REPORT 3.2

KamchatNIRO experts comments on the external evaluation report of the SOO assessment model *(letter #07-03/1904 of May 30, 2016)*

Recommendation 1:
Disaggregate fishery independent survey indices of abundance into age specific. Model age structure assuming a multinomial distribution for catch at age, discard at age, index proportion at age, and include age composition in the objective function. This is the most immediate change that can cover the most significant gap in the estimation of uncertainty.

Response:
Of course, any credible information about the age composition of North Sea of Okhotsk pollock based on scientific survey data can and should be used but, unfortunately, such information is unavailable. Data on the numbers of pollock at the age of 1–2 years based on pelagic trawl surveys performed in the spring are of little use for this purpose because they are very noisy. The reason is that it is hard to register these age groups by trawling method. In particular, the percentage of these age groups is rather small compared with that of 3-year-old individuals (see the figure). The number of 2-3-year-old individuals if often higher than that of yearlings. E.E. Ovsyannikov (2011) pointed out at this circumstance earlier and explained it by localized aggregations of pollock of these groups close to the seabed on the shelf (yearlings) or seabed drop-off (2-year-old individuals) (Avdeyev, Ovsyannikov, 2001), while they are virtually inaccessible for catching by trawls in areas with a rough seabed topography, say, in Shelikhov Bay.

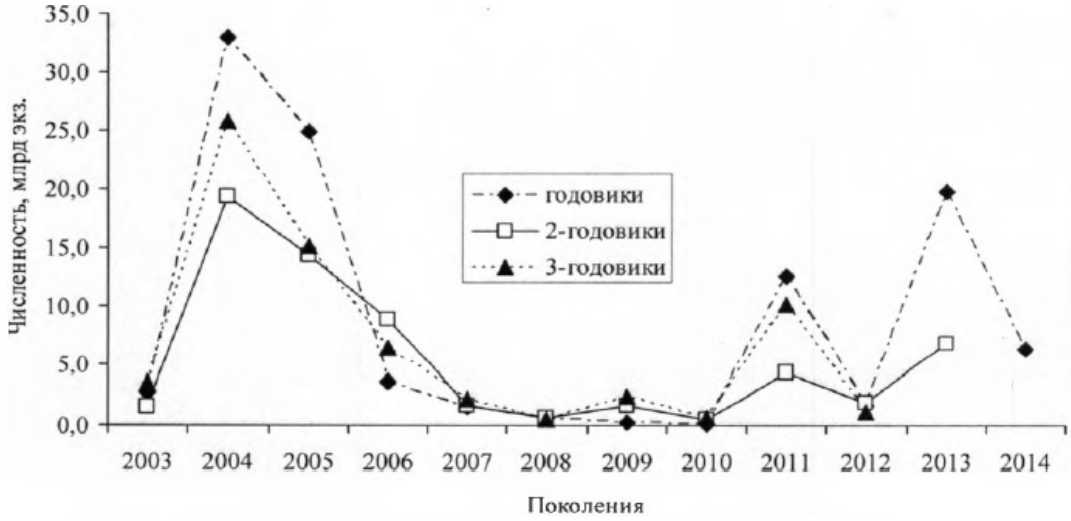

Fig. Pollock abundance at the age of 1–3 years by year classes
based on pelagic trawl surveys performed by TINRO-Center in the spring

Численность, млрд. экз. = Abundance, billions of individuals
годовики = yearlings
2-годовики = 2-year-old individuals
3-годовики = 3-year-old individuals
Поколения = Year classes

Recommendation 2:
Consider the introduction of ageing error in the model. Ageing error matrices (AEM) are often used to account for ageing uncertainty during fisheries stock assessment and define age

misclassification rates for the observed age range from sub-sampled harvest (Richards et al. 1992; Punt et al. 2008). Alternatively, a fixed level of ageing error (i.e. a constant CV estimated from an age verification study) can be set.

Comment 2
We plan to apply a similar approach in the nearest future.

Recommendation 3:
Consider different weighting of the objective function components. This provides important information about the robustness of the assessment. Not all stock assessments are sensitive to changes in data weighting but we can't know about any such sensitivity unless we investigate alternative weightings (Francis, R. C., 2011).

Comment 3
Weightings of the objective function components, if it is a weighted sum of squared deviations of observed values from theoretical values, are inversely proportional to error dispersions. Logarithms of maximum likelihood functions for various data sources (catch by age, stock index, etc.) are currently used as objective function components for North Sea of Okhotsk pollock. As for the assumption that errors in survey data and age composition of catches are lognormal, dispersions of these errors are evaluated by observation data together with other parameters of the model. In this connection, model sensitivity to dispersion variations may, in principle, be roughly evaluated using bootstrap analysis results and/or Monte Carlo method.

Recommendation 4:
Conduct sensitivity analyses to investigate model sensitivity to a variety of assumptions, including but not limited to: natural mortality, growth, maturity, the stock – recruitment relationship, selectivity, environmental factors, and alternative indices.

Comment 4
Yes, we agree that this needs to be done and plan to do this, at least in relation to instantaneous rates of natural mortality and to selectivity curve shape.

Recommendation 5:
Consider modeling fishing fleets separately. Each fleet may have unique selectivity vectors so modeling them separately may lead to a reduction in uncertainty. Discards could be modeled separately as well.

Comment 5
We agree with this recommendation, the more so that we have such data. At the present time, the overall catch-at-age matrix is initially prepared separately for the trawl fishery and the Danish seine fishery and then summed up. However, it should be kept in mind that North Sea of Okhotsk pollock yield in the seine fishery is much smaller than in the trawl fishery (6.2% of total yield in 2015). Due to this reason, such separation can be neglected.

Recommendation 6:
Currently risk evaluation is considering only the probability of falling below biomass threshold B_{lim}. Including of the probability of achieving SSB_{target} will strengthen further current precautionary approach and correspond to fuller extent to the MSC requirement on appropriate handling of uncertainty in harvest control rule.

Comment 6

We agree with this comment and in the future we will indicate probability of stock assessment exceeding B_{tr} in the forecast year or in long-term prospects.

Recommendation 7:

Consider accounting for the uncertainty in reference points. Examples of such an approach include Prager et. al. (2003), Grabowsky and Chen (2004), and Shertzer et. al. (2008).

Comment 7

We evaluate statistical characteristics for biological reference points such as F40%, F45%, F01, Fmed, Fmax, Fmsy, Bloss, B25%vir by bootstrap analysis results. Unfortunately, they were not presented in the final document. When reference points are being revised once again, we will present statistical characteristics (confidence intervals, standard errors) as it is done, for instance, in Ilyin's paper (Ilyin et al., 2016).

Recommendation 8:

A more substantial recommendation that will require a significant effort, but may also provide a very substantial benefit, is to recode the model in the AD Model Builder environment (Fournier et al., 2012) or adopt the existing, tried and tested versions of Statistical Catch at Age Model such as ASAP (Legault 2008), BAM (Williams and Shertzer, 2015) or namesake "Stock Synthesis" model by Methot (2013). ADMB is the most widely used software package for the development of state-of-the-art fisheries stock assessment methods. It can be downloaded without charge from a public web site, http://admb-project.org. Published benchmark assessments have shown that it provides faster and more reliable parameter estimation than other generic function minimizers. The advantage of such a move is twofold. First, this software provides a very powerful modeling environment and second, it has become a standard environment for assessment scientists throughout the world, making any future peer review of model structure and performance easy and transparent.

Comment 8

As far as we know, ADMB is a package intended for optimization of objective functions using fast automatic differentiation methods. Such packages were developed in the USSR for much more complicated tasks in early 1980s. However, time-honored finite difference methods are still in use and valid. Of course, the model algorithm would work much faster in ADMB environment than it works now but would it be (much) more accurate? Anyway, we might try the model in ADMB or similar environment.

Recommendation 9:

Moving the model into the Stock Synthesis framework (Methot, 2013) will even further advance the stock assessment of Pollock due to extreme flexibility of the model and its ability to accommodate all sources of data (e.g. size frequency information from the catch and the surveys that current model does not utilize). The Stock Synthesis model also uses maximum likelihood estimation and incorporates options for Bayesian analysis which would allow more complete analysis of model uncertainty.

Comment 9

In essence, this is the only one model – cohort model dating back to Baranov's ideas (1918). All of its modifications vary in assumptions about the nature of errors, different setup information use, different parametrization of stock parameters and parameter evaluation methods. Nonetheless there are stocks in the world still assessed by classical VPA method. We are skeptical about model "bloating" and increasing of the number of parameters being evaluated to the number currently used in Stock Synthesis 3. Furthermore, we believe that the time required for "introduction" of such a program as Stock Synthesis 3 is comparable with the time required for development of a customized version of the cohort model fully accommodating specifics of the object of study and level of available information support.