**Exercise 2. Data-rich Methods (SWNS/BoF herring)**

**Exercise Goal:**

Identify ways to approach defining an LRP for SWNS/BoF herring in a data-rich context.

**Exercise Questions:**

1. Evaluate at least 3 approaches to defining an LRP and identify the “preferred” approach that you feel is most consistent with the candidate criteria for best-practice indicators and LRPs
2. As a group, prepare a 1-2 slide (< 5 minute) presentation to explain

* Some pros/cons of each candidate approach
* The preferred approach (indicator and LRP)
* The rationale for the preferred approach
* Include a time series plot of the indicator and add a line to represent the LRP.

**Background:**

An age structured model for SWNS/BoF herring “stock” (a management component of the 4VWX herring stock) has been fit. The model is a multi-fleet Stock Reduction Analysis (SRA, Walters et al. 2006) fit using the Rapid Conditioning Model in [SAMtool](https://cran.r-project.org/web/packages/SAMtool/SAMtool.pdf). The SRA model applied here is comparable to other statistical catch-at-age (SCA) models such as iSCAM ([Martell 2017](https://github.com/smartell/iSCAM)). As an SRA, the model assumes historical catches are known exactly. The model assumes a Beverton-Holt stock recruitment (SR) relationship with steepness of 0.75 and a constant natural mortality rate of 0.35. The models were conditioned to catch and size composition data (1968-2018), an acoustic survey of spawning stock biomass (1999-2018), and a larval survey used as an index of spawning stock abundance (1972-1998, 2009). The fleets consist of a purse seine fleet (generally > 90% of landings) with logistic selectivity, a gillnet fleet with dome shaped selectivity, and an “other” fleet that consists of all other gear types with dome shaped selectivity.

**Dataset:**

* Model estimated spawning stock biomass, recruitment, total biomass, catch, apical F
* Mean weight-at-age, maturity-at-age, and selectivity-at-age over the historical time period
* A dynamic unfished spawning stock biomass (dynamic SSB0) has been provided for the historical time series (a projected SSB0 from the beginning of the time series with F=0 using the recruitment deviations from the model fit with the catches removed, and using the time series mean growth and recruitment). The acoustic index (used for tuning the model) is also provided.
* Equilibrium SSBMSY is calculated in the R script.

**Note:**

For the purpose of this exercise, vital rates are assumed to be at equilibrium. The variability in annual estimates of weight-at-age, maturity-at-age, and selectivity-at-age is assumed to be random variation about the mean.