Trawl survey age and length composition input sample size

September Plan Team, 2023

Background on input sample size

- Comes from observation that fish age/length are similar within a haul, and have more than expected variability across hauls
- Using multinomial, variance is a function of sample size, inversely related
- Reduce sample size to account for additional variability – this is input sample size

Coming up with input sample size

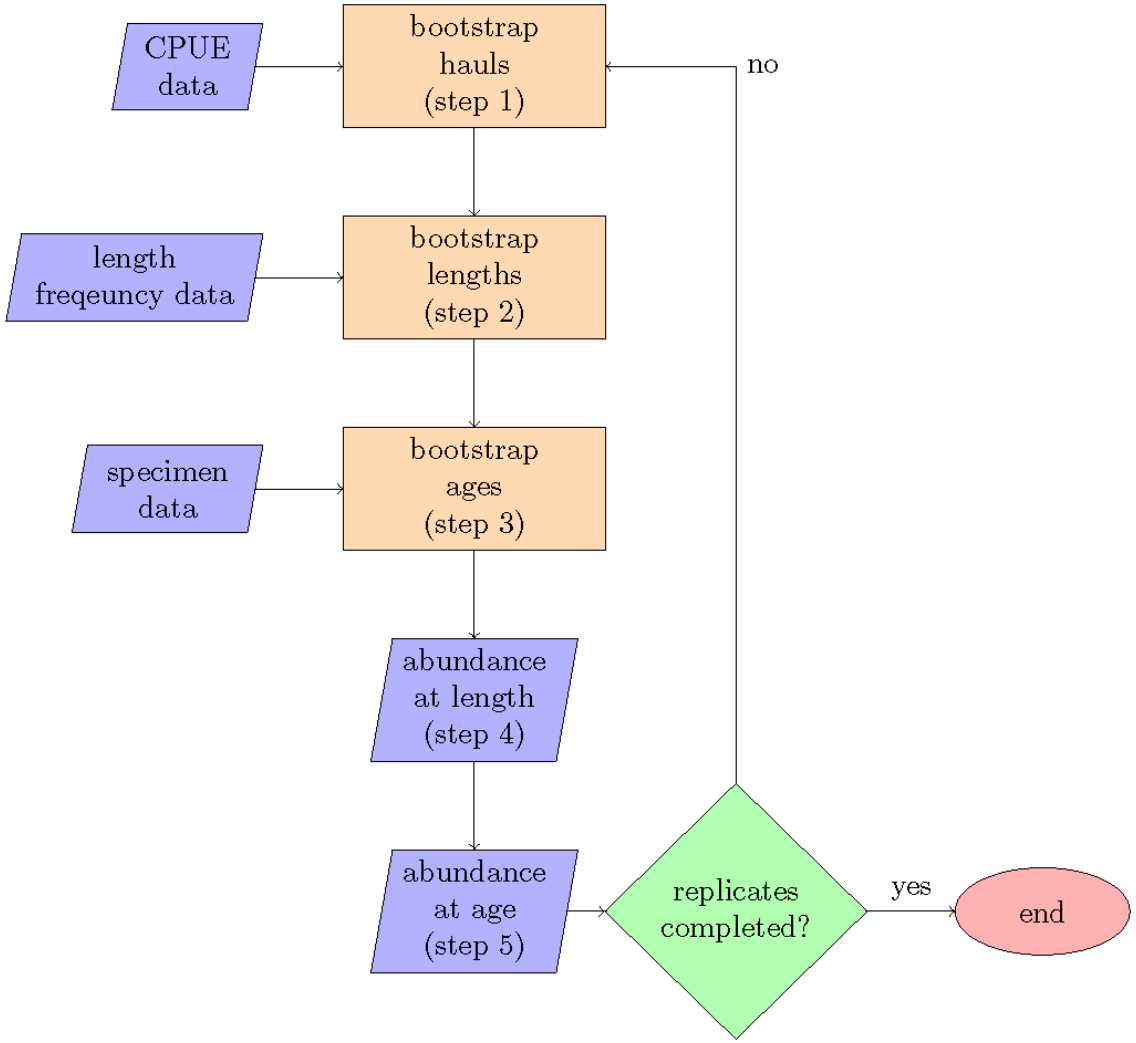
- Variety of ways we've (AFSC and globally speaking) have come up with ISS
- AFSC – fixed, number of hauls, some function of number of samples, some function of number of samples and hauls, quasibootstrap – only thing consistent is that we're so inconsistent
- Globally
  - Bootstrap (Crone and Sampson, 1997; Stewart and Hamel, 2014)
  - Model-based (Berg and Nielsen, 2016; Thorson, 2014; Thorson and Haltuch, 2018)
  - Design-based (Miller and Skalski, 2006)

Terminology

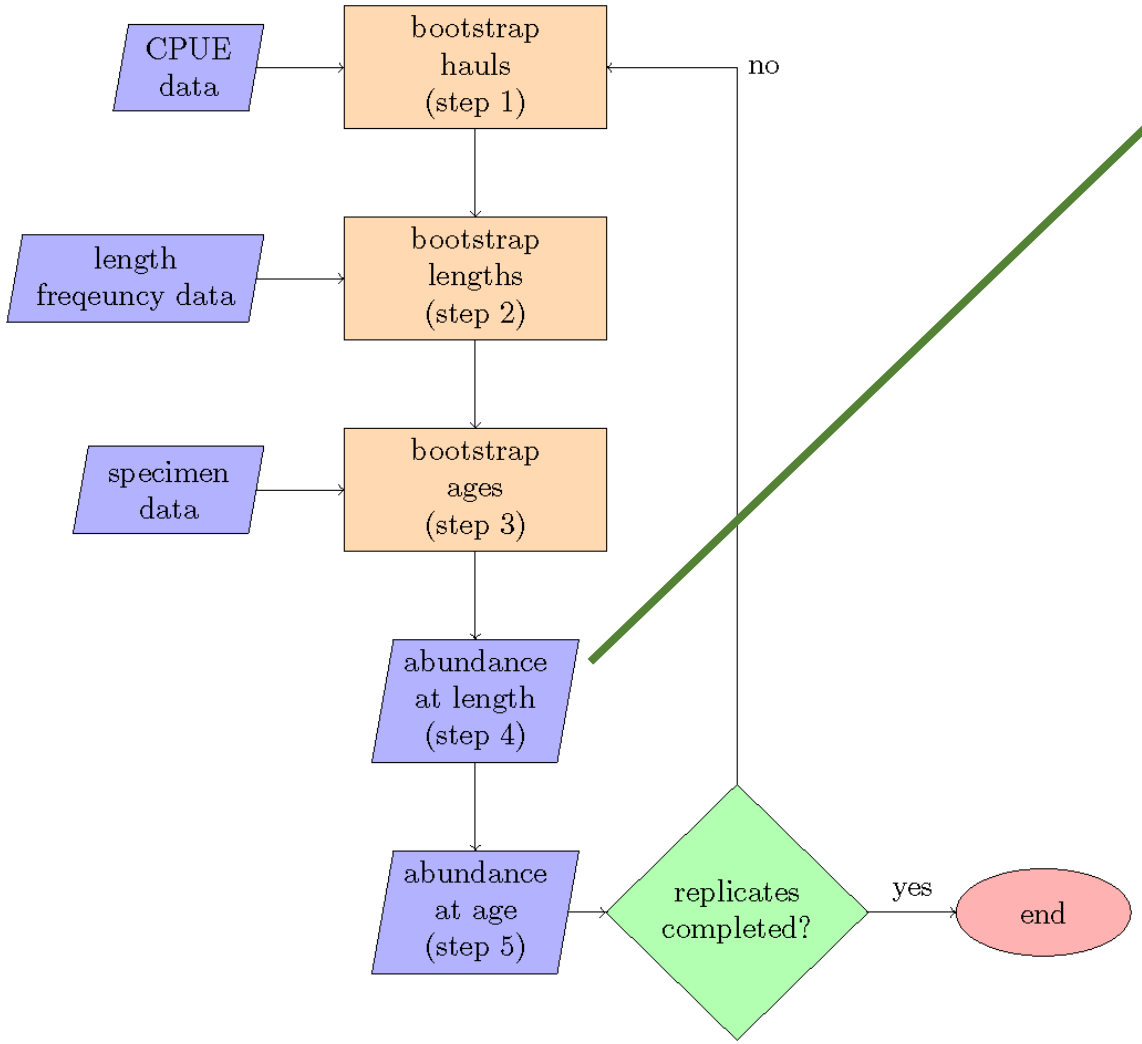
- Effective sample size (ESS) is a term that get's thrown around a lot, add to that a bunch of others that have been proposed over the years

- Terms we're using today:
  - Use Nominal sample size (NSS) to mean the number of samples you actually collected
  - Use Input sample size (ISS) as the number that you use to initially weight your comp data, ISS < NSS
  - Use Effective sample size (ESS) as the statistic to measure model fit to observed data, ESS < ISS
  - Use Realized sample size (RSS) in the bootstrap resampling sense, it's computed similarly to ESS for each replicate of the bootstrap, then the ISS shown here is the harmonic mean of the RSS across the bootstrap replicates

Production trawl survey ISS

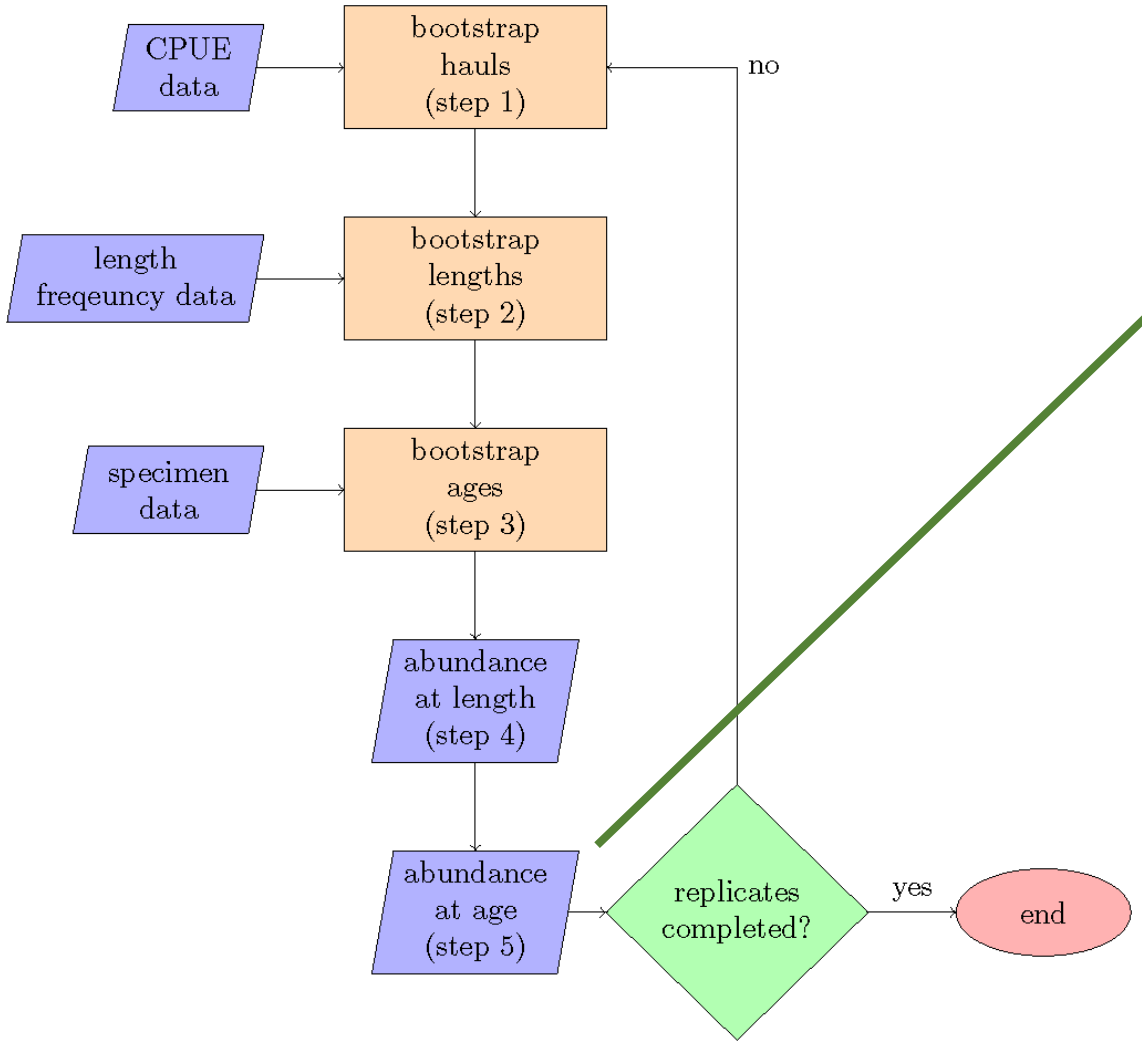


Production trawl survey ISS



- Expanded at strata level for sex-specific categories
- Fist compute pop'n numbers in strata (area weighted avg cpue)
- Partition pop'n numbers into length bins (cm) by haul-level cpue weighted length proportions, sum across hauls
- Strata pop'n numbers at length are then summed to whatever desired level

Production trawl survey ISS



- Expanded at management area
- Create pooled age-length key (proportions of age-at-length)
- Multiply by pop'n numbers at length, sum across lengths for each age

Application

- Ran for sex-specific data and combined sex data
- All years of each survey

Stock	Survey evaluated
Alaska plaice	EBS shelf
arrowtooth flounder	AI, EBS shelf, EBS slope, GOA
Atka mackerel	AI
Dover sole	GOA
Dusky rockfish	GOA
flathead sole	EBS shelf, GOA
Greenland turbot	EBS shelf, EBS slope
Kamchatka flounder	AI, EBS shelf, EBS slope
northern rock sole	EBS shelf, GOA
northern rockfish	AI, GOA
Pacific cod	AI, EBS shelf, GOA
Pacific ocean perch	AI, EBS slope, GOA
Rougheye/blackspotted rockfish	AI, GOA
rex sole	GOA
sablefish	GOA
southern rock sole	GOA
walleye pollock	AI, EBS shelf, GOA
yellowfin sole	EBS shelf

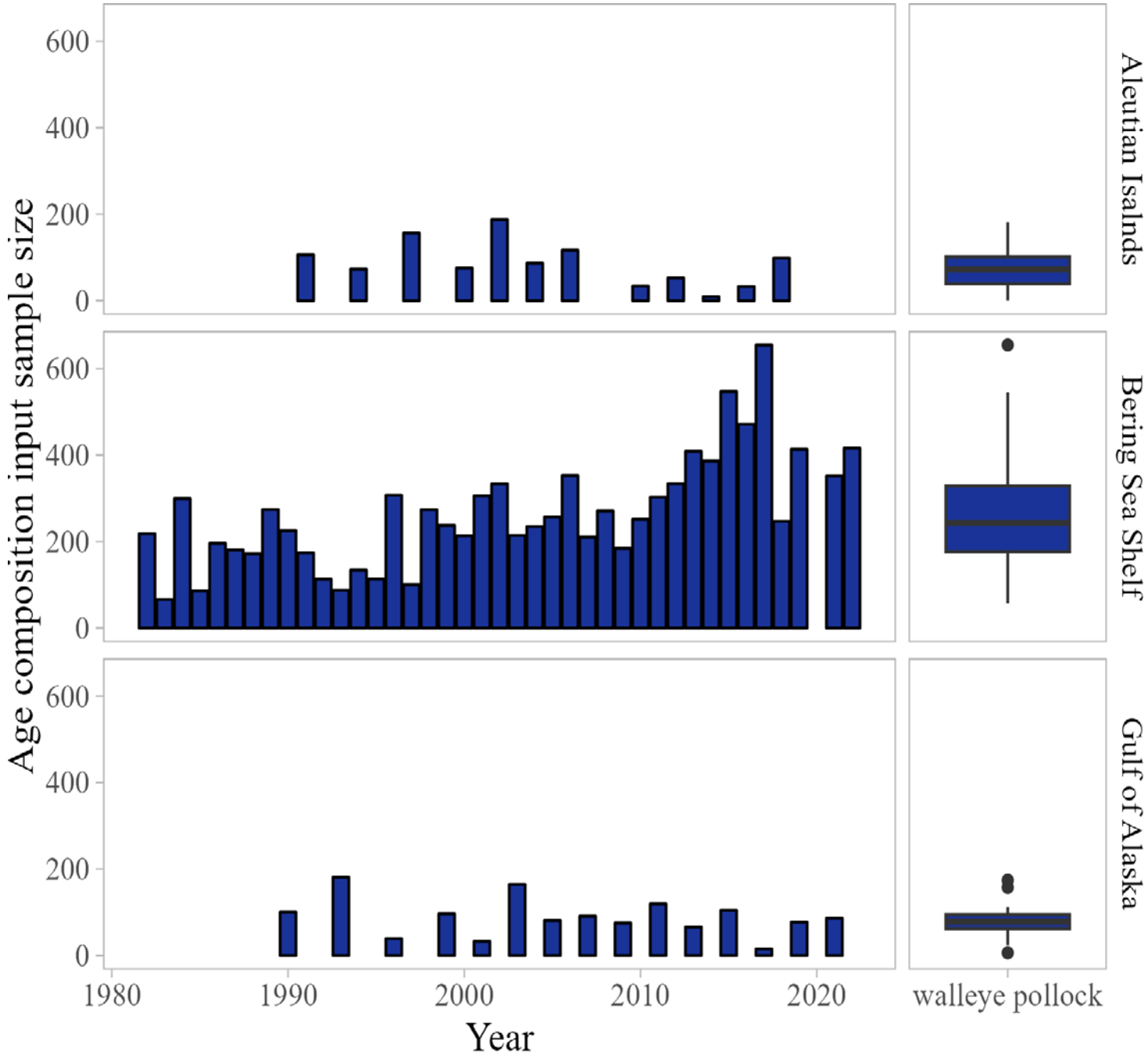
Special cases

- Complexes : Blackspotted and Rougheye, or Rougheye and Blackspotted – don’t forget about duskies too

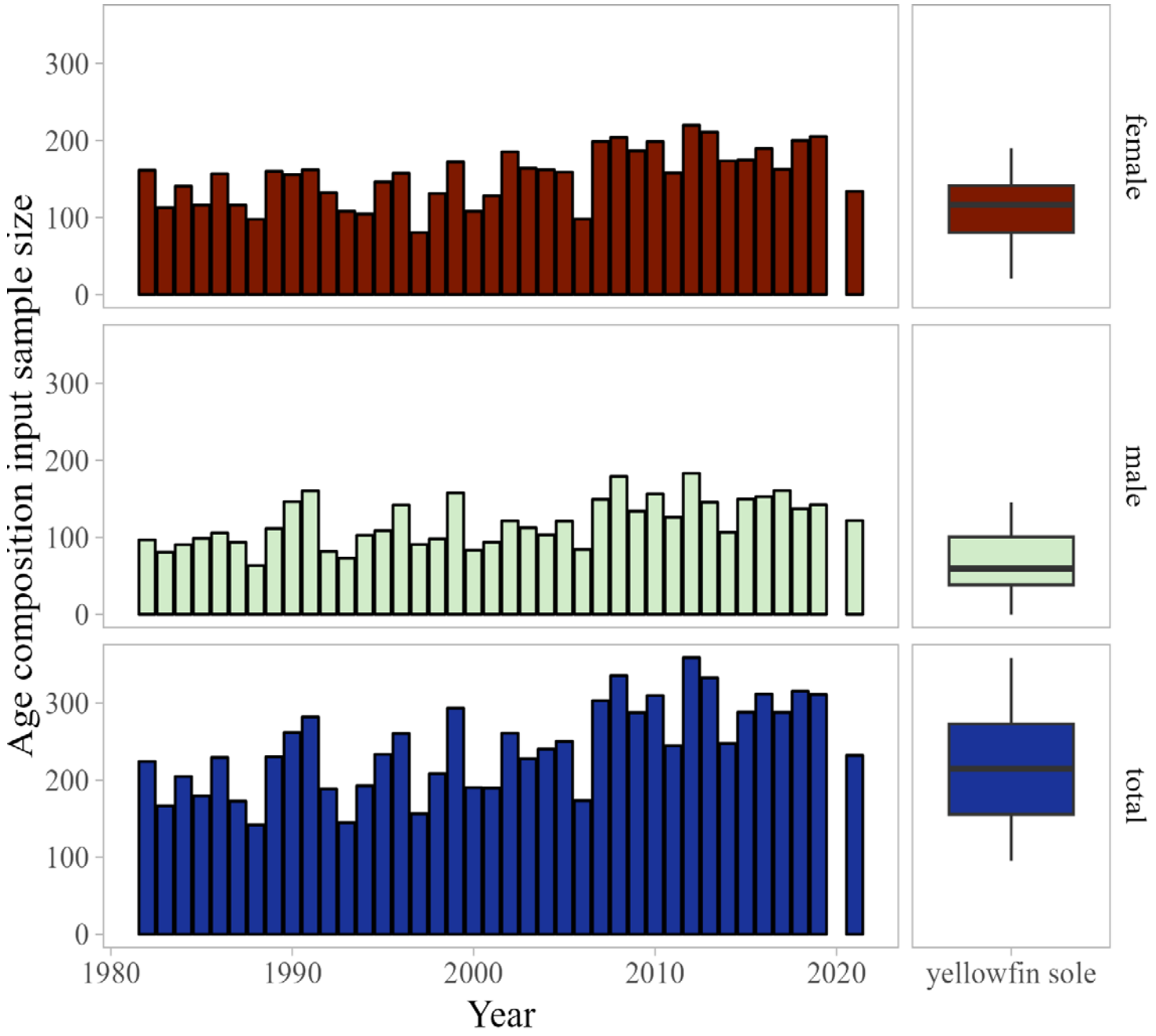
- Spatial models: rex (wc & egoa), n/s rock sole (w & cgoa, egoa too)

- Overall to say, these are generic functions that work for any species code (or vector of species codes)

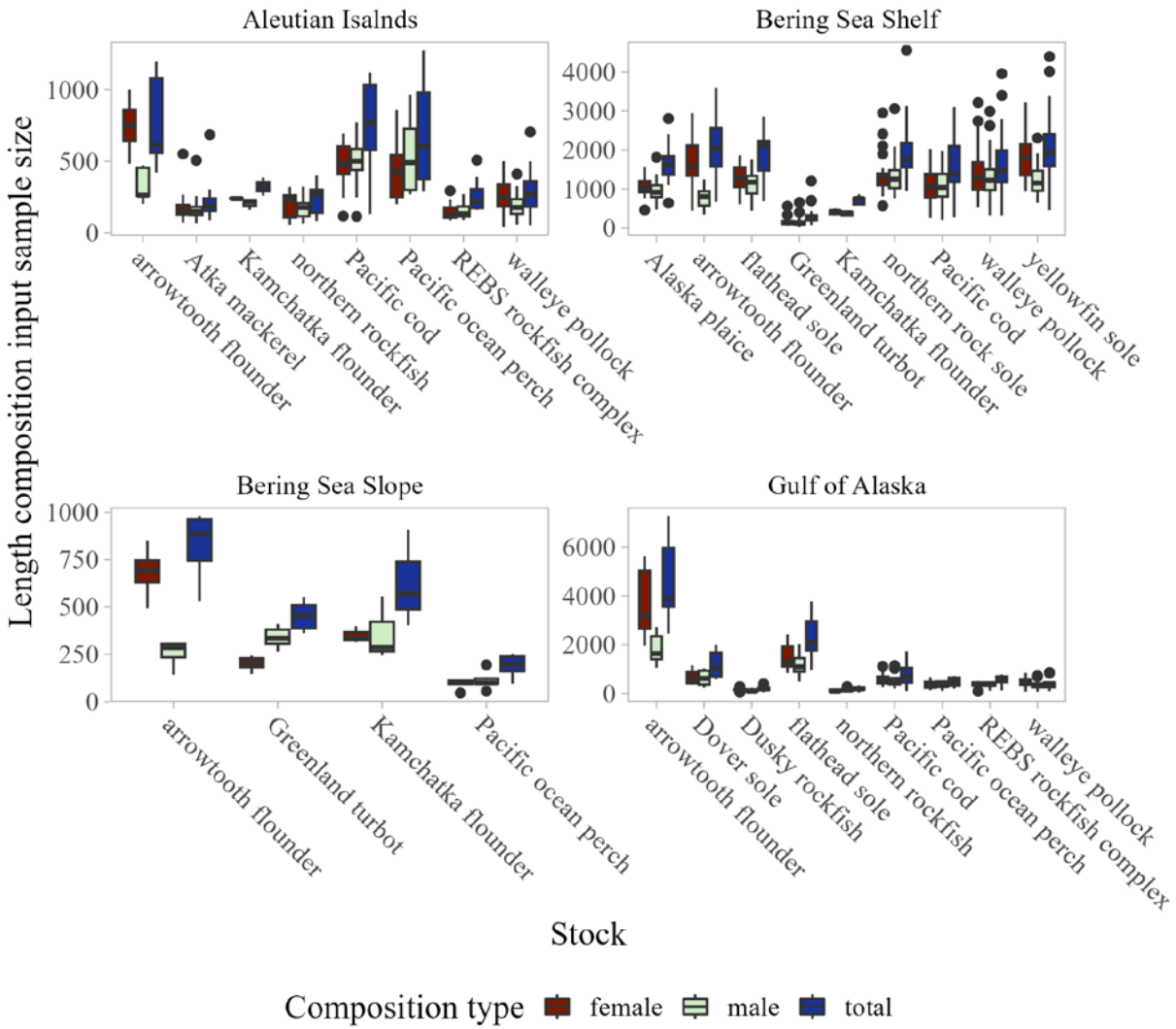
What you get


Age composition input sample size
600
400
200
0
Aleutian Isalnds
Bering Sea Shelf
Gulf of Alaska
1980
1990
2000
2010
2020
Year
walleye pollock

What you get


Age composition input sample size
300
200
100
0
1980
1990
2000
2010
2020
Year
female
male
total
yellowfin sole

What you get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Bering Sea Slope
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Length composition input sample size
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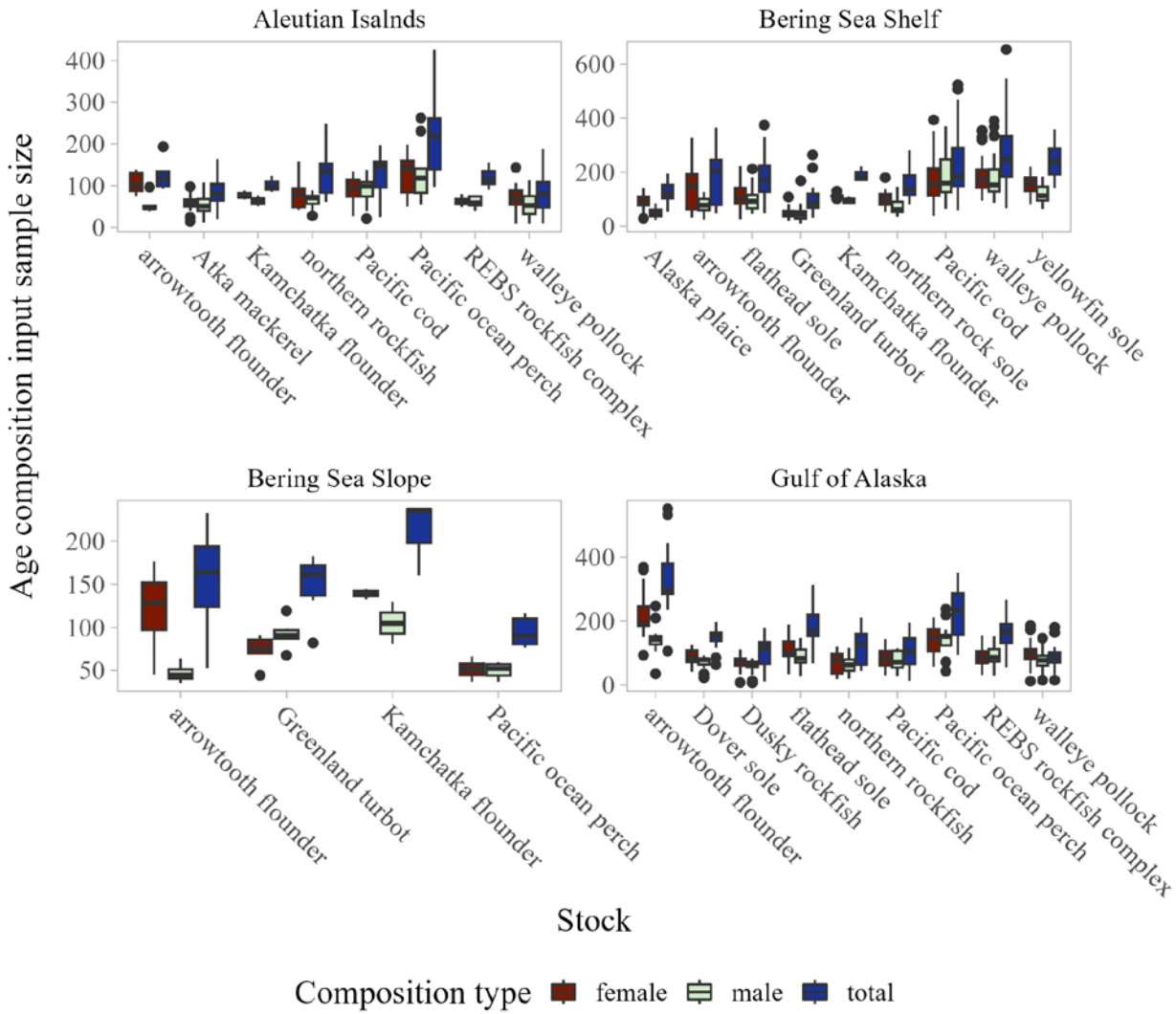
Kamchatka flounder
northern rockfish
Pacific cod
Pacific ocean perch
REBS rockfish complex
walleye pollock
Alaska plaice
flathead sole
Greenland turbot
northern rock sole
yellowfin sole
Dover sole
Dusky rockfish
Stock
Composition type
female
male
total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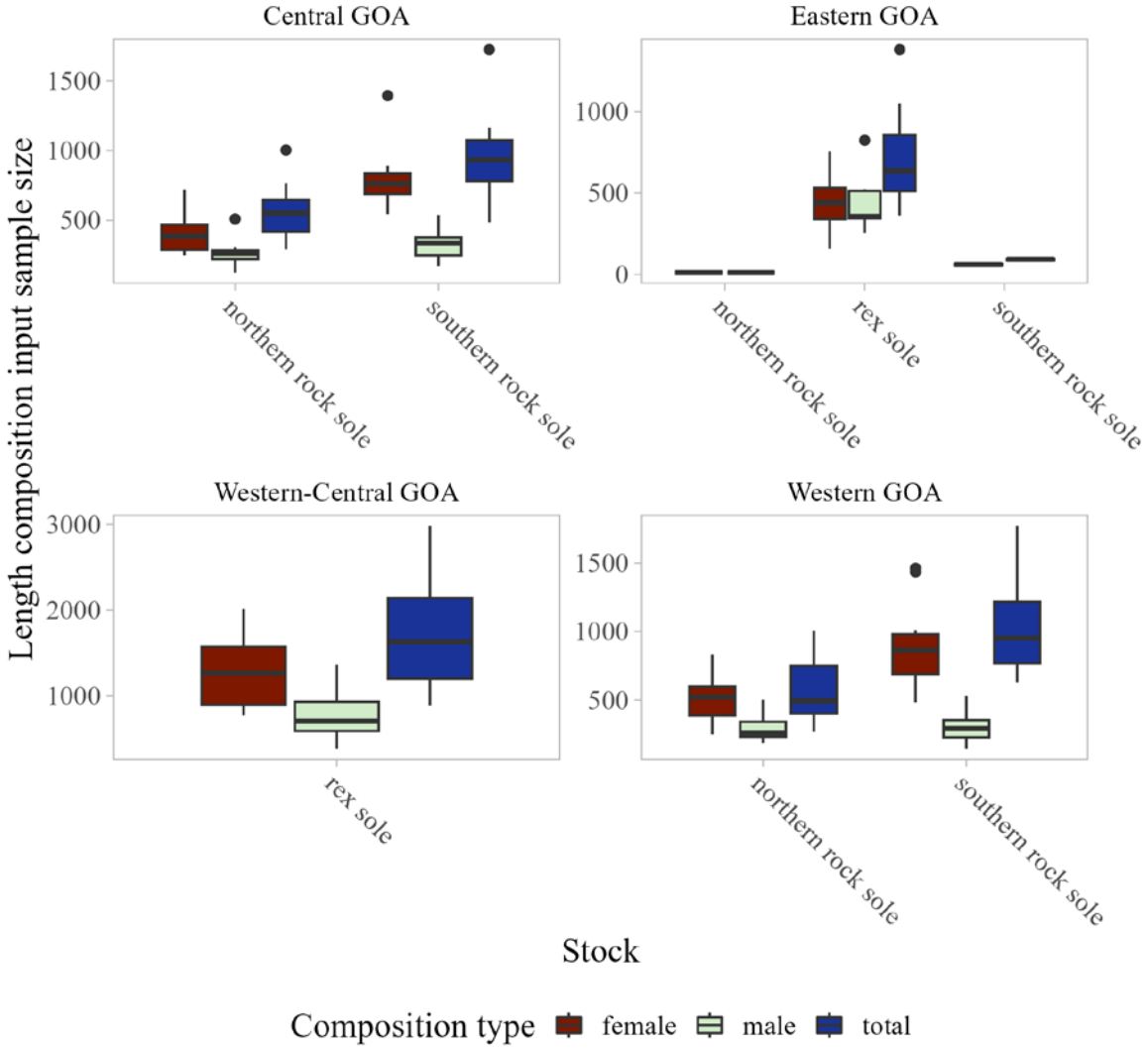
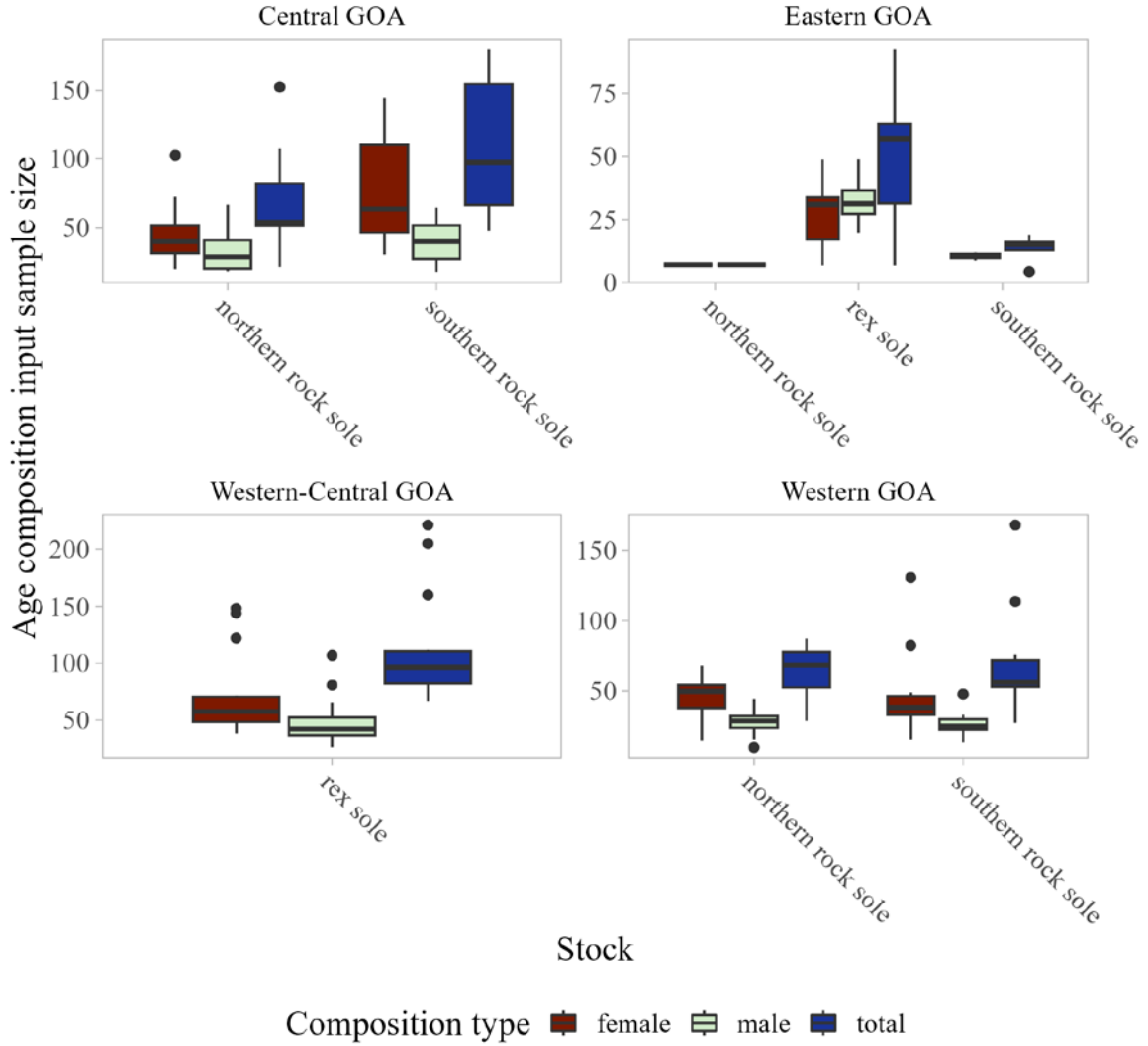
flathead sole
Greenland turbot
northern rock sole
yellowfin sole
Dover sole
Dusky rockfish
Stock
Composition type
female
male
total

What you get

	female					male				
Species	cgoa	egoa	wcgoa	wgoa	goa	cgoa	egoa	wcgoa	wgoa	goa
10200		25	72		101		29	51		76
10261	48	9		46	88	32			29	54
10262	78	12		48	129	40	5		27	72





What we've got so far

- Annual ISS for bottom trawl surveys for all Tier 3 and above species (for each combination that could be need for assessment)
- Synthesizing results:
  - Length comp ISS > Age comp ISS
  - Total comp ISS > Sex-specific ISS
  - Male ISS ≠ Female ISS in many cases
- Two packages:
  - https://github.com/BenWilliams-NOAA/swo: evaluates consequences of sub-sampling
  - https://github.com/BenWilliams-NOAA/surveyISS: production ISS script, also has options for what we'll talk about next
- Couple of tech memos

What we don’t got:

- Code to get ISS for other surveys: longline, acoustic, adf&g

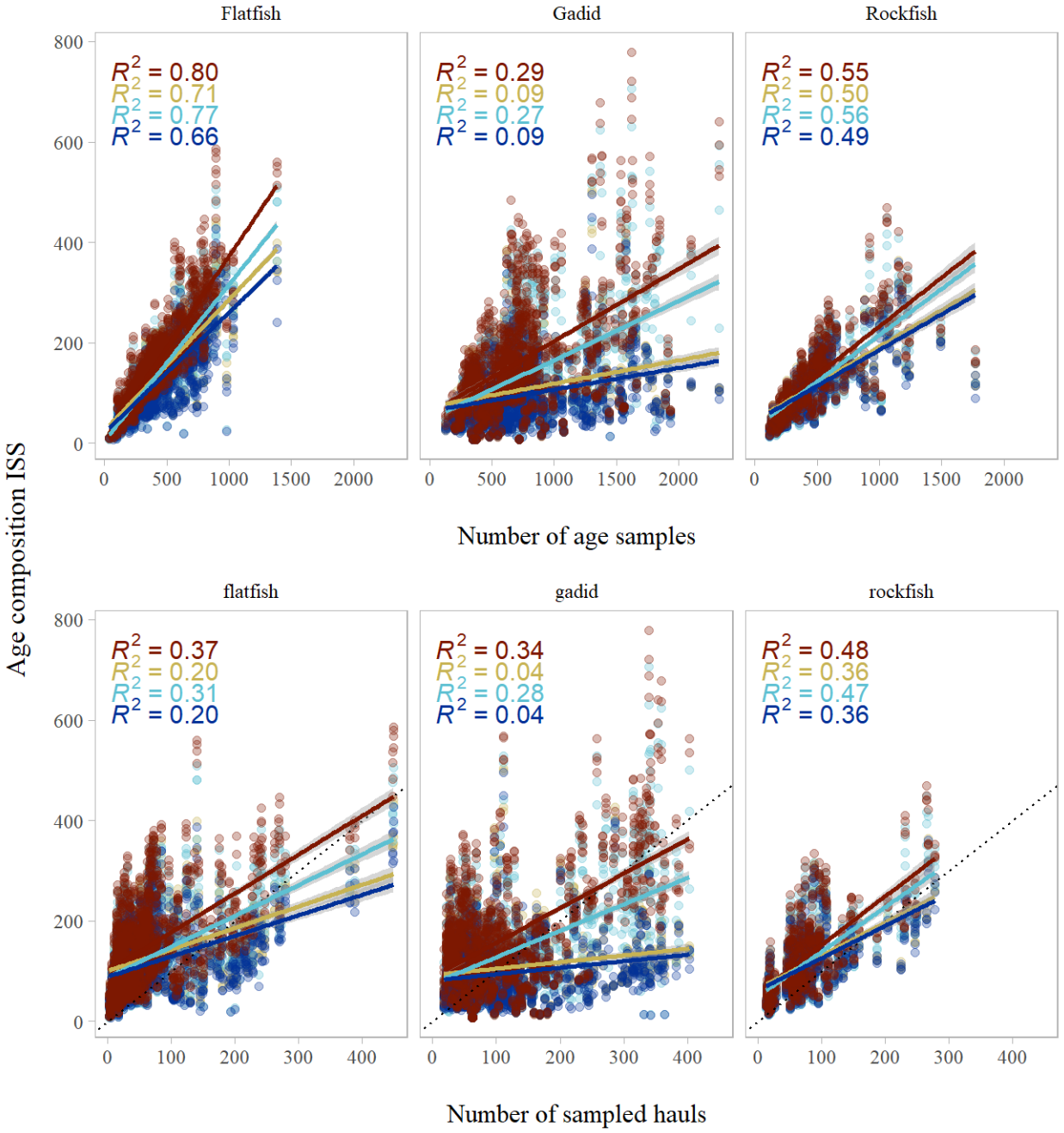
- Code for fishery-dependent ISS: got funding for post doc, will be starting this early in the new year

- Other dangling special cases:
  - AI northerns with spatial ALKs
  - Sex-specific comps that sum to 1

Some considerations:

- Often hauls (or nomial sample size) can be used as proxy for ISS

- Weak relationship between bootstrapped ISS with hauls/nominal sample size

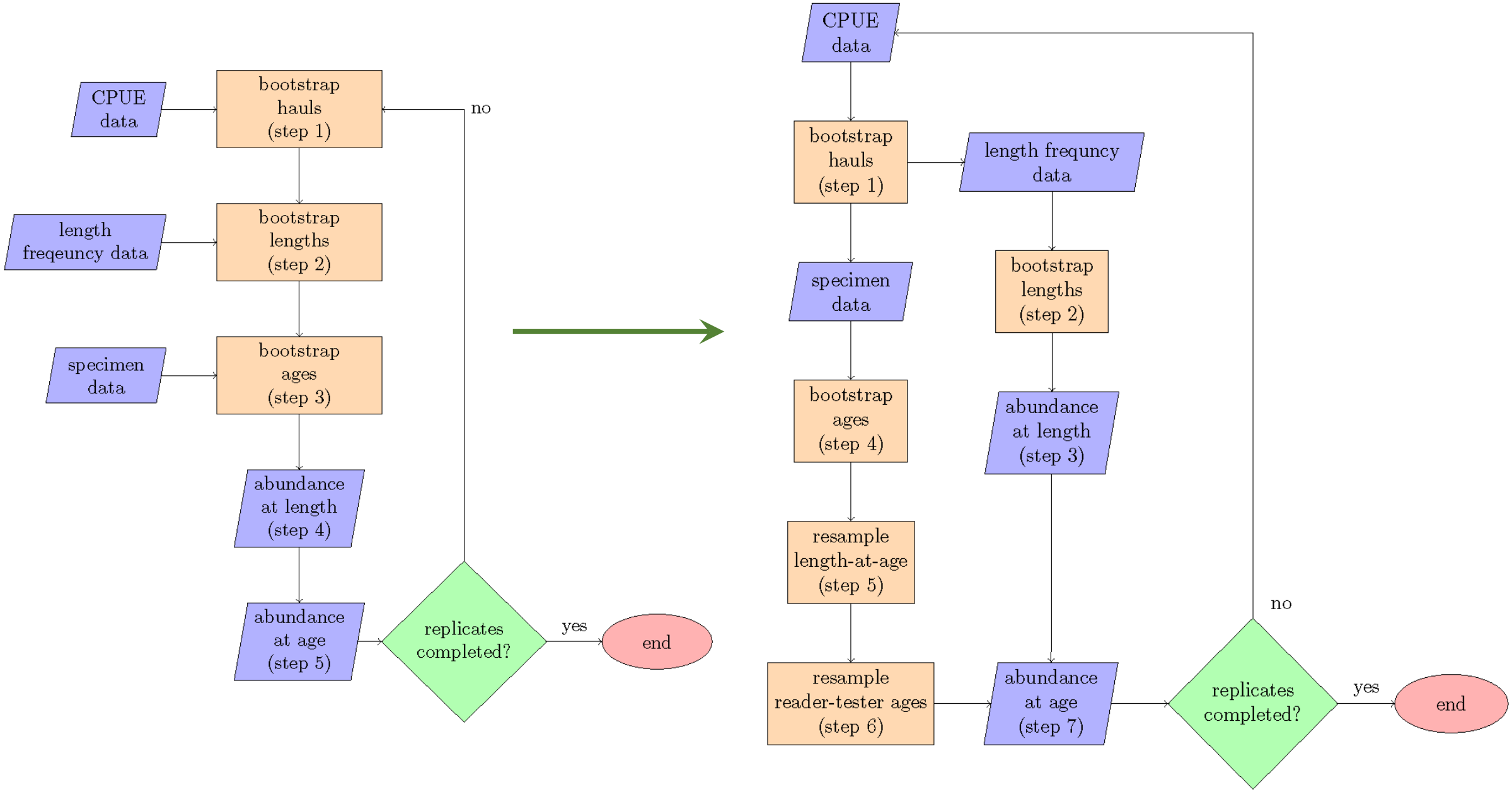


Current research developments

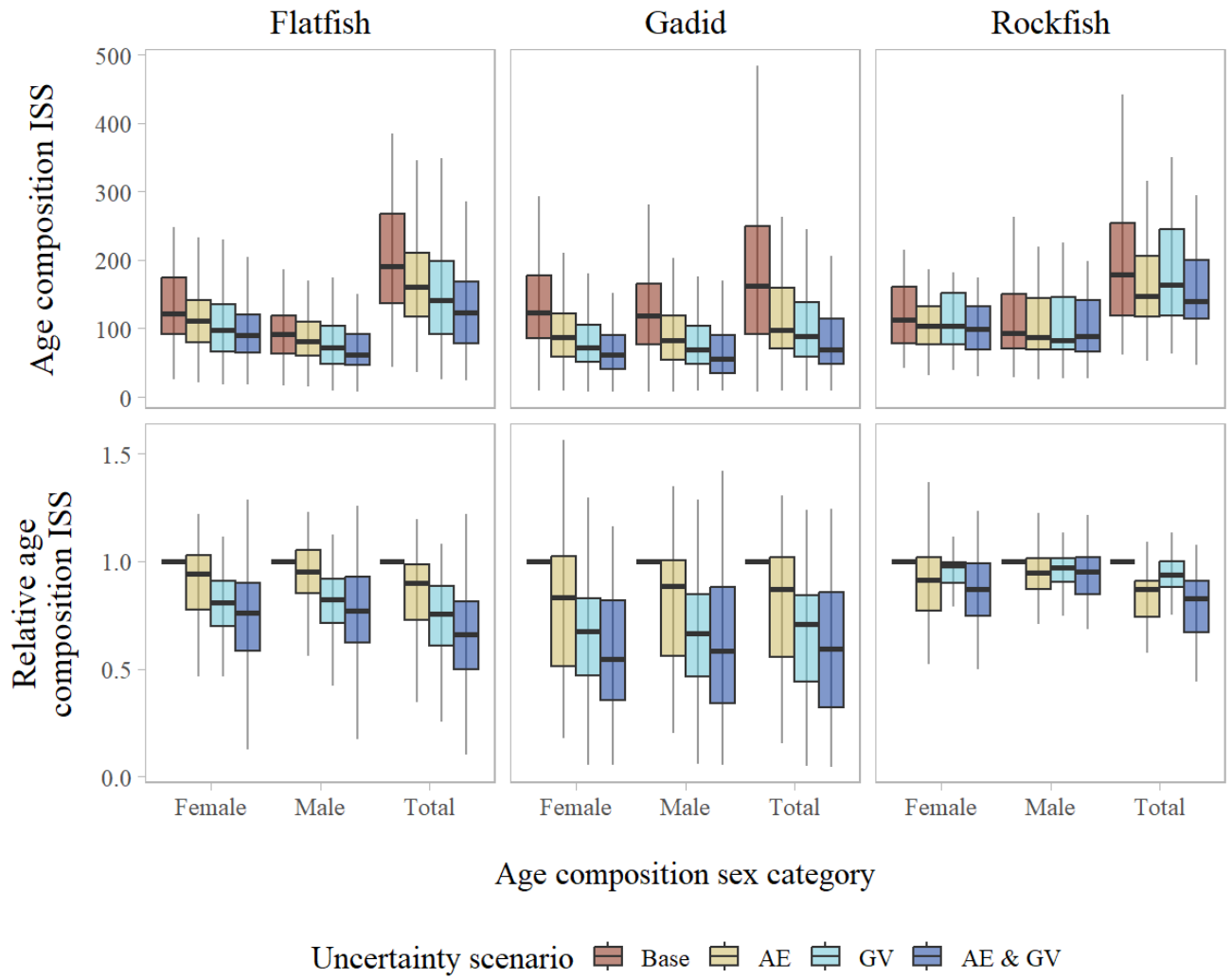
- Realized there's two sources of error were not accounting for

- When constructing the age-length key, not taking the variability in lengths for a given age into account
  - This is because when specimen data is resampled the age-length (and all other data) is paired together

- When using the age data itself, not taking into account ageing error produced by the reader-tester agreement (or disagreement)


CPUE data
bootstrap hauls (step 1)
no
length freqeuncy data
bootstrap lengths (step 2)
specimen data
bootstrap ages (step 3)
abundance at length (step 4)
abundance at age (step 5)
replicates completed?
yes
end
CPUE data
bootstrap hauls (step 1)
length frequncy data
specimen data
bootstrap lengths (step 2)
bootstrap ages (step 4)
abundance at length (step 3)
resample length-at-age (step 5)
resample reader-tester ages (step 6)
abundance at age (step 7)
no
replicates completed?
yes
end

Adding ageing error and growth variability:



Wrap up:

- Production age/length ISS available for trawl survey

- Broader question: compared to other ways we weight comp data (hauls, samples, etc, etc) is the bootstrap really a better indication of ISS? Does it capture the variability we want it to? Are we including too much variability, or maybe not enough?

Questions?