Frank et al 2016

Hypotheses:

1. Changes in the **timing of life cycle events**  
   (i.e., changes in timing of spawning which led to a spatiotemporal disconnect between timing of survey and arrival of spawning capelin)
2. Shifts in the behaviour of capelin from a highly migratory stock to one that has become predominantly **non-migratory**   
   (i.e. capelin stays inshore year-round, which benefit predators that normally inhabit coastal zones (murres, gannets))

Evidence for the non-collapse:

Analyses of NL ecosystem prior to, during and after reported decline

* 1. Capelin distribution
     1. Acoustic surveys: fish did not migrate offshore
     2. bottom trawl surveys: expected smaller area of occupancy. Used Engels and Campelen. Capelin in ESS and Flemish Cap
     3. Depth distribution: description of patterns
  2. Capelin residence time: if timing of migration didn’t change, length of survey is adequate for capturing biomass of migrating fish
  3. Inshore capelin indices indices from aerial surveys and commercial catch rates (inshore traps) increased through 1980s and 1990s
  4. Capelin demographic changes from harvest age and length declined in 1991
  5. Timing of inshore spawning: Trinity Bay. Peak spawning 25 days later. Therefore survey might have been too early
  6. Capelin recruitment Trinity Bay larval production did not change post 1991. Therefore it is inconsistent with capelin collapse
  7. Ecosystem response
     1. Cod weight at age and condition Latitudinal differences (2J, 3K, 3L) in liver condition and weight at age. Weight at age of Div 3L 3-4 yr old cod increased
     2. Harp seal population trends and diet population growth did not stop or slow down. Estimate of capelin consumption model
     3. Seabird population trends \* murres: increased from 10k to 100k (Funk). Capelin dominated diet  
        \* gannets: lots of capelin in diet 1990-2004  
        \* puffins: colonies in Great and Gull Islands increased
     4. Zooplankton response CPR data. No change in abundance post 1991
     5. Physical variability shift from cold to warm in mid 1990s