



Fisheries and Oceans
Canada

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Credit: Kristen Daniel, ADFG

Biology, Ecology, and Management of Pacific Herring (*Clupea pallasii*) stocks in British Columbia

Jaclyn Cleary

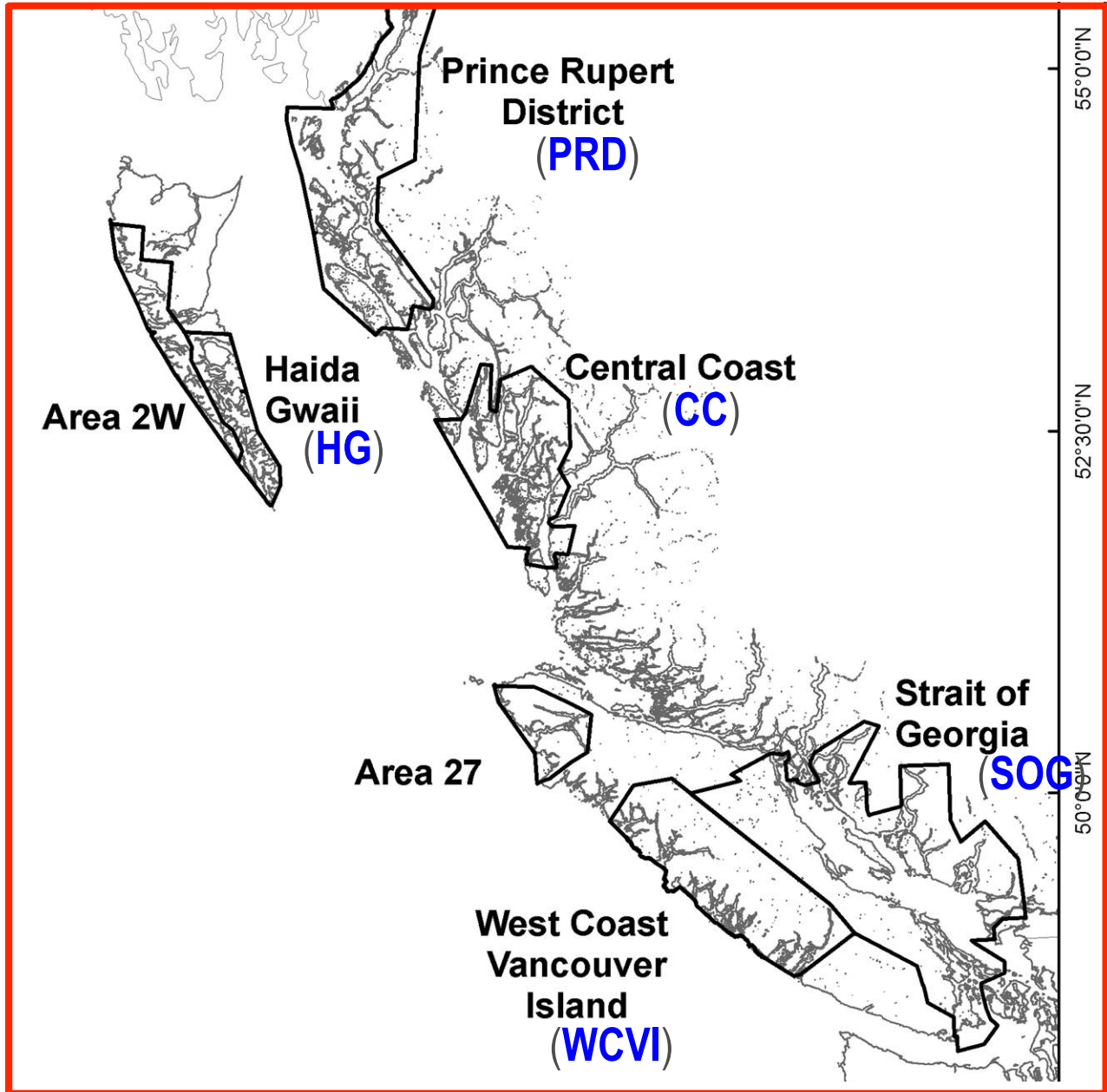
Fisheries and Oceans Canada, Nanaimo, BC, Canada.



Canada

BRITISH COLUMBIA PACIFIC HERRING

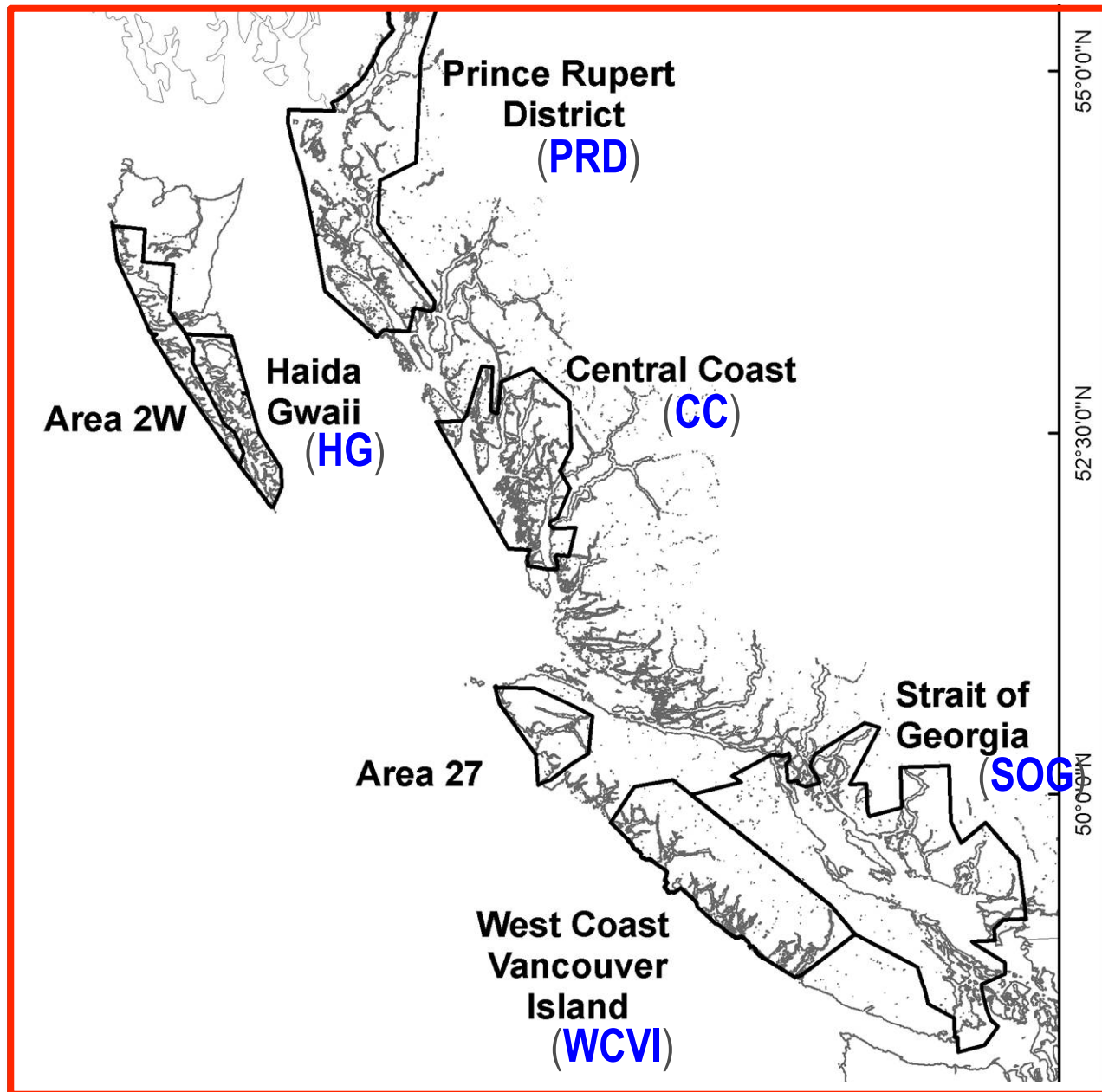
5 major & 2 minor
fishing stocks



BRITISH COLUMBIA PACIFIC HERRING

5 major & 2 minor fishing stocks


Data collection (scientific surveys) and DFO science advice is also provided at this scale



HERRING RESEARCH TENDS TO BE DIRECTED BY
WHAT WE CAN SEE...



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- 
- An aerial photograph showing a coastal landscape. In the foreground, a white, curved structure, likely part of a boat or aircraft, is visible on the left. The water is a vibrant green, indicating a high concentration of phytoplankton or a specific water type. A small, rocky island with a few buildings and a red-roofed structure is situated in the middle of the water. The background shows a forested coastline with a mix of green and brown patches, suggesting a mix of vegetation and possibly some cleared areas. The sky is blue with some white clouds.
- So we understand the most about Pacific herring from the life cycle stages that we can see: the mature adult spawners

SPAWNING

- Timing: Feb – April
 - SOG: primarily March
- Habitat: intertidal and subtidal habitats, on kelp, eelgrass, rock weed, cobble, gravel, and less desirable locations
- Females herring release eggs in a sticky substance that allows them to adhere eggs to substrate
 - Males then release milt into the water column for fertilization



Feb-March: Aerial photos of herring spawn activity



Typical colour of Pacific ocean

Herring milt turning water aqua blue



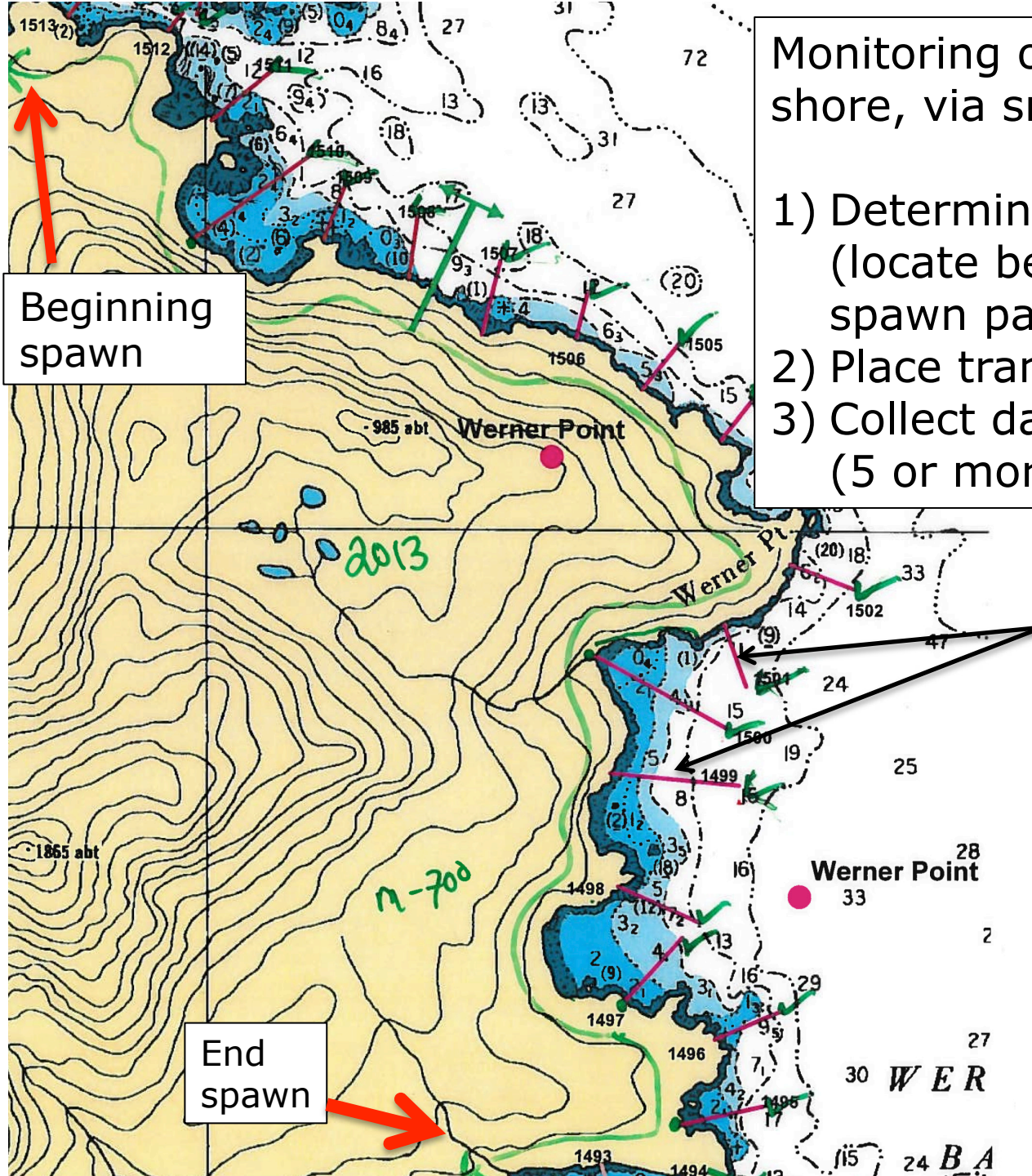
Monitoring of the **eggs** from shore, via small boats or SCUBA

- 1) Determine spawn length (locate beginning and end of spawn parallel to shore)
- 2) Place transects every 350m
- 3) Collect data using quadrats (5 or more per transect)

Beginning spawn

Transects

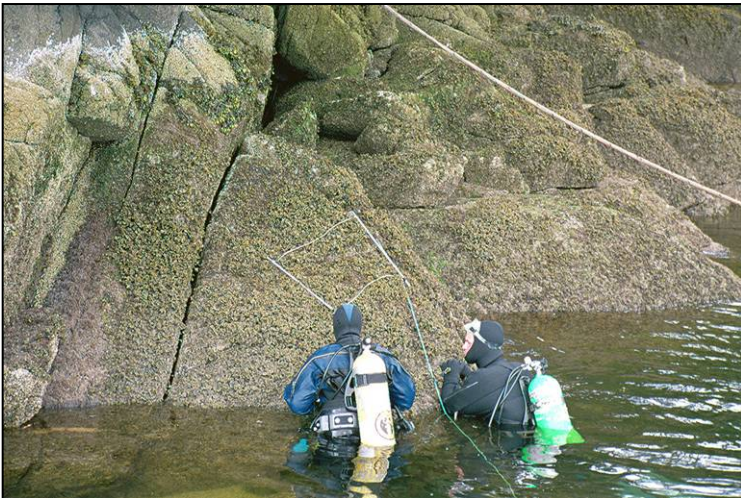
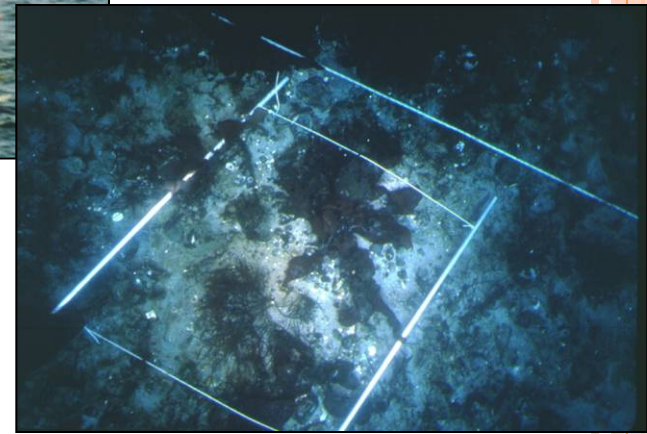
End spawn



Spawn Deposition Surveys



Area = Length x Width
Egg Density = Egg
Layers, measured by
Vegetation Type and %
Coverage



ANNUAL SURVEYS

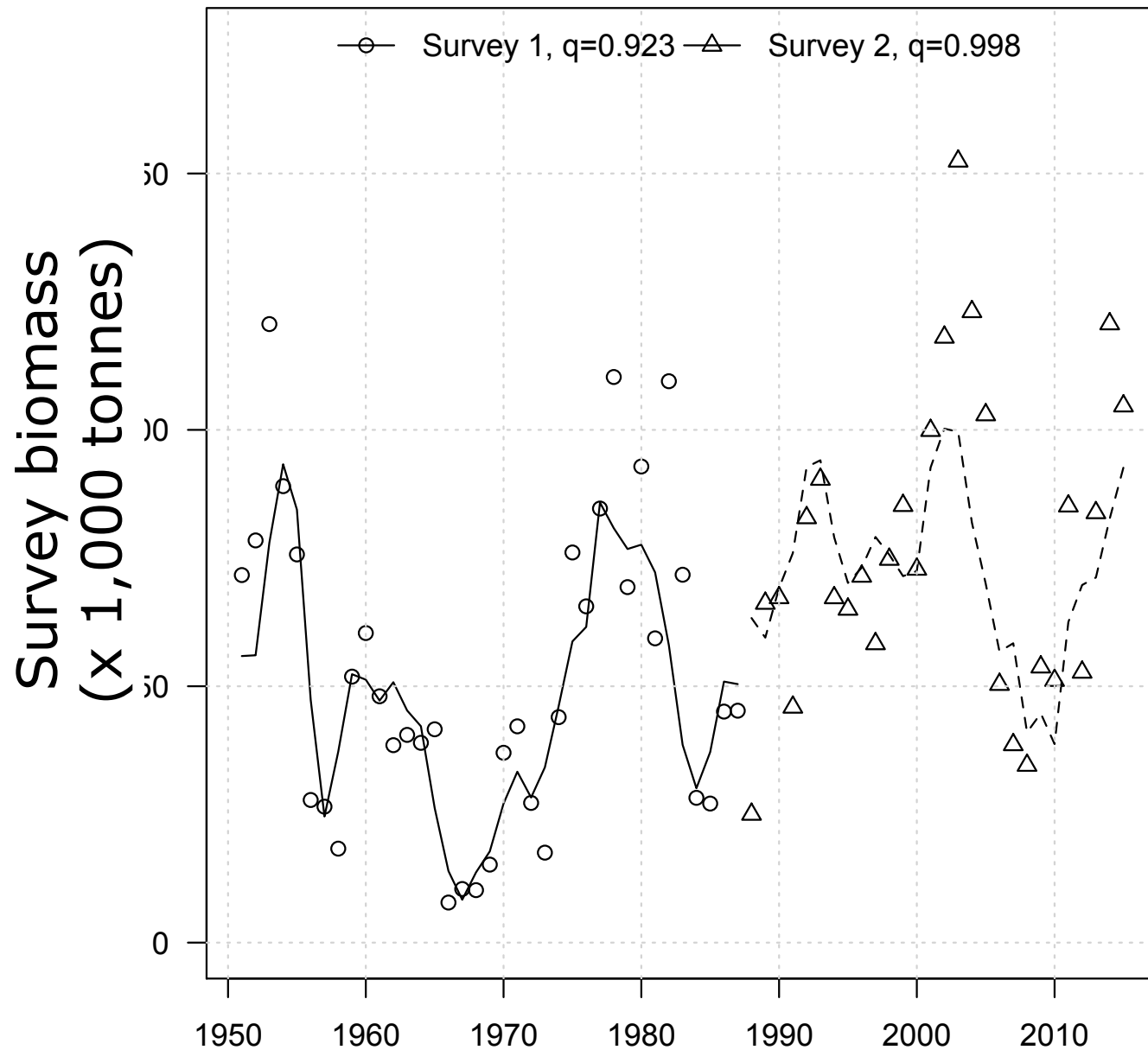
- Annual spawn monitoring coastwide
- Additionally, biological sampling program provides collects herring to provide population level information on age proportions, length, weight, sex, maturity



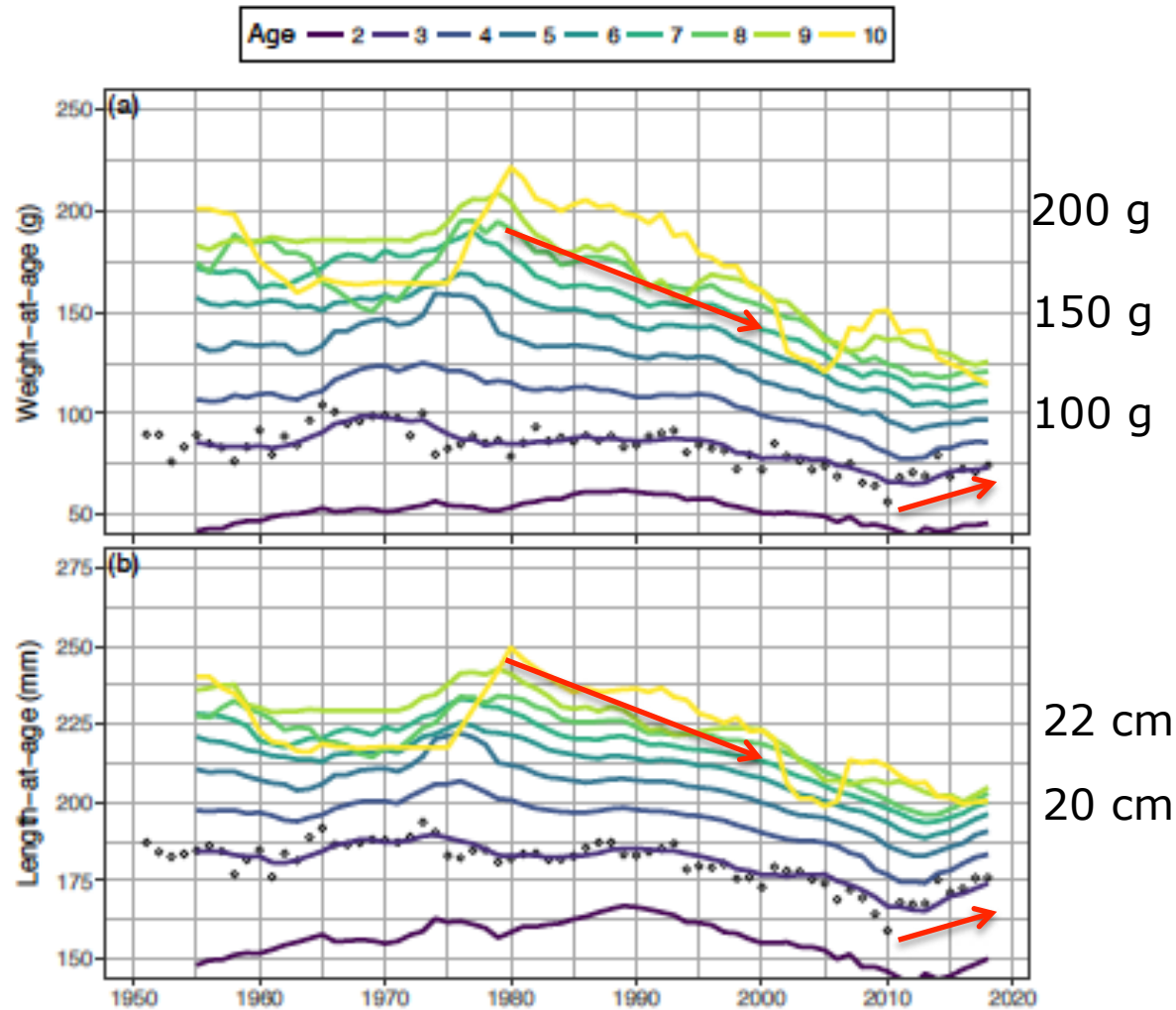
What do herring biological data look like?



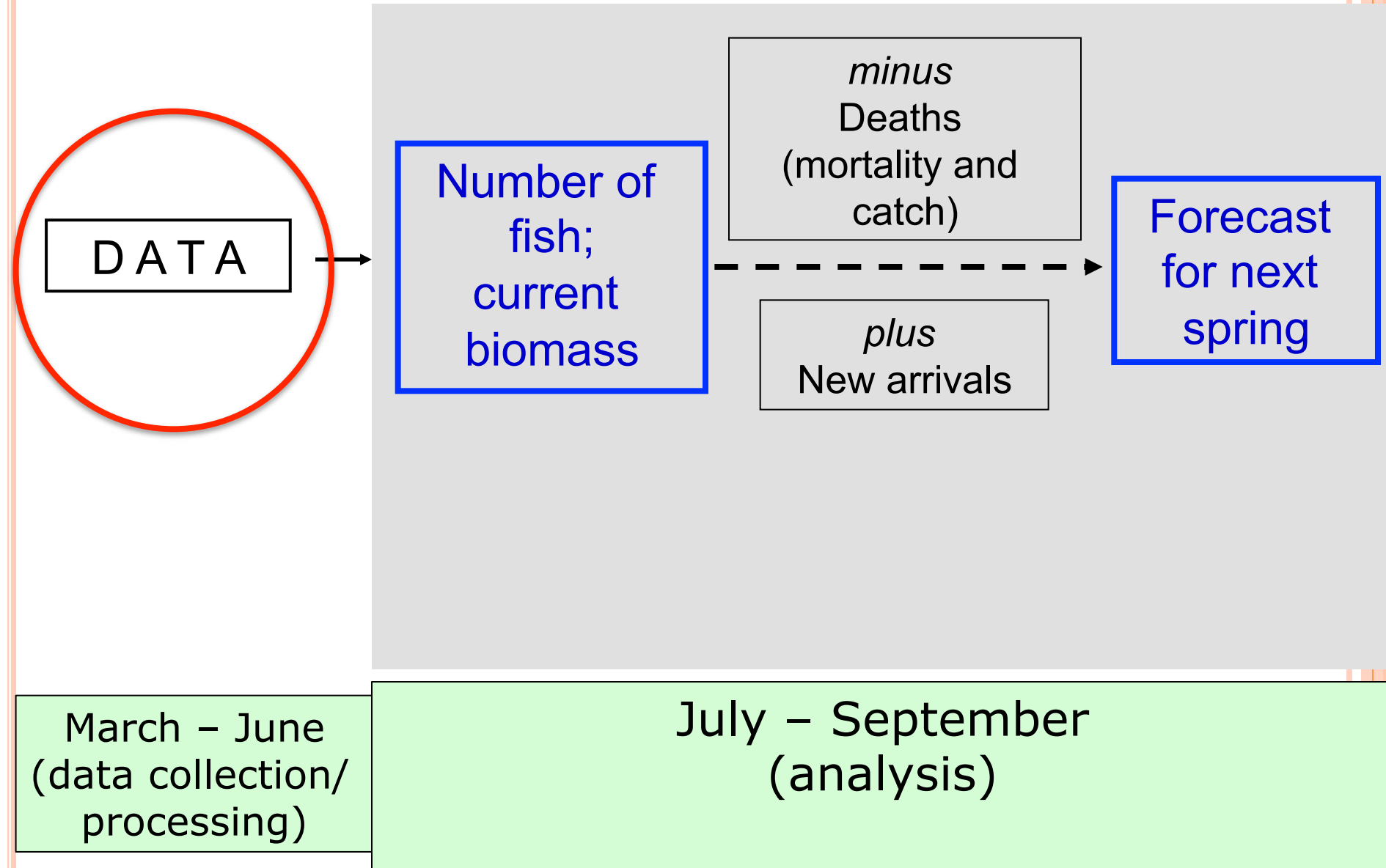
SURVEY ABUNDANCE TIME SERIES



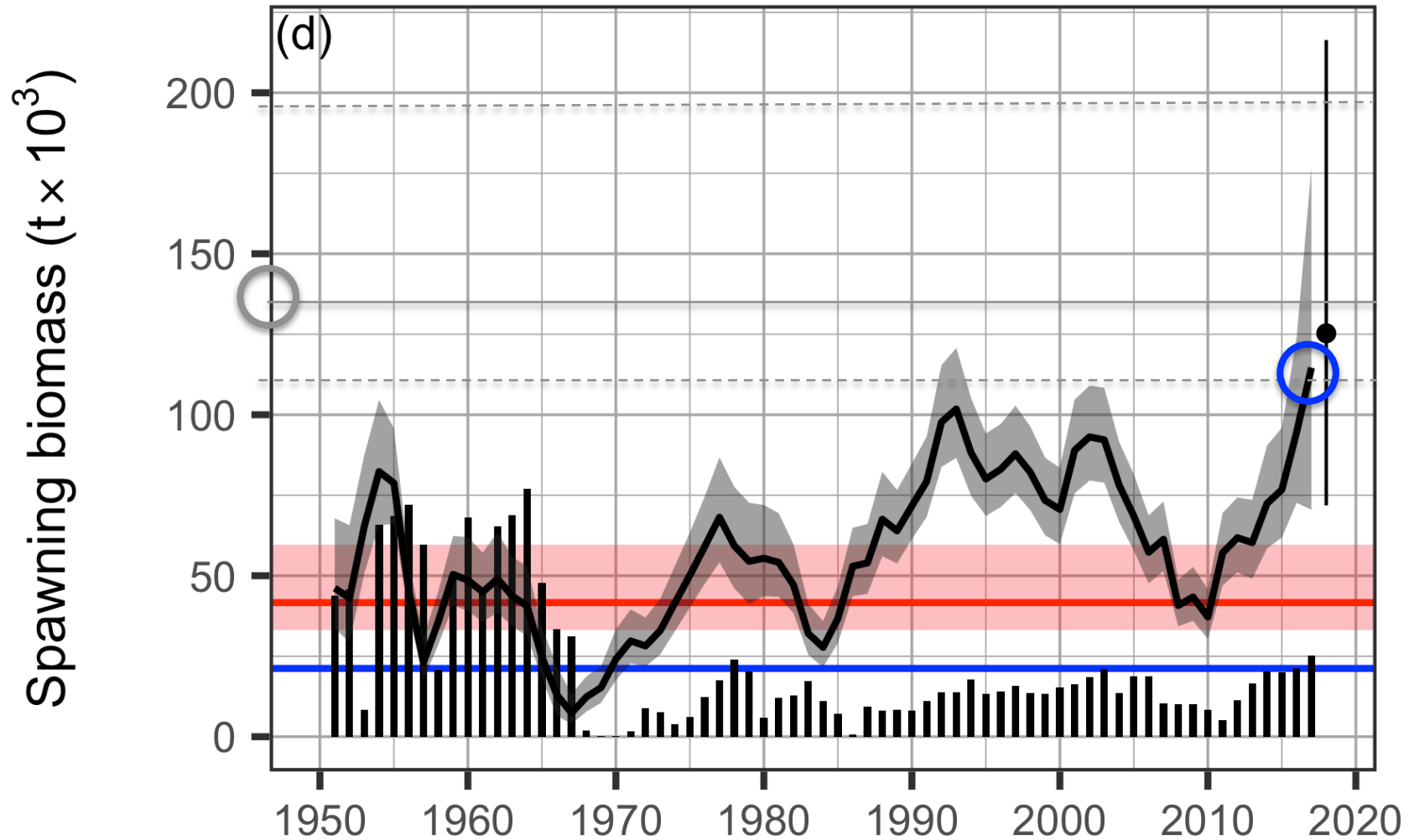
TRENDS IN WEIGHT AGE (1950-2018)



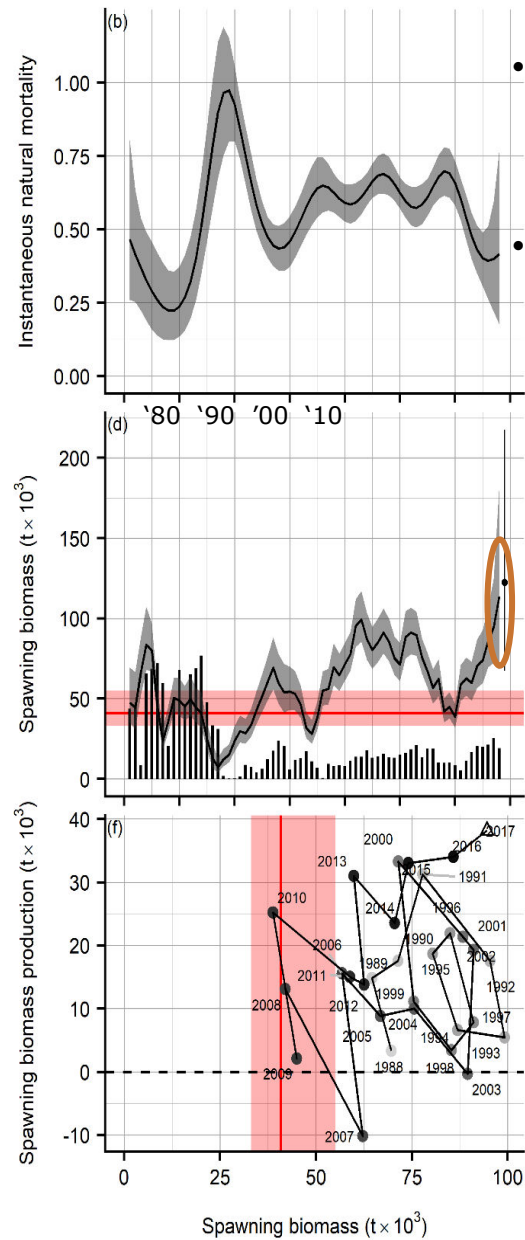
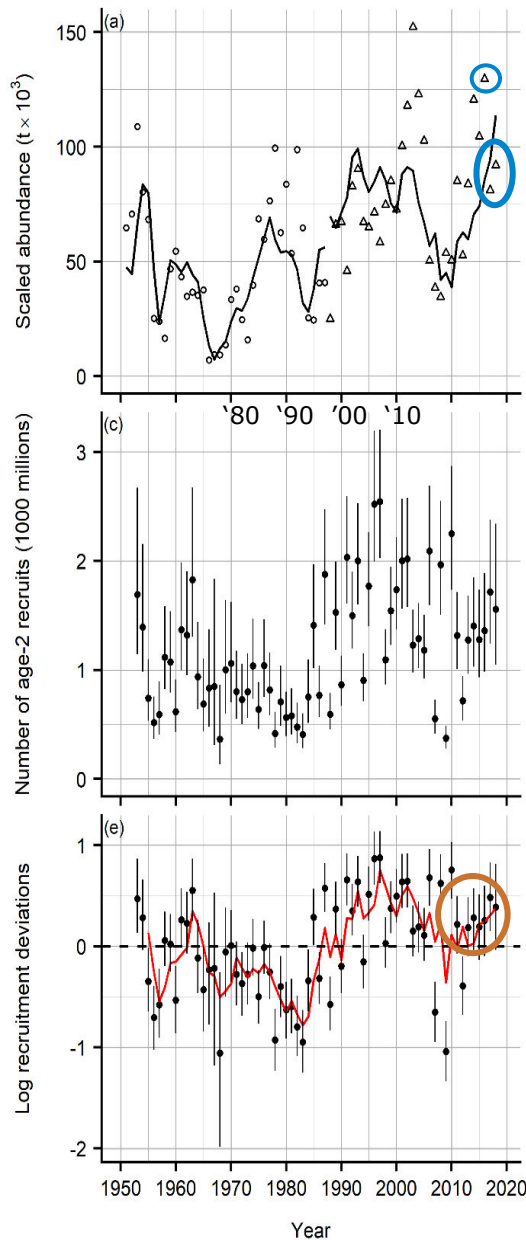
HERRING STOCK ASSESSMENT PROGRAM: ANNUAL CYCLE OF DATA COLLECTION AND ANALYSIS



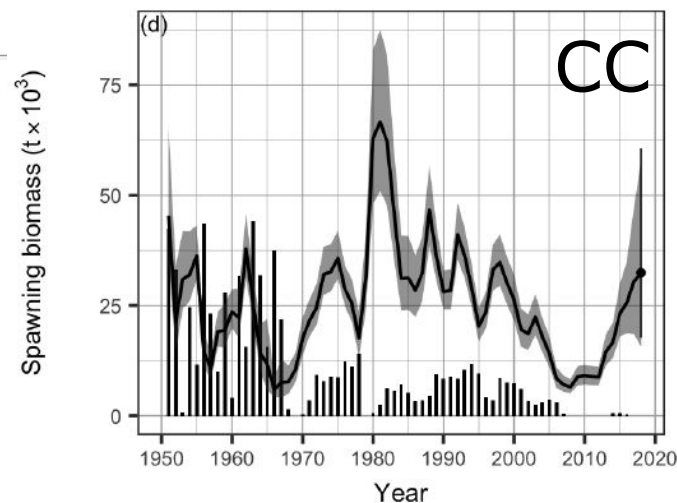
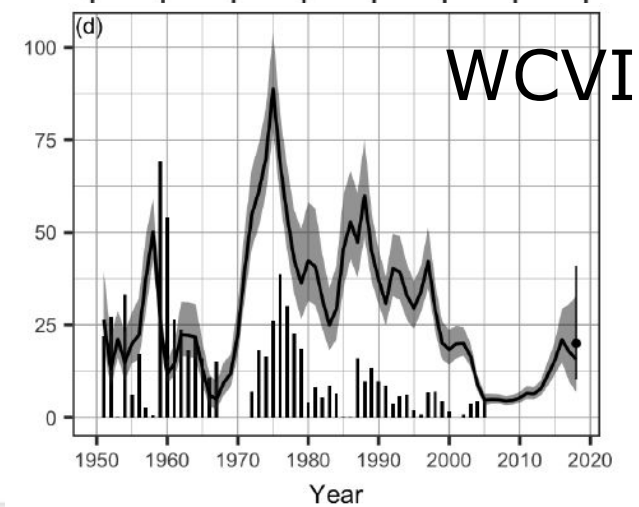
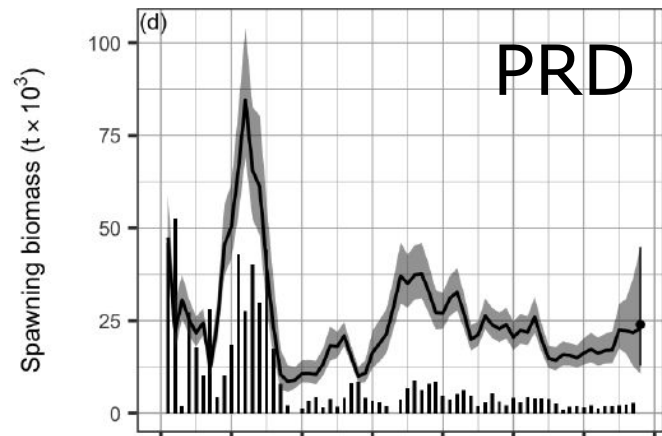
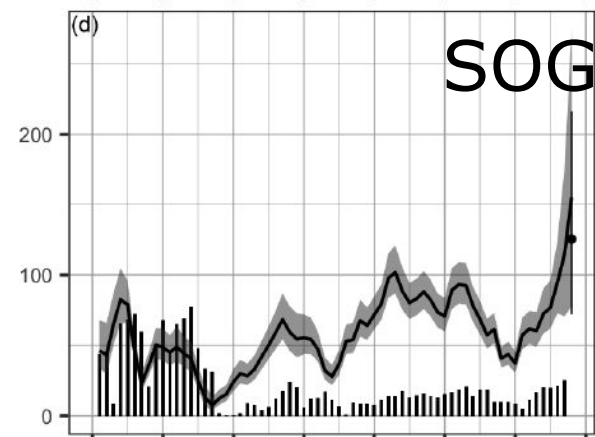
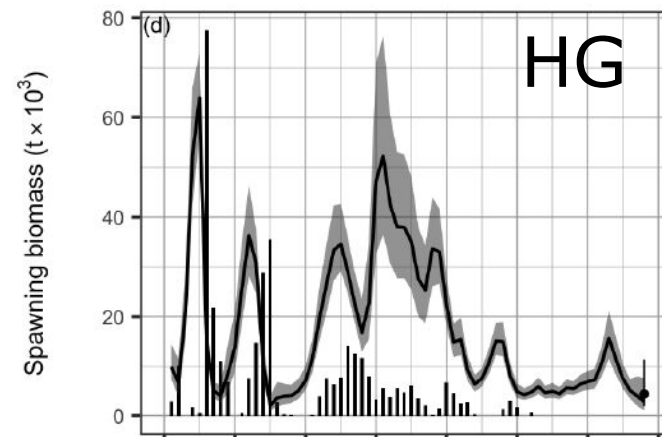
Status: SOG major stock



Strait of Georgia



- Increasing trend in estimated spawning biomass since 2010
- The model estimates above average recruitment in most years from 2010-2018
- The increasing trend in estimated spawning biomass since about 2010 coincides with a decline in estimated natural mortality that began in the late 2000s.



**Pacific Herring
spawning biomass,
1951 to 2017**



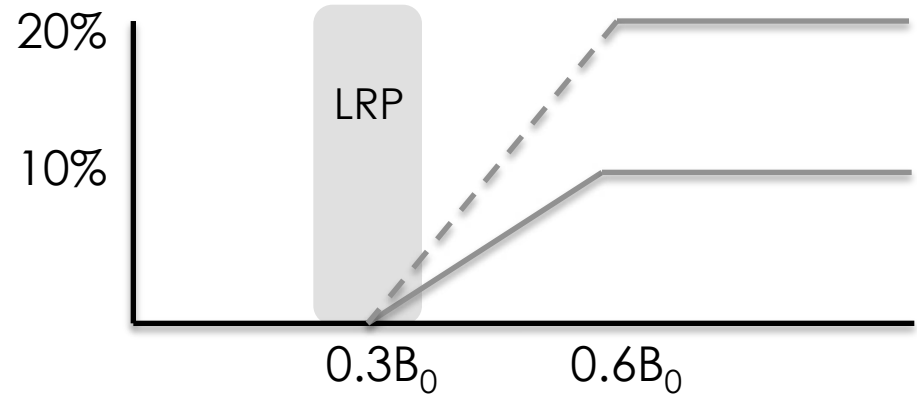
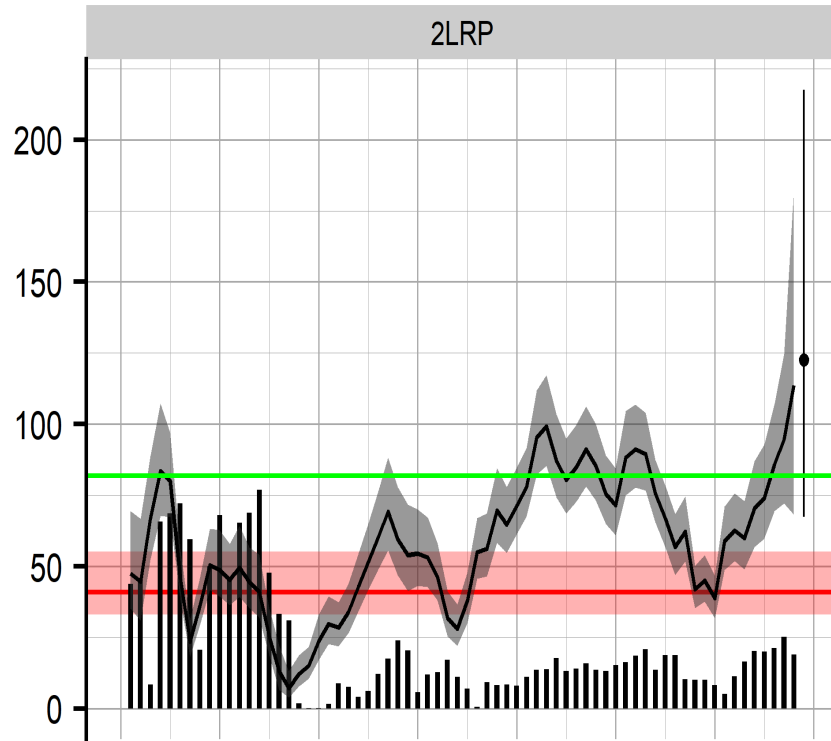
HOW IS THIS INFORMATION USED TO INFORM MANAGEMENT DECISIONS?



Science advice → Harvest decision rules

credit: Kristen Daniel

Eg., Strait of Georgia

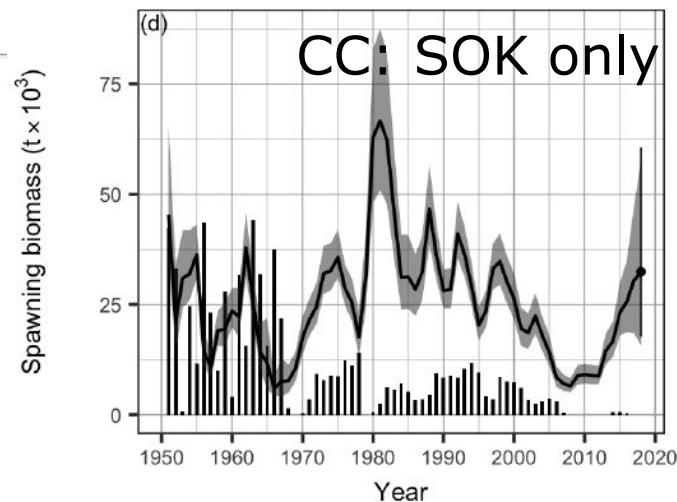
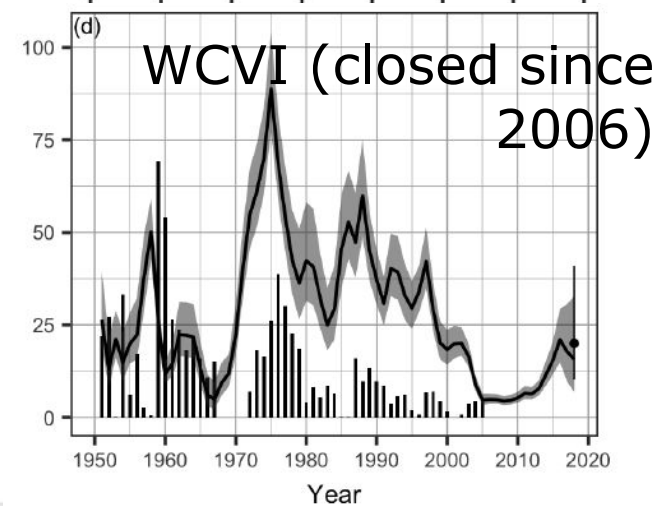
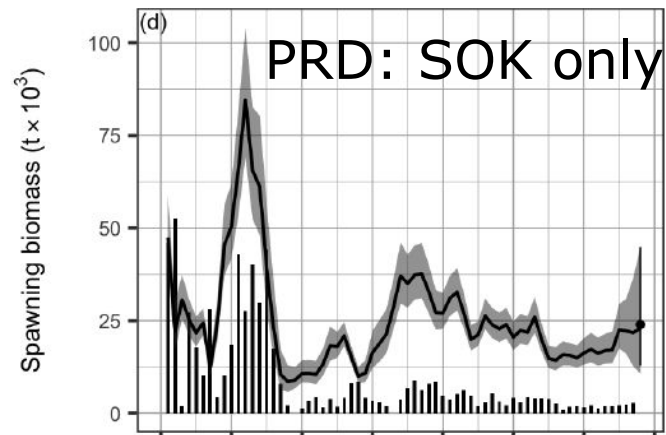
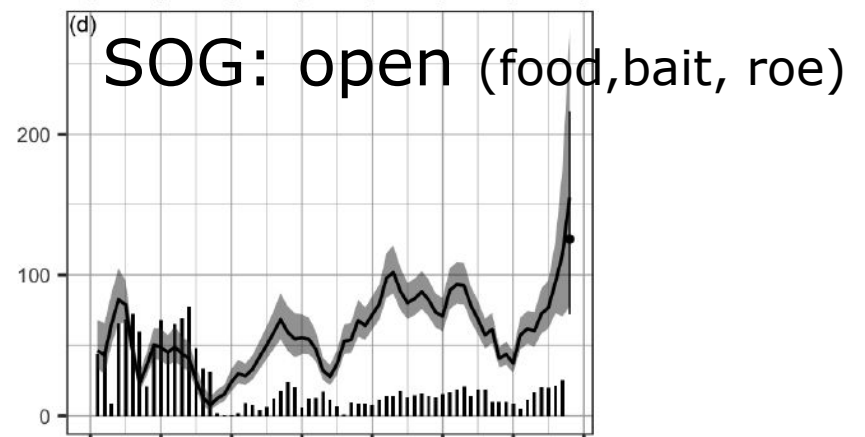
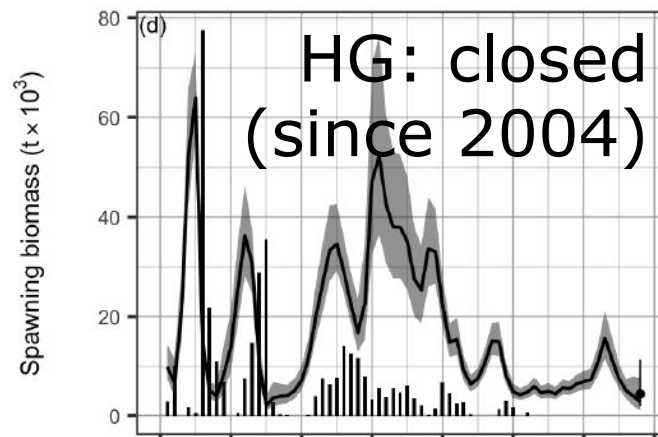


SOG Decision rule:
Lower and upper control
points, sliding harvest rate,
30,000 t catch cap



2019 MANAGEMENT DECISIONS





SO WHAT THEN ARE WE STRUGGLING TO
UNDERSTAND?

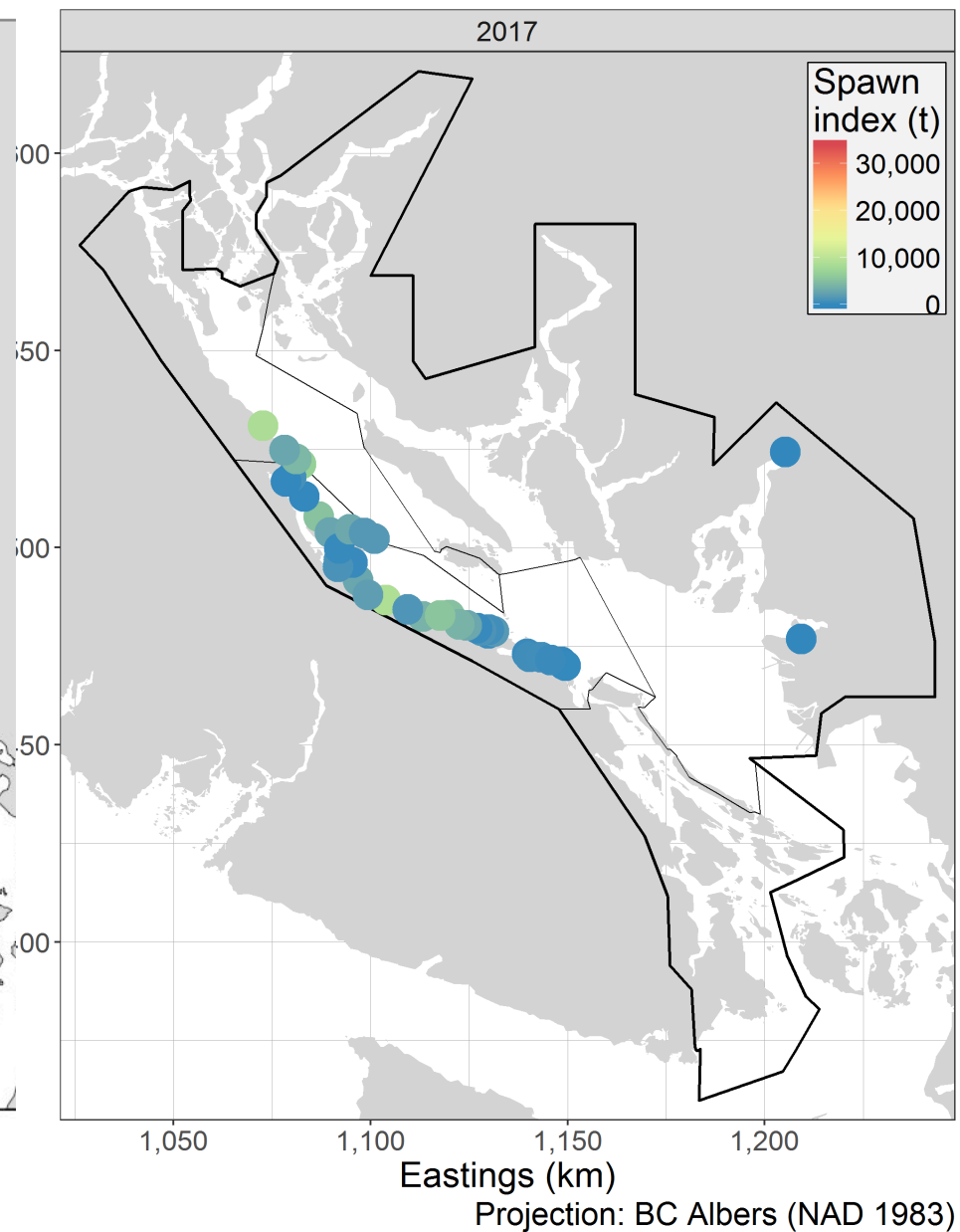
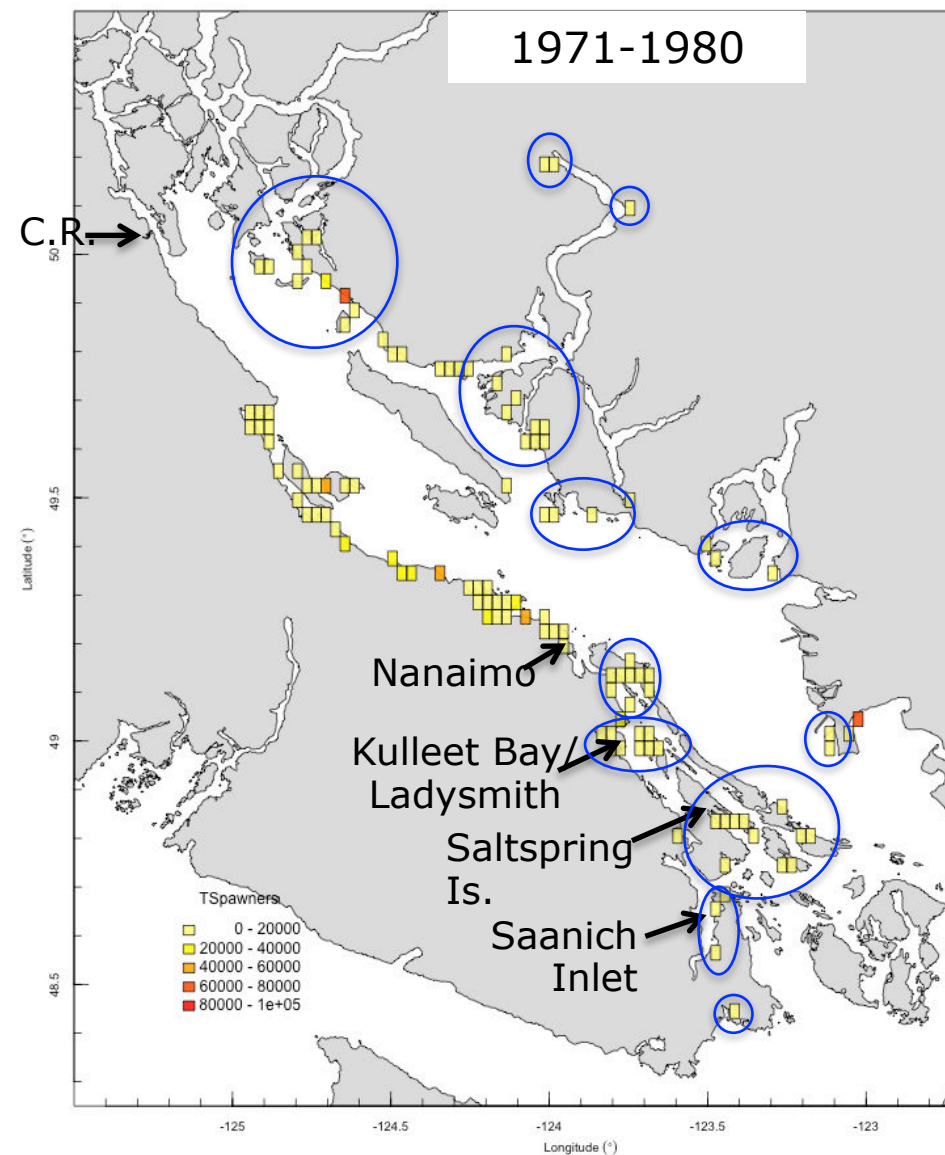


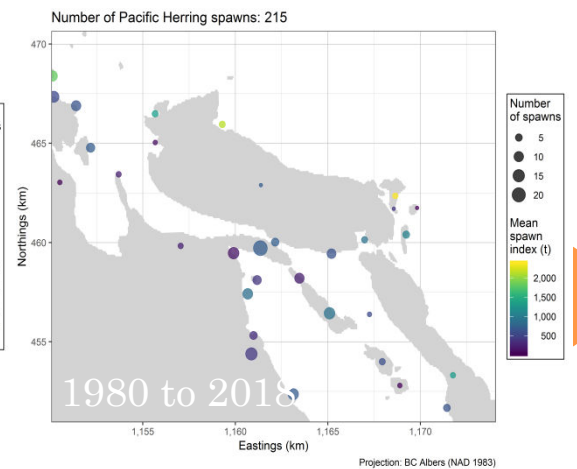
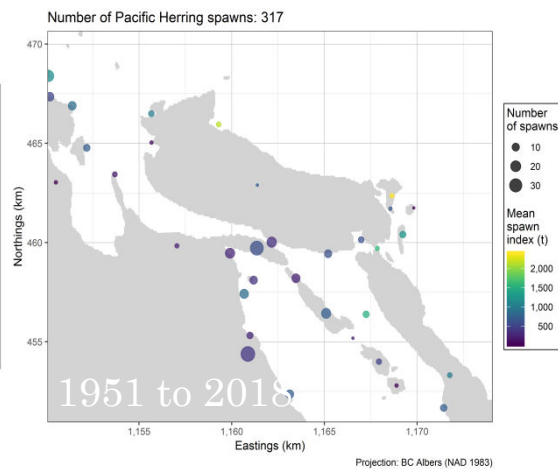
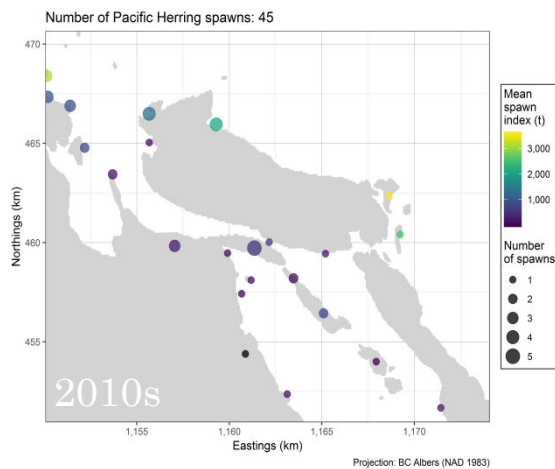
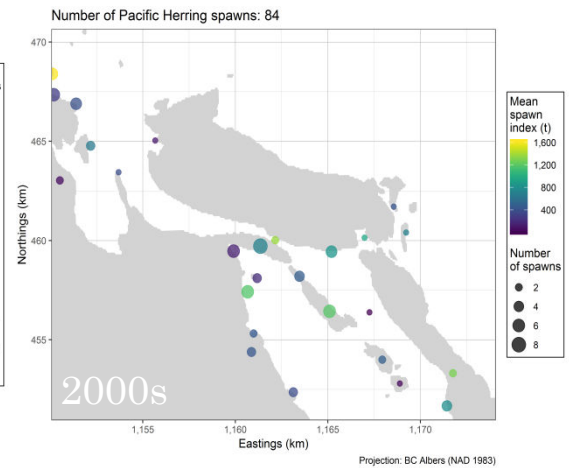
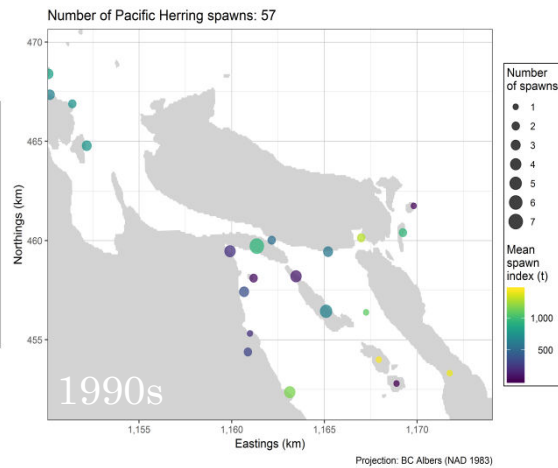
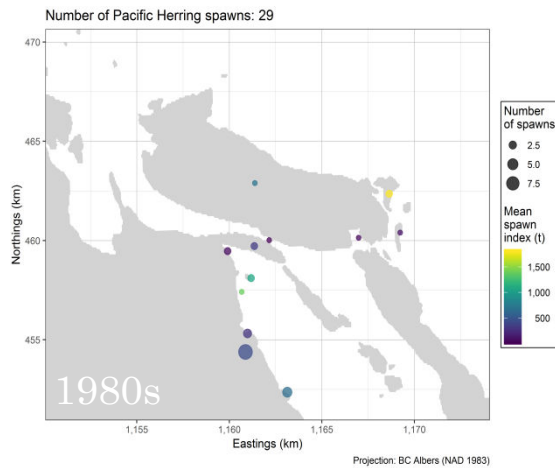
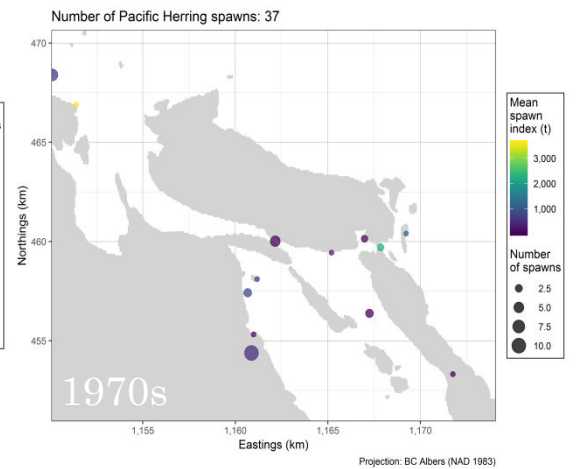
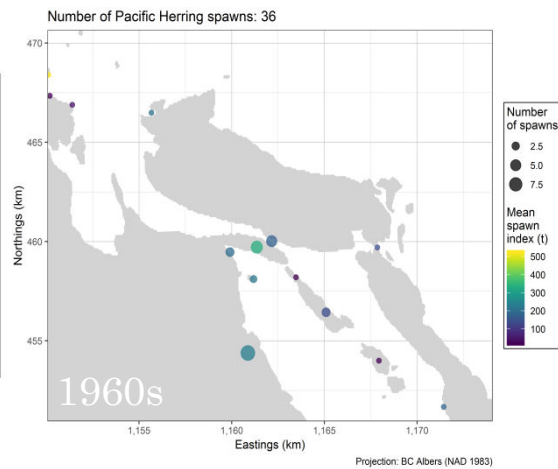
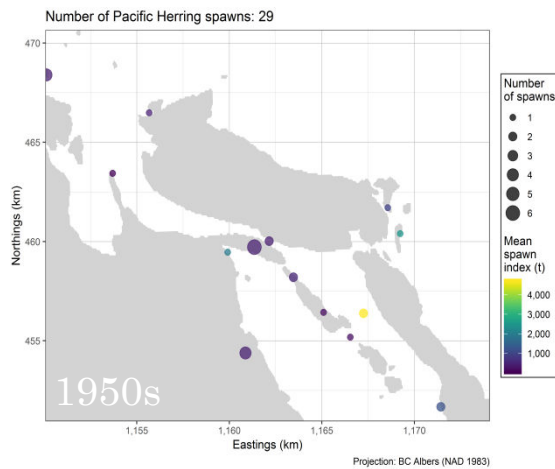
SO WHAT THEN ARE WE STRUGGLING TO UNDERSTAND?

- Stock assessment – focused on main migratory stock, aggregate stock biomass (coast wide)
- How to integrate key uncertainties into science advice
 - Spawn distribution (changes in)
 - Spawn timing (changes in)
 - Migration and stock structure
 - Ecosystem interactions
 - Top down/ bottom up processes



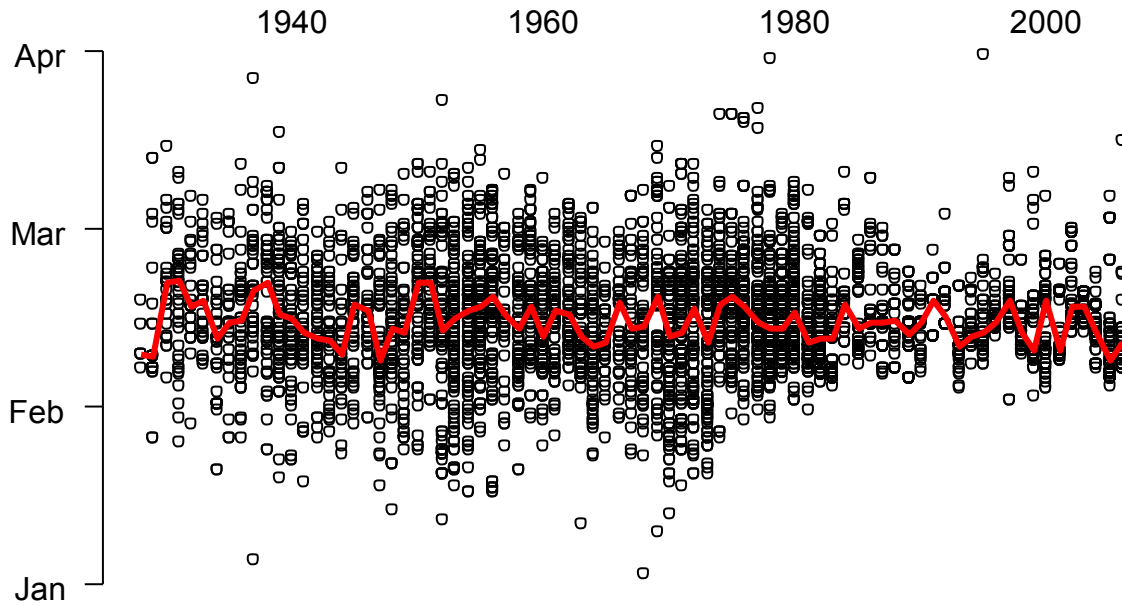
SOG: SPAWNING LOCATIONS (CHANGES IN)





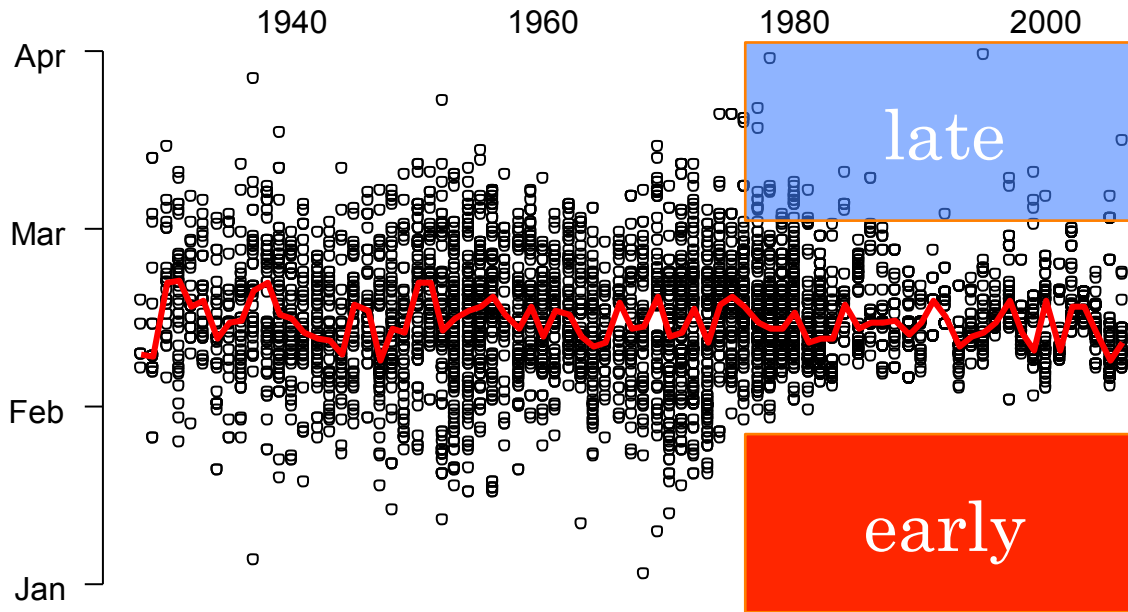
SOG: CHANGES IN SPAWN TIMING

Spawn day of year



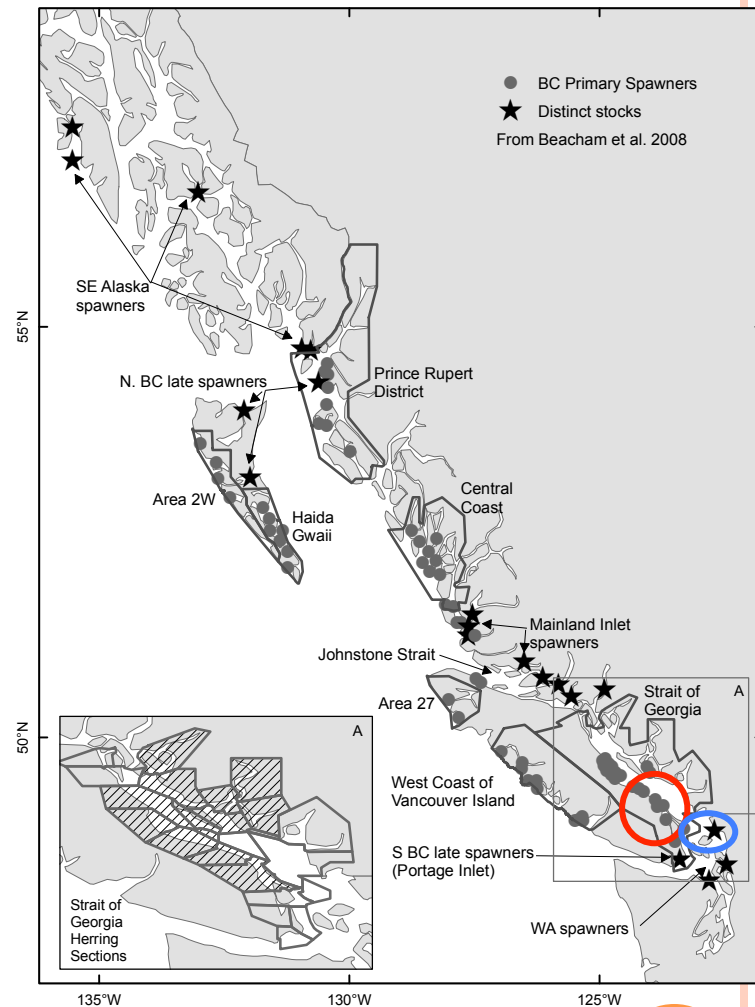
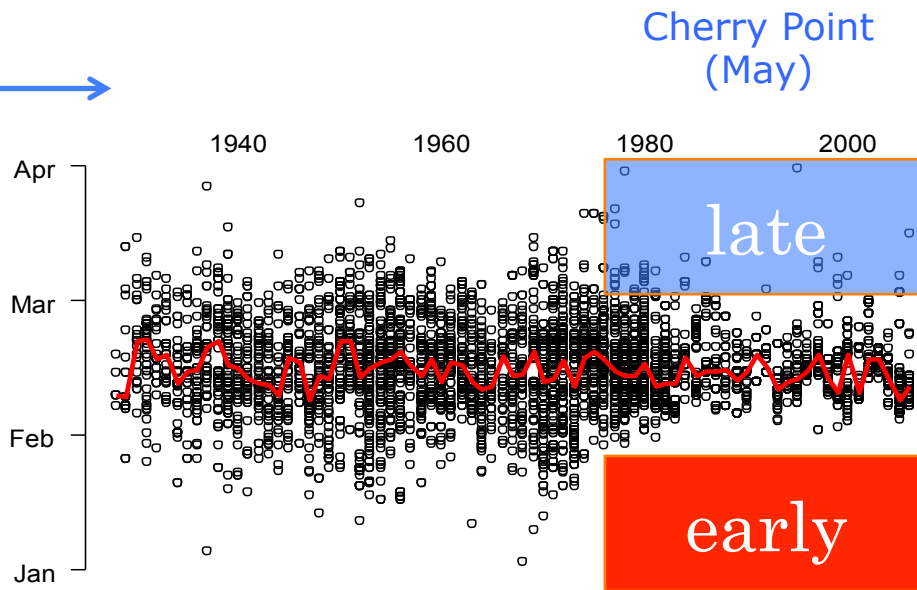
SOG: CHANGES IN SPAWN TIMING

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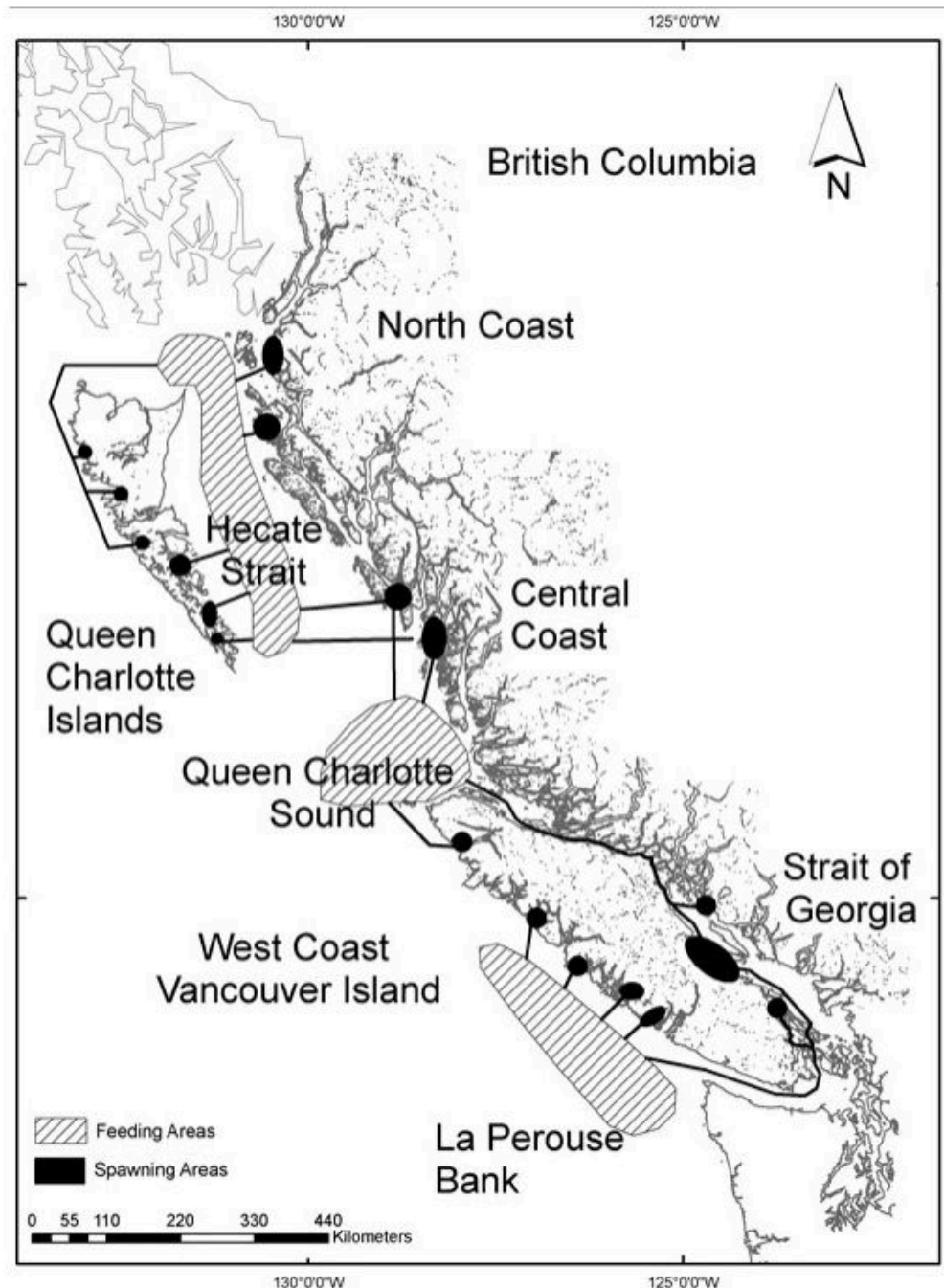
General coast wide migration patterns

Spring spawning (inshore)

-easiest time to study them

Summer feeding (offshore)

-generally mixed stocks



AREAS OF ON-GOING RESEARCH:

- Stock assessment – linkages between aggregate stock biomass and biomass at local scales
- How to integrate key uncertainties into science advice
 - Spawn distribution (changes in)
 - Spawn timing (changes in)
 - Migration and stock structure
 - Ecosystem interactions
 - Top down/ bottom up processes





Credit: Kristen Daniel