TESA Small Pelagics Workshop

Day 2: Wednesday Nov 22, 2023

Talk 1: Allan Debertin

Practices and Practicalities of MAR Region Herring Acoustic Survey Design

Herring were historically very abundant in in Maritimes Region

Mix of purse seine, gillnet and Wier fishery

Use Love equation to convert target strength to biomass

BUT

The target strength portion of the equation cannot be traced back to literature, where does it really come from?

Target strength frequency response is uncertain

Use a standard target strength over years and length. But Weight and size-at-age are changing, so is this a appropriate assumption? Probably not

There are also changes in L50, and they discount SSB if 10% <23cm, so is a consistent threshold really applicable with changes in L50.

Acoustician Editors have changed over time- with relatively little overlap through time.

This could bias biomass estimates.

Introduced a new dataflow in echoview to remove attenuated noise, this is important but only started in 2018, so it needs to be applied back in time.

Also machines have changed through time, so not exact same amount of noise by different systems.

Plotting biomass through time is telling.

Can see changes in arrival on spawning grounds, very interesting approach.

How do you fill gaps, and account for changes in effort in survey (i.e. changes in CPUE).

Adhoc surveys can be a problem, better to use standardized transect.

Hard to apply adhoc surveys consistently.

Another problem, changes in survey area

Last issue, potential double counting.

-A good way to understand if this is an issue is with tagging studies. Seeing how long fish tend to stay on a spawning ground.

-Use a double counting and turnover equation to account for double counting and adjust biomass to discount the double counting.

However the turnover equation is not perfect, uses an instantenous Rate of Change.

Essential sums fish appear and disappear. A better way may be a CDF and Bayesian approach

Formal list of Issues: - Proposed SOLUTIONS

1. Target Strength frequency response – Use growth estimates, using length-freq distributions
2. Standard target by year or Spawning Ground
3. Changes in L50, Discount acoustic SSB <23cm?
4. Acoustic Editor changes
5. Including Noise algorithms
6. Changes in Temporal Distributions – Account for changes with packages like VAST or sdmTMB
7. Changes in # Surveys (CPUE)
8. Adhoc Surveys – pre-stratification based on effort.
9. Changes in Spatial Coverage- Don’t use extra areas
10. Turnover Equation Improvements

SHANNI makes a great point, Very important to understand acoustic biomass estimates are relative NOT absolute. This is because all regions are using different equations (i.e. Foot vs howig). Comapring across regions at absolute is very dangerous.

Biomass estimates using different equations can result in very different biomass estimates (.e. 4x)

STEPHANE added: Slope of equation based on fish size (i.e. 20log) is super important, so even if looking at relative biomass, if you change this slope or have different length-freq this can cause major issues and can make relative results incomparable. This slope assumption could be wrong, need experimental data to validate this.

Relative abundance is super important, rather than assuming absolute abundance

Laurie and Rachel: Practices and Practicalities of GULF Region Herring Acoustic Design

Two types of surveys

-DFO fishery independent study in Baie des Chaleur / Miscou Banks – mid Sep to mid Oct – 18 Stata and 168 transects

-Industry surveys -

DFO Survey Challenges:

-Large area to cover- weather and long transit limit ability for full coverage

-Can’t cover entire southern Gulf

-Minimum 2 DFO staff, hard to secure when othe surveys are going on

-Timing of fishery. Fishery cannot be occurring when we are surveying

-Vessel downtime

-Find fish – not always easy to find and/or catch

Fairly good coverage through time.

Can partition biomass estimate by spring and fall spawning component

INDUSTRY SURVEYS:

-Contracting has become an issue.

Used to be sole source, now must post competitive bidding

This makes it hard to forecast the price, if only 1 valid bid, must accept that bid

FALL Industry Surveys:

-On weekend closures

-5 surveys in each week, 1 per week starting week before fishery began

Major challenges:

-Contracting

-Cost is unpredictable and not controlled. Only way to cut costs is to reduce # of surveys

-Many fishers conducting acoustics at same time, but start times vary per region based on fishery timing

-Equipment problems, very technical equipment being used by non-technical individuals.

-Troubleshooting in evening/nights on weekends-hard on DFO staff

-Mean biomass per year increased in 2016 then decreased across all regions

SPRING Industry Surveys

-aim for 5 surveys per season, 1 before and 1 after fishing season

-Selected strata areas based on fisherman input.

-Then selected strata, and randomize transects in strata

Challenges:

-same as fall plus more:

-Missing surveys if ice stays long

-Other fisheries interrupt survey (i.e. too much lobster or fisherman switch to fishing scallop mid-season)

-Difficult getting fish samples using experimental nets, nets set in evening, basically shooting in the dark.

-Difficult setting strata to survey, fisherman giving new opinions on where surveys should be, presence of lobster gear

-Spawning to shallow, hard to collect acoustic data in less than 5m of water.

Future of Spring survey, they may be NO more.

Ron Lewis gave some suggestions: For spring, shallow water- reduce power, may help

Stephane mentioned – assigning species can be an issue, ground truthing is super important to validate what you see on acoustics is the species you think it is.

-Shallow water is a huge issue. Could be ways to predict the proportion of the population you are missing.

-120 HZ can be problematic from zooplankton or Krill that don’t have swim bladders. Can resonate lots at 120 and artificially inflate your biomass index.

- Jenni justified 120 HZ saying we are i shallow water so it helps. Plus we ave fairly empty water

Tiffany Said it would be valuable to compare editing approaches, consistency in editing approaches would be valuable to allow for comparability.

David Fishman Herring Data Flow Talk

ANDES: Port sampling and at sea sampling

-Helps improve dataflow, Andes can create reports and feed other systems (i.e. HERMAN)

-Port sampling app- helps improve the sampling, helps sampler to collect the port-samples, improves implementation of sampling protocol.

HERMAN:

-Ingests reports from ANDES

-Helps streamline fish processing

DFO dots: Will eventually be used for ageing and otolith annotations

Overall revolutionizes the workflow and saves a lot of time on data entry and fish processing.

SANA – NFLD Herring Acoustic Survey

- 5 stock complexes

-Assesses spring and fall spawners together

-2 acoustic times series: 1983-2001

-Then no data from 2001-2019

-New survey back in 2019

-Many changes from the two surveys, so hard to compare ‘apples to apples’

-Towed body from vessels!

Missed 2 talks before lunch due to appointment

CHRIS ROOPER:

RES at Pacific Biological Station

A wide range of surveys in Pacific Region, seems like many more than other regions. Great spatial and habitat coverage

ICES/PICES working group on Small Pelagic Fishes

Have database of surveys across the world focused on small pelagic fishes. If folks want to contribute data to this database contact Chris!!!!

We at GULF region should contribute our data

Chris brought up Potential Issues with SPF:

1. Gear Changes/ Vessel Changes/Net Changes

Potential solutions: K.Williams NOAA AFSC- using sterocamera’s mounted in net to look at within haul patchiness of species composition- horizontal variability in water coloum.

Also pocket nets to see what was getting through the net. SO previously all acoustic signal was assigned to pollock, but rreally it was representative of a range of small pelagics

1. Technology Creep

-J.Boldt introduced a digital measuring board to look at differences in measurements from old school board, and found no difference. Brings up point that we need to calibrate new equipment.

Important to constantly re-evaluate our methods. Use R to standerdize code to see if we can detect changes through time.

1. Historical change in objectives/design considerations

-Integrated Pelagics Ecosystem Survey. Basically combined 3 surveys into 1, so the surveys were not comparable through time

-Used sdmTMB to develop spatial temporal models to tie historic estimate together with new changes in survey to make the time series comparable, SUPER IMPORTANT!

1. Inconsistency in methods over time

-Pacific Egg survey is another good example. Historicall it was just a visual survey with surface sampling, then transitioned to a dive survey. Use to use these as separate index, but developed a blended index using q to deal with this discontinuity through time.

1. Unforeseen gaps in Time Series (funding/COVID)

-ICES working groups on this

1. Incomplete coverage of species distribution

-Age-0 Herring survey

-Use blind purse seine sets, then later look at acoustics.

-use moored transducers and stereo cameras to see what age 0 herring are doing through the season (outside survey season).

Highlights the value of moored gear to obtain acoustic estimates and target verification.

-Could potentially be used to increase efficiencies by use stereo cameras for target verification instead of setting nets. This is great way to save time and actually provides relatively high quality information.

1. High Variability in space and time, very hard to deal with
2. Underutilizations of platform data

-Pacific Hake survey, using a ecosystem approach to cllect more information on fish community

Lessons Learned from Chris

-Understand its an index.

-Use consistency in sampling

-Modelling can address some issue, to an extent, will not solve everything, particularly with complex small pelagics

-Pair monitoring with research. Use monitoring datasets to dive into research questions and better understand the monitoring efforts.

-Single species surveys are coming to and end. Make use of ecosystem surveys to better understand and integrate EAFM.

STEPHANE mentioned, using stereo camera’s are great. But also simple camera setups, such as go pros facing in toward codend can be super helpful and telling.

Shanni mentioned convincing management to add camera’s into trawls can be a tough conversation. They want something that is proven and works rather than a Magivered camera. Having a proven system would be great, and if we collaborate across regions, we can come up with a great, robus solution.

Allan mentioned, efficiencies are important to consider, need the staff and time to actually analyze camera data. But automated tools to classify fish species from camera, and can help with acoustic target verification.

Expert Session: The GOOD, BAD AND UGLY OF SMALL PELAGIC ACOUSTIC SURVEY DESIGN

-Diversity of surveys on both coasts of Canada.

-With advancement of technology we are doing things differently, not always better but different

Core assumptions of acoustic surveys

1. Assume spatial area covers the spatial extent of a population
2. Assume temporally captures the population
3. Stationarity implicit assumption i.e. assuming a stationary population, when this is often not true

Hard to deal with these assumptions as they are often not true.

From Sarah Power: We have two conflicting ideas on here. Perhaps the core assumptions are not core assumptions. - Surveys are indexes, vs surveys assume complete coverage. Can we revise to make two ideas one consistent message? Yes, I think the way we do this is acknowledge we don’t have complete coverage and the surveys are indexes.

One Bridge (way forward) is there are some geospatial statistical approaches to help with this. But important to identify when core assumptions aren’t met

ALSO how to reconcile previous historic samples with new ones, something that is challenging to do.

Biomass estimates are always relative, VERY IMPORTANT TO CONSIDER AND ACKNOWLEDGE

In short, standardizing approaches across regions would help provide more comparable relative indices

Need research to help inform biomass estimates. RESEARCH IS ESSENTIAL

BUT need to maintain time series when possible, and can be difficult to integrate research in a standardized survey.

No need to focus on finding all the biomass, but a better way may be to have a representative area and treat it as a relative index.

Space-Time mismatches can cause huge issues and important to be aware of

Geospatial statistics are good at interpolation but not extrapolation. When seeing large amounts of fish near the edge of survey this can be problematic.

Difficulties with time constraints associated with Coast Guard Vessels. Charters can be helpful, sometimes…. So maybe not always too helpful. Also perception /optics can play into it when using charters.

Unmanned survey vessels…..may be helpful for flexible timing. Sail drones can maybe used to cover more area and address spatial research questions.

eDNA to help validate targets.

From Noel: in SA context, a good survey will cover a portion of the population. With a relative index scale is irrelevant

For acoustics is scale irrelevant, or is it a partial estimate? How do we reconcile this.

Underestimates and overestimates can be very important from a SA context. How relevant are the actual biomass estimates from Acoustic methods.

Overall Noel believes we can do more than just acknowledge it as an index.

Incorporating and being transparent about uncertainties is essential, but hard to capture.

TWO REASONS WHY ACOUSTICS IS INDEX AND NOT BIOMASS

1. Are you capturing the whole population
2. Target strength issue. Target strength-length relationships are hard to acquire and can be hard to trust. Small changes in the equation used (about 15 you can use) has massive implications on biomass estimates

THE Potential UGLY:

Some people treat acoustic biomass estimates as a true biomass estimate and some treat it as an index, hard to reconcile the two, and can be oversold at time.

We say index so industry and public understand they are not used to represent the entire biomass. Surveys that chase industries conception of fish abundance can be dangerous. Recognizing it as an index facilitates standardization of the approach.

Allan’s RMarkdown Tutorial

Everyone should have a NAS, can store large amounts of Data and avoid portable hard drives. Several staff can access simultaneously when on DFO network.