**Survey station displacement history**

The southern Gulf snow crab annual survey has a 34-year history, from initial exploratory forays in 1987 and 1988 up to the present. During this period, the survey has undergone gradual expansions of the survey area, as well as changes in its spatial sampling design. Details on the sampling protocol and development of this survey can be found in Moriyasu et al. 2008.

The sampling design was based on randomly selected sampling stations within a regular grid overlaying the survey area. Rectangular 10’x10’ grids were used from 1988 to 2011, which were dropped in favour of square grids in 2012 onwards. Subsets of sampling stations were generally held fixed from year to year, though new sampling stations were continually added through survey expansions, relocation of sampling stations from difficult to more favourable trawling locations, and changes in spatial sampling design in 1991, 2006, 2012 and 2013.

**Figure 1** shows a generated historical summary of sampling stations used in the snow crab surveys from 1988 to 2020. Stations lying within a 0.75 km distance of each other were labelled as belonging to the same sampling station.

Macintosh HD:Users:crustacean:Desktop:Stock-Assessment-2020:results:figures:Survey Station History.pdf

**Figure 1**: Historical cumulative summary of sampling stations added during the annual southern Gulf of Saint Lawrence snow crab survey. The y axis shows the order of appearance of sampling stations, with older sampling stations found near the bottom and the most recent stations near the top. Annotations show major changes in survey sampling design.

From an initial set of stations in 1988, this figure shows that stations were added or redistributed for the majority of survey years. In particular, new stations were rapidly added in the early part of the survey, which had its greatest areal expansion from 1988 to 1993. Due to funding collapse, only a partial survey was conducted in 1996.

The period from 1994 to 2005 saw progressively smaller proportions of stations being re-located, in part due to improvements in geo-location technologies.

After a major survey sampling redesign in 2006, the set of sampling stations remained constant from 2006 to 2011, indicating that the survey crews heavily favoured resampling after a failed tow attempt, rather than relocating at an alternate sampling station.

Following a spatial sampling design was changed in 2012 a completely new set of survey stations were generated. The process was repeated in 2013.

From 2013 onward, the survey crew favoured alternate sampling stations, rather than repeating tows after a failed attempt at towing.

**Figure 2** shows the proportion of failed tows for each survey year. In 2012 and 2013, 17% and 20% of attempted tows failed on the first attempt. Given that the spatial sampling density over the survey area is fairly uniform, these proportions also represent the proportion of the current survey area which is trawlable on the first attempt.

However, these proportions were much higher than in previous years, which were around 8% to 10% in 2006 to 2011. Largely because of this, the trawl stations were held fixed from 2013 onward, with the proportion of failed tows again decreasing as alternate sampling stations replaced many stations from the original 2013 station set. Since 2013, about 200 sampling stations have been moved, which represent an important proportion of the survey’s 355 stations.

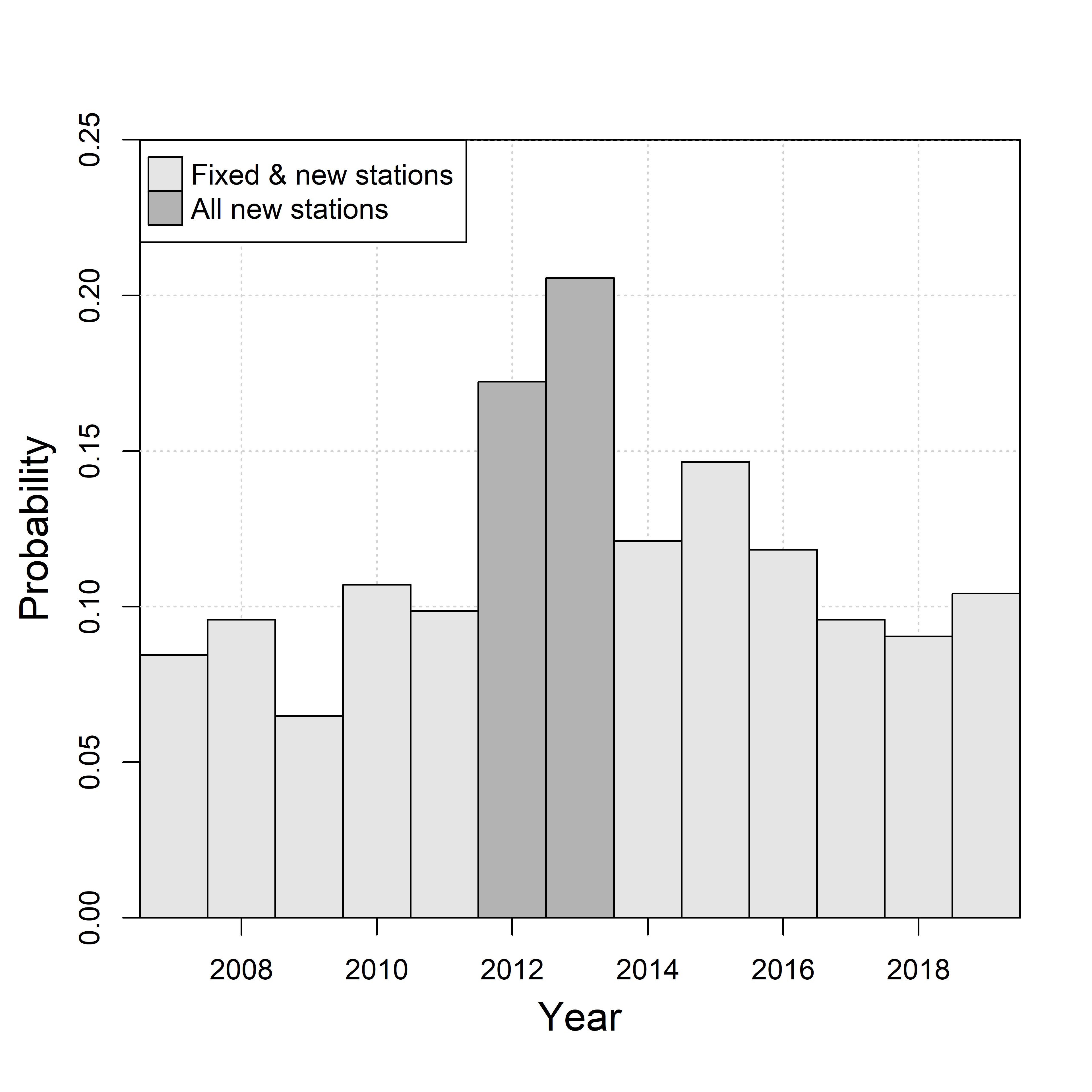
**Figure 3** shows where the relocations have occurred, indicating that problematic areas lie mostly between Prince Edward Island and the Magdalen Islands and along the Laurentian Channel.

**What are the implications of these changes?**

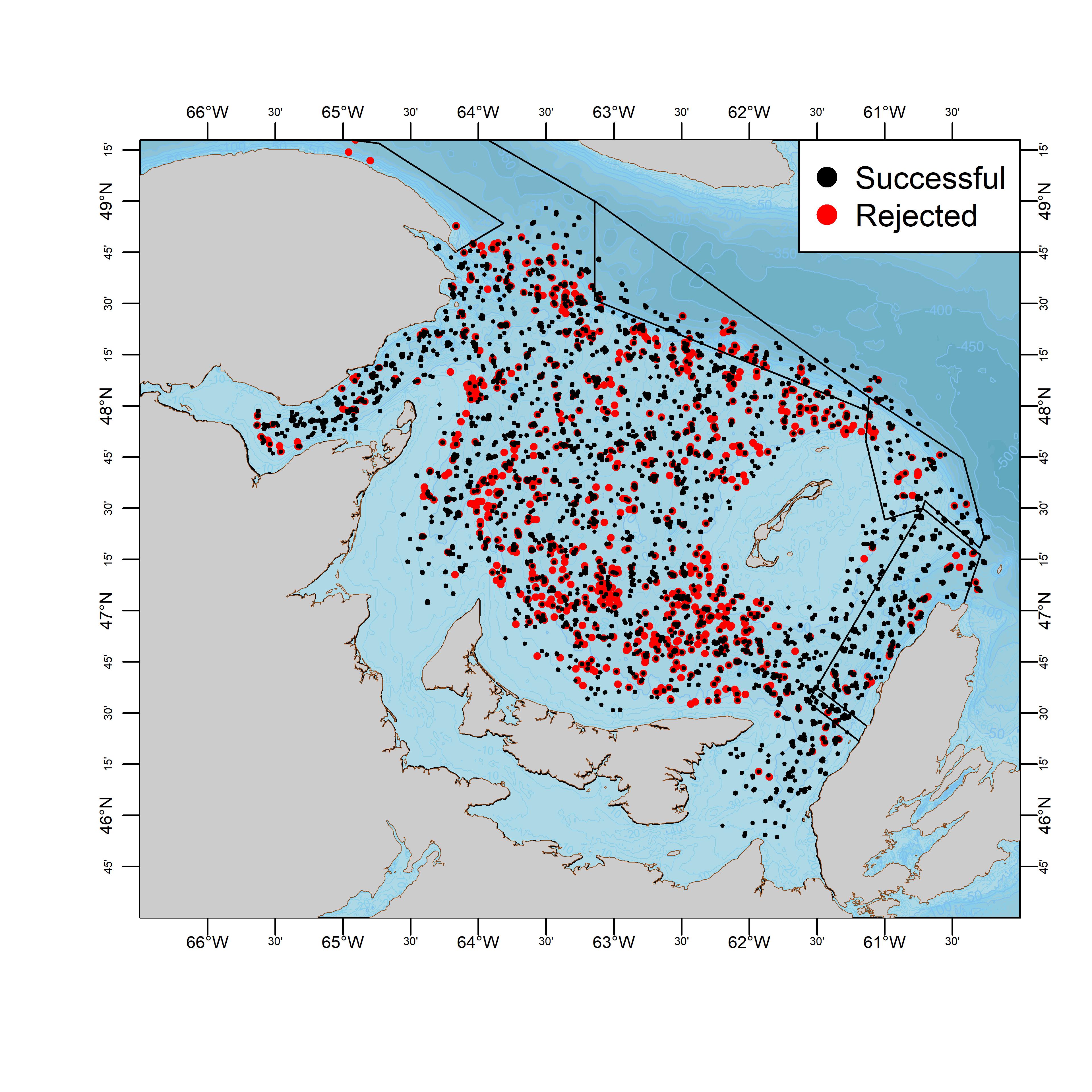
**Does the progressive redistribution of tows to more favourable areas for trawling entail biases in the abudance and biomass estimates?**

**How would we address the above questions ?**

* **We know which stations have been redistributed, so we can calculate abundance and biomass estimates with and without these stations. We can check how much the estimates vary.**
* **Are there hints of progressive changes in the abundance trends of snow crab ? In the survey’s other species ?**



**Figure 2**: Proportion of tows rejected on the first attempt during the 2007 to 2019 snow crab surveys.



**Figure 3**: Locations of successful (black) and rejected (red) tows in the 2000 to 2019 snow crab surveys.

**Bibliography:**

Moriyasu, M., Wade, E., Hébert, M. and Biron, M. 2008. Review of the survey and analytical protocols used for estimating abundance indices of southern Gulf of St. Lawrence snow crab from 1988 to 2006. DFO Can. Sci. Advis. Sec. Res. Doc. 2008/069.