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 FRAN
     2. bottom trawl surveys: expected smaller area of occupancy. Used Engels and Campelen. Capelin in ESS and Flemish Cap. FRAN, DIVYA, AARON
     3. Depth distribution: description of patterns FRAN
  2. Capelin residence time: if timing of migration didn’t change, length of survey is adequate for capturing biomass of migrating fish FRAN
  3. Inshore capelin indices indices from aerial surveys and commercial catch rates (inshore traps) increased through 1980s and 1990s HANNAH
  4. Capelin demographic changes from harvest age and length declined in 1991 AARON
  5. Timing of inshore spawning: Trinity Bay. Peak spawning 25 days later. Therefore survey might have been too early HANNAH, DOM
  6. Capelin recruitment Trinity Bay larval production did not change post 1991. Therefore it is inconsistent with capelin collapse HANNAH, DOM
  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 MARIANO, ALE
     2. Harp seal population trends and diet population growth did not stop or slow down. Estimate of capelin consumption model GARRY, ALE
     3. Seabird population trends \* murres: increased from 10k to 100k (Funk). Capelin dominated diet

Frank et al (2016; Figure 11B) consider the population of common murres *Uria aalge* on Funk Island since 1990 is contrary to expectation given the purported order of magnitude decrease in their primary prey (Montevecchi 2000; Davoren and Montevecchi 2003). In doing so, Franks et al. (2016) misinterpreted the murre abundance graph from Figure 3 in Davoren and Montevecchi (2003) as an indication of population increase on Funk Island (mislabeled as Fogo Island in Figure 1 of Frank et al 2016). Figure 3 in Davoren and Montevecchi (2003) depicts the numbers of breeding murres present during August and documents a temporal shift in toward later breeding in the late 1990s. This shift in breeding corresponds with the later inshore arrivals of capelin in the murres’ foraging range. Yet the population of murres on Funk Island, did increase during the 2000s (Chardine et al. 2003), though it is in no way paradoxical with reduced capelin biomass. Much of this population increase is associated major reductions in adult mortality with the coincident with the closure of northern cod fishery and the removal of thousands of gillnets from inshore areas during the 1990s and 2000s and consequent bycatch mortality (Regular et al. 2014). As well, reductions in adult mortality associated with ship-source oil pollution and with hunting have also decreased during this same period (Robertson et al. 2008), and the cumulative effects of these reductions in adult mortality would have overweighed negative population effects associated with bottom-up prey base reductions. Along the same lines the population growth of Atlantic puffins *Fratercula arctica* and northern gannets *Morus bassanus* also increased over this period (Chardine et al. 2003), and these increases are associated with the above cumulative effects.

While the overall abundance of capelin is well below 33% long-term stock biomass assumed to be a critical threshold for seabird production (Curry et al 2011), it appears that the distribution and density of the forage fish within the seabird foraging around Funk Island is robust representing a hotspot in an otherwise very sparse overall distribution [Gail; Mowbray]. Interestingly, the common murres’ largest colony is on Funk Island, perhaps as a consequence of these conditions.

Frank et al. (2016) also questioned why the northern gannets’ consumption of capelin is considerably higher from 1990- 2004 (20 – 100 %;) than it is before 1990 (<12; Montevecchi 2007%), yet they ignore our primary contention that the cold water regime shift precluded the gannet’s preferred large pelagic warm-water prey from moving into the region hence facilitating ther prey switch to capelin. (Montevecchi and Myers 1997; Montevecchi 2007).

Literature Cited

Chardine et al. (2003)

Chardine et al. 2013)

Curry et al 2011

Montevecchi 2000

Montevecchi 2007).

Regular et al. 2014)

Robertson et al. 2008)

Zooplankton response CPR data. No change in abundance post 1991 PIERRE

* + 1. Physical variability shift from cold to warm in mid 1990s PIERRE

Frank et al. (2016) question why the increase in SST in the late 1990s occurred 5 years after the capelin collapse and is not temporally associated with it. However, they fail to acknowledge that this patterning well reflects a regime shift in which the biological consequences continue in an altered state well after physical conditions have returned to pre-perturbation levels (Hare and Mantua 2000). Missing this point, Frnak et al (2016) mistakenly conclude – “The evidence is weak, therefore, that changes in the physical environment were responsible for the rported 1991 collapse of capelin.

On page 1999, Frank et al. (2016) not - “we would expect that if a large fraction of the post-1990 capelin population became coastal residents of the major embayments of eastern NL (i.e. from White Bay in the north to Placentia Bay in the south), noticeable reductions in condition, growth, maturation timing and eventually population size would be expected.”

**Literature Cited**

Hare and Mantua 2000).

PAUL: inshore capelin density in ‘blind spots’