**Statement of the problem:**

**Abundance and Biomass indices:**

* A good sampling protocol aims to control factors which may bias abundance of biomass indices between different survey years or regions.
* Factors that are not controlled have to be taken into account in some way in the analyses.
* In this way, we can meaningfully compare densities between different years or regions.

**Survey protocol and catch standardization:**

* Same gear.
* 5-minute tows @ 2 knots.
* Fishing during daylight hours.
* Wind conditions < 25 knots.
* Reject tows with too much net damage.
* Standardize catches by swept area.

**Issues with the survey time series**

* Survey design has changed multiple times:
  + Survey area has expanded through time.
  + Switch from 10’x10’ grids to square grids from 2012 onwards.
  + Number of sampling stations has increased.
  + Five different survey vessels (e.g. increasing horsepower, tonnage).
  + Switch from side to stern trawling early in the time series.
* Survey stations have been either fixed or relocated inconsistently.
* Scale differences between the 2018 and 2019 surveys:
  + Length-frequency data for females and males 2018 versus 2019 (global).
  + However, comparative survey revealed no such issues (local).
  + Protocol adjustments and passive trawling phase update for 2020.
  + Length-frequency data for females and males 2018 , 2019 2020 (global).

**All Is Not Lost:**

* Highlight that these issues are common to most surveys, because of the difficulty of maintaining constancy of protocols through time, shifting priorities and practical implementation.
* The quality and quantity of survey data allows for some capacity to make self-diagnostics and possibly correct some of the issues outlined above.

1. History of survey station relocations.
2. Year-over-year catch comparisons for snow crab and by-catches.
3. Population models
   1. Provides a synthesis of fishery and biological processes and models their interaction.
   2. Can provide inferences on trawl size-selectivity, natural and fishery mortality, survey catchability, growth and molting, recruitment, etc…
   3. Modelling of these processes can yield improved predictions of population dynamics.
   4. Time series standardization.
   5. If useful, it may be relied more and more in future assessments.

**However, this is unsettling, especially for the sGSL snow crab stock (move to end of time):**

* Reference points are defined using the index.
* Quotas set according to the biomass index.
* Changing of the index may require a review of set reference points.

Brooks , Mollie E., Kristensen, Kasper, van Benthem, Koen J., Magnusson Arni, Berg, Casper W., Nielsen, Anders, Skaug, Hans J., Maechler, Martin and . Bolker , Benjamin M. 2017. **glmmTMB** Balances Speed and Flexibility Among Packages for Zero-inflated Generalized Linear Mixed Modeling. The R Journal, 9(2), 378-400.

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.