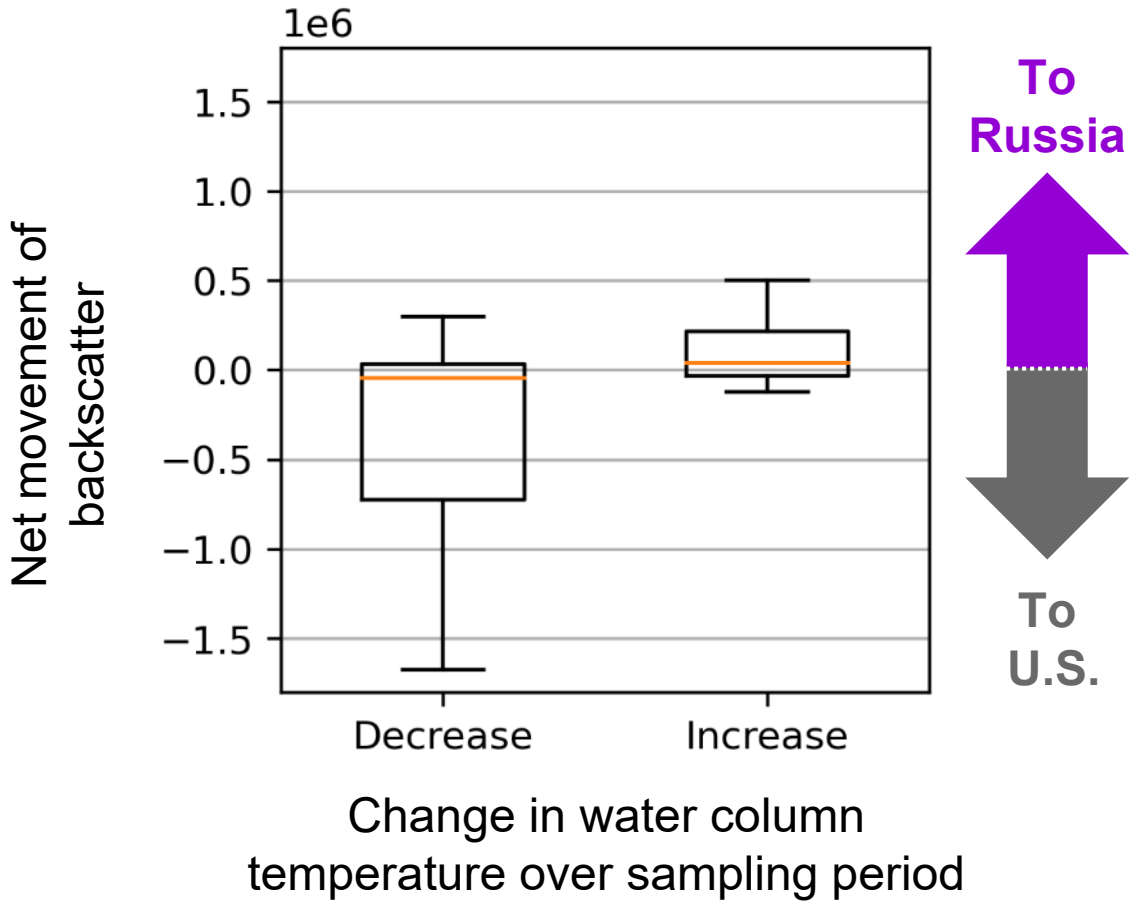
Current analysis indicates that more backscatter moved into the U.S. in fall/winter than moved into Russia in spring/summer during the 2019-2020 deployment period

Fish movement may be linked to changes in water temperature

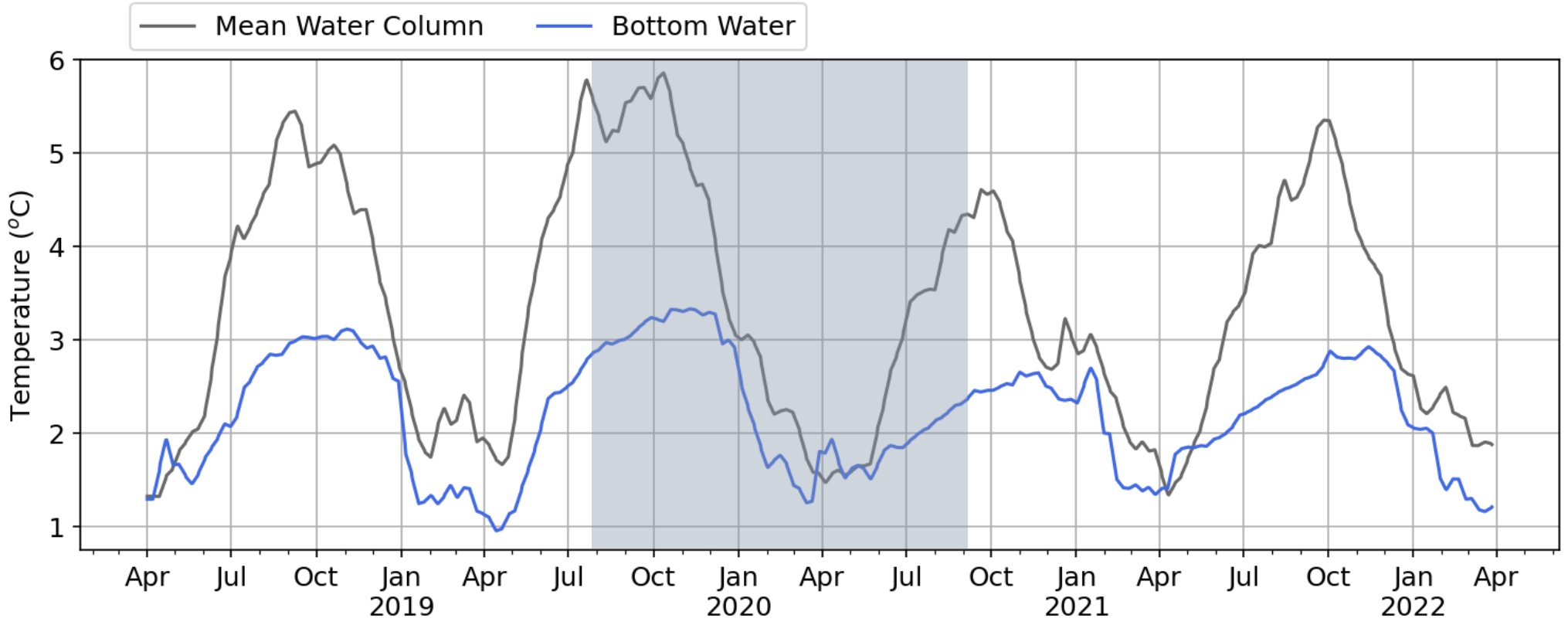
Fish movement into the U.S. was associated with cooling

The net difference in movement during the deployment may be driven by the shift in population due to annual temperature differences

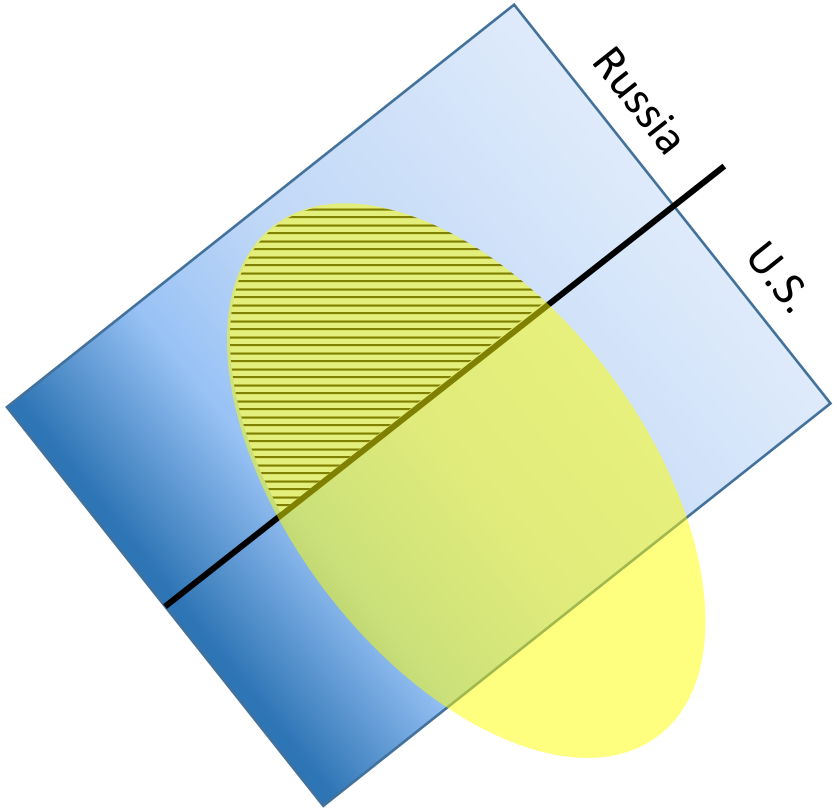
This may be linked with the associated changes in ice, salinity, and light



Fish movement may be linked to changes in water temperature

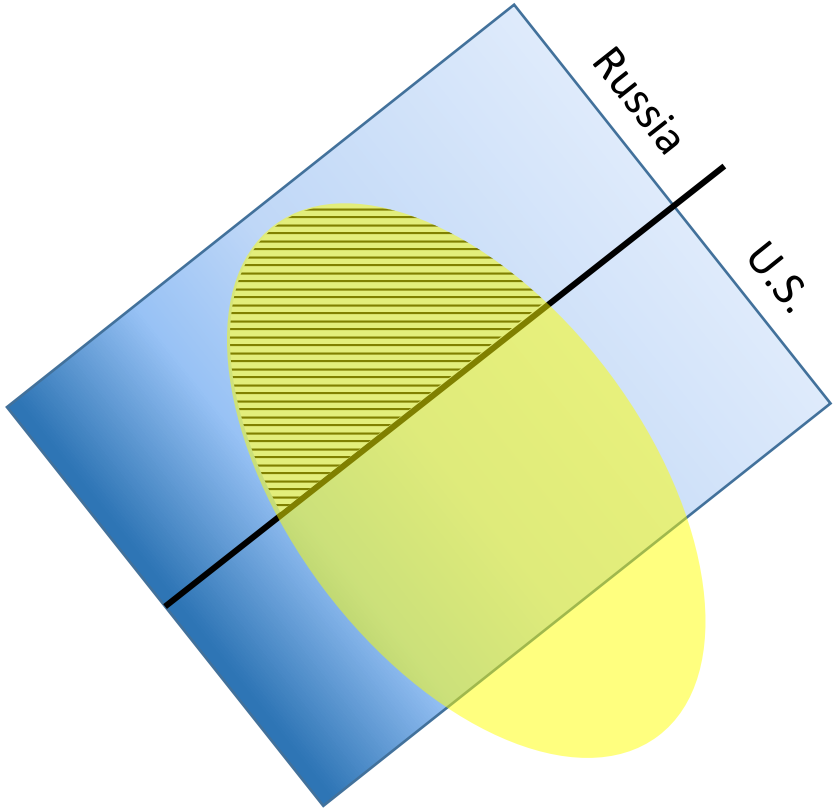


Summer 2019



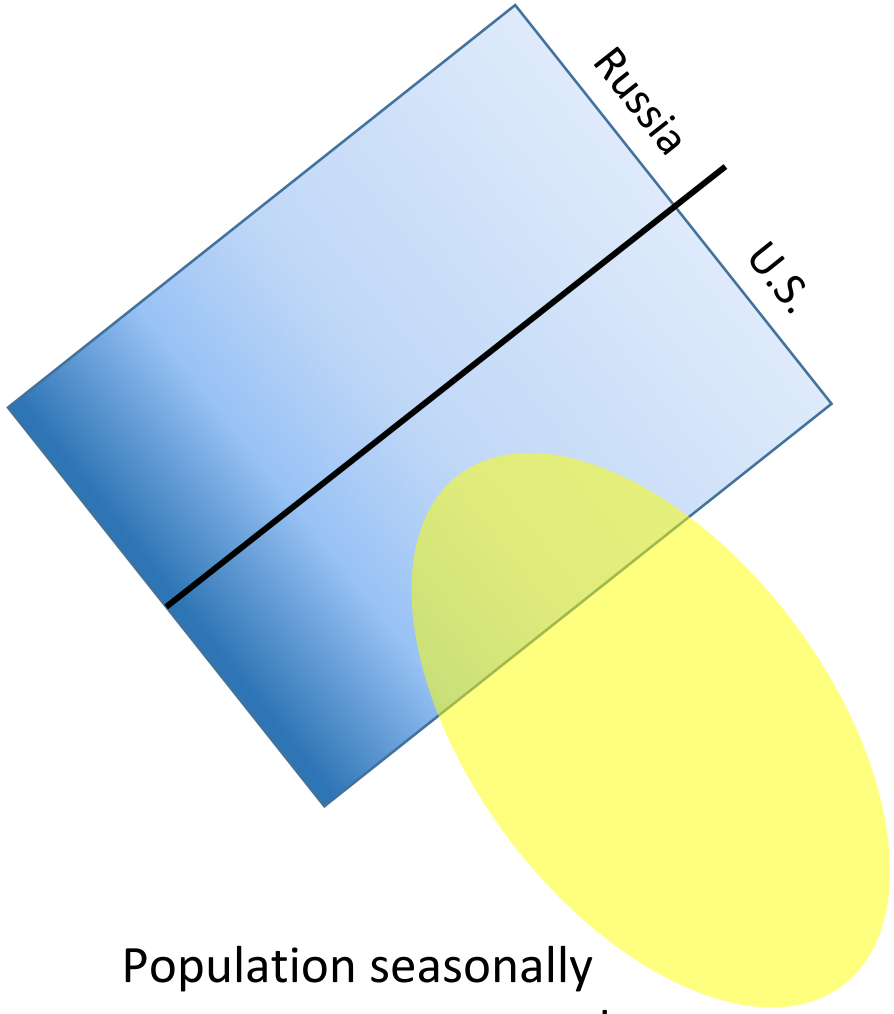
Historically warm conditions in the northwestern Bering Sea

Summer 2019



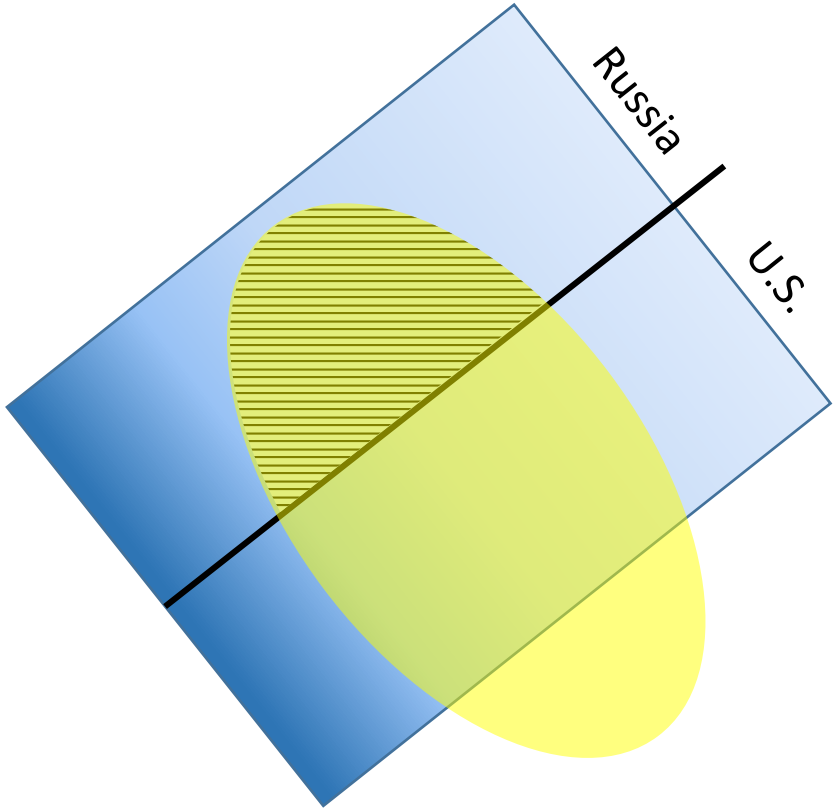
Historically warm conditions in the northwestern Bering Sea

Winter 2019/2020



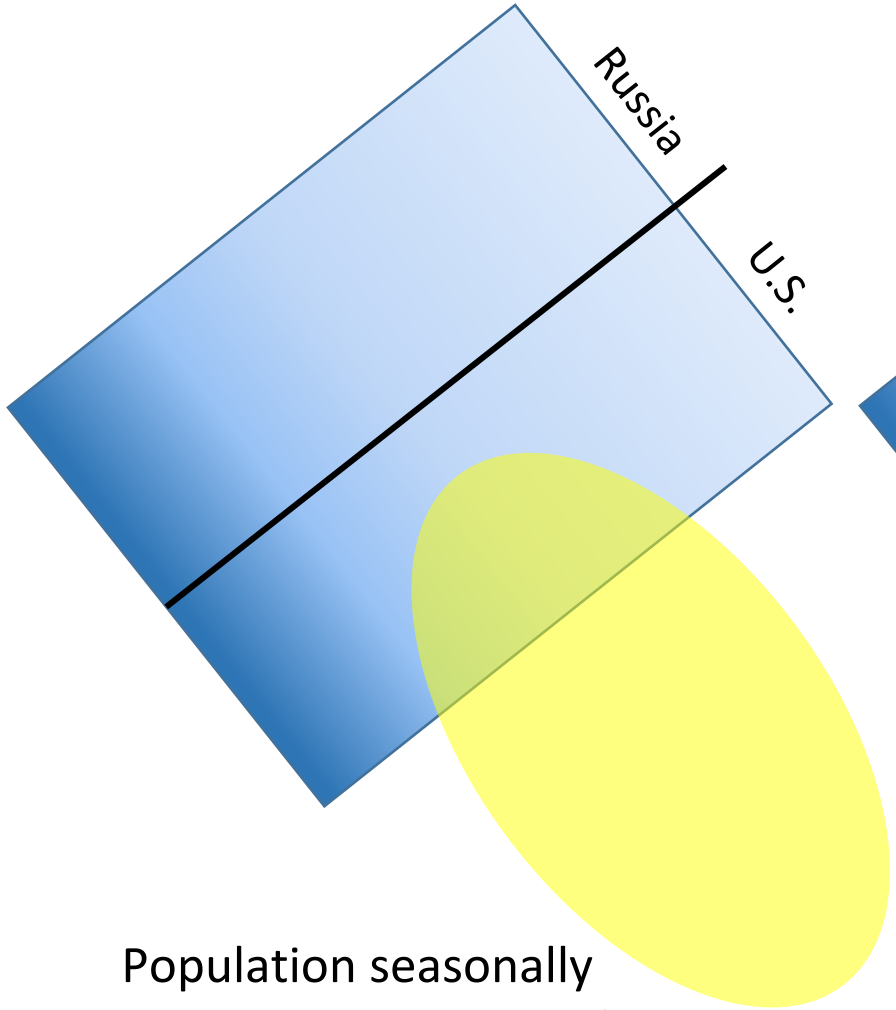
Population seasonally retreats to warmer and deeper water in winter

Summer 2019



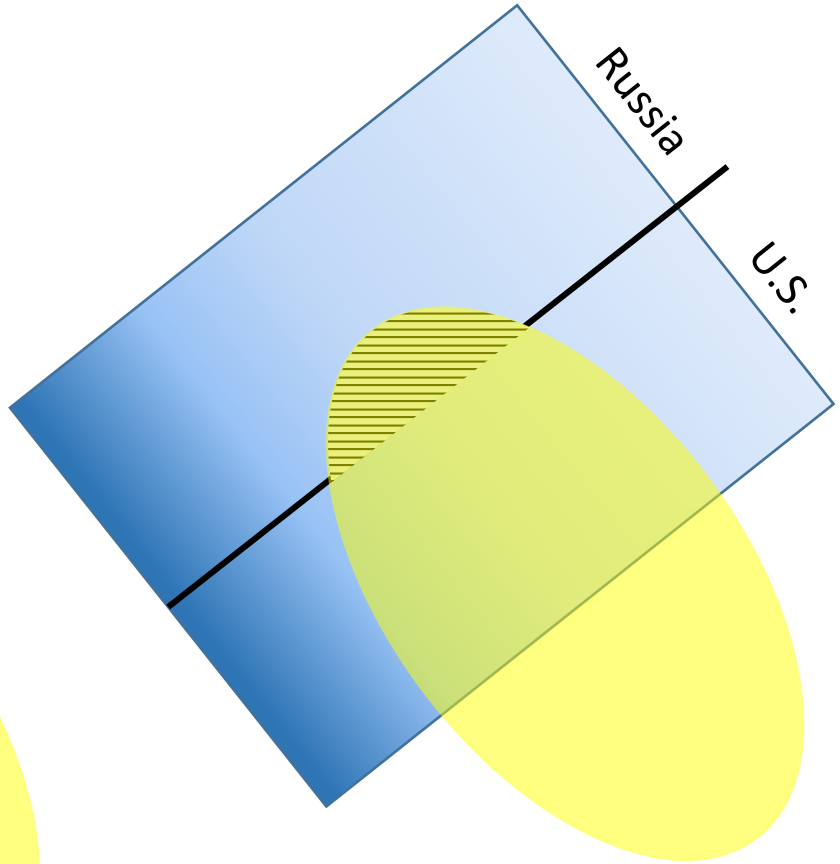
Historically warm conditions in the northwestern Bering Sea

Winter 2019/2020



Population seasonally retreats to warmer and deeper water in winter

Summer 2020



The northwestern Bering Sea was cooler than the previous year and a greater portion of the population stayed in U.S. waters

Conclusions

From a methods perspective…

- Using observations of tracks and backscatter, we were able to estimate movement of fish across a line

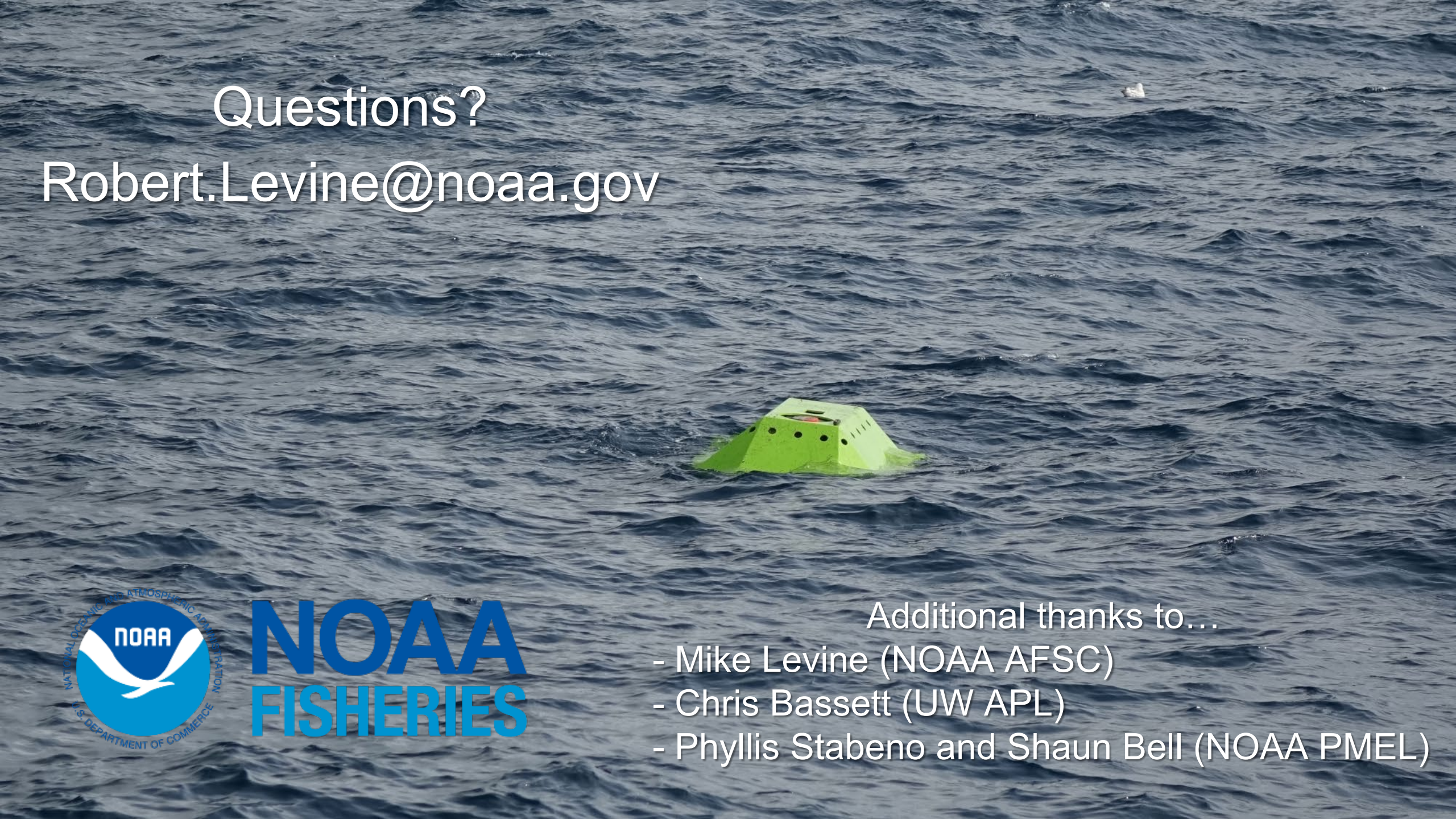
Conclusions

From a methods perspective…

- Using observations of tracks and backscatter, we were able to estimate movement of fish across a line

Pollock migration across the border is significant…

- We saw seasonal patterns in abundance that were consistent across all four moorings, with peak abundance in winter
- Pollock moved southeast towards the U.S. in winter and northwest towards Russia in late-spring/early-summer, likely driven by seasonal cooling/warming



Questions?

Robert.Levine@noaa.gov

NOAA FISHERIES

Additional thanks to…
- Mike Levine (NOAA AFSC)
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- Phyllis Stabeno and Shaun Bell (NOAA PMEL)