Jan 13, 2003

From: Dr. Marc Labelle, OFP-SPC
To: SCTB-MWG participants
Re: Multi-model testing

First and foremost, the OFP staff sincerely wish you all the best for the new year. Bon, formalities aside, its time to get back to business.

As requested by the Methods Working Group of SCTB15, new fishery data sets were generated for multi-model testing in 2003. Several modifications were made to the operational model, so the underlying dynamics of the simulated fisheries/populations are more realistic, which should be reflected by the new data sets generated. As you will recall, three simplistic fishery scenarios were requested by the MWG participants to investigate the effects of spatial stratification, tagging information, higher exploitation levels, and increased number of realizations. What follows is a brief description of three new data sets generated for this purpose.

As before, all scenarios involve a closed tuna population occupying the Western and Central Pacific Ocean (WCPO) stratified into 320 5^{o}x5^{o} (lat.-lon.) cells. Growth conforms strictly the von Bertalanffy model, with no sex-specific or time-specific variability. Natural mortality is age-specific, but not sex-specific. Growth and natural mortality rates are the same for all scenarios, but may not conform to those of yellowfin tuna as reported in the literature, or in the MWG-1 paper presented at SCTB15.

Maximum longevity is 28 quarters (84 months), with data reported below in 20 quarterly age groups, with the last group including fish older than 60 months of age (i.e. a plus group). It is assumed that scientists have some information on the age-length relation from growth studies. The approximate lower and upper bounds (95% CI) of length-at-age (fork length in cm, age in quarters) at the start of a quarter are as follows

Age	LB	UB	Age	LB	UB
1	17	46	11	103	155
2	38	68	12	105	158
3	54	87	13	107	160
4	66	103	14	109	161
5	76	115	15	111	161
6	83	126	16	112	162
7	89	134	17	113	162
8	94	141	18	114	163
9	98	147	19	115	163
10	101	151	20	116	163

Fish weight (W in kg) is a function of fork length (L in cm), expressed as $W = 0.00001759\ L^{3.0}$. The proportion of fish in each age group (in quarters) that are mature is 0 0 0 0 0 0 0.5 0.5 1 1 1 1 1 1 1 1 1 1 1 1. Spawning activity can occur each month in cells having a spawning population and a SST > 26^{o}C. Recruitment is predicted based on spawning biomass in each cell using the Beverton-Holt model with a log-normal error. Recruitment occurs after 2 months of growth. For simplification purposes, there is no time lag between spawning and

recruitment. All fish recruiting to a time/area strata form a distinct school, whose members grow and move together until the last one has dies. There is no exchange of fish between schools, but there can be several schools in the same strata. School movement across cells is a function of fish size, and is modelled as an unbiased random walk, constrained only by sea surface temperatures (SST). Movement occurs instantaneously at the beginning of each month. The simulator also accounts for about 40,000 tagged fish released during 1989-92. Tagged fish in each size category are assigned to a school in the same stratum with the same mean fork length, and move with that school until all fish have died. For these scenarios, tag reporting rates are constant across strata, and there are no misreporting.

The population is subject to exploitation throughout the year during 1962-98, but effort is not deployed uniformly across all time/area strata. The effort series are similar to the actual patterns in the WCPO, and may not provide the unusually high contrast desired for testing purposes. The following scenarios involve purse seine (PS) and longline (LL) fleets. These first 3 scenarios consist of (i) 1 LL fishery operating in a single region, (ii) 2 fisheries (1 LL, 1 PS) operating in a single region, and 4 fisheries operating in 2 regions (1 LL + 1 PS in each). For the two region scenario, the WCPO was split in two unequal regions, with overall effort in each fishery also split based on fishing location. Thus, the fishery data for the 4 fisheries by two region scenario is almost identical to the 2 fishery by one region scenario. Catchability rates are fishery-specific, not necessarily constant throughout 1962-98, and not identical across scenarios. There is no seasonal change in longline catchability. Gear selectivities are fishery-specific and constant over time, but patterns are not be identical across scenarios.

Catches in each strata are sampled at low rates (<20%) that not necessarily uniform across strata, or constant through time. Given a sampling rate, the simulator selects sizes at random from the actual catch length frequencies, up to 10% of the sample size. For each size sampled, 10 fish are added to the associated frequencies when generating the dataset. Consequently, the variation in the length frequency datasets generated exceeds that of the actual [simulated] catch length frequency data as if catch sampling was not conducted in a representative manner. No additional observation and measurement errors are implied when generating the length frequency datasets.

The data generated are reported by fishery, region and quarter. For longline fisheries, standardized effort is expressed in numbers of hooks, and catches in pieces. For purse seine fisheries, standardized effort is expressed in numbers of sets, and catches in weights (mt). The top 19 lines of the .frq file is used to configure MULTIFAN-CL (MFCL), and can be ignored by those not using this model. The following numbers represent the number of records, number of size intervals (100), the first interval (10 cm), the interval width (2 cm). The remaining numbers on that line can be ignored since no weight frequency data are supplied. The following records states the fishing year, the month (middle of each quarter), and the week (always 1 for these cases). This is followed by the fish length frequencies from catch samples. Fishery records are also given in file A-SCALA.txt in the format requested by IATTC in 2002.

Tag release and recovery data are given in the .tag file The release records are temporally stratified into 14 quarters (see first line). Fish size is in cm, with the smallest of the 100 categories being 10-12 cm. Tag recovery data are stratified by quarter and release size. The

number of recovery strata associated with each release is given under 'tag recoveries'. The release/recovery record details follow and consist of release region, release period, size frequencies at release, total number released, and total number recovered. Recovery details consist of release size, fishery where the recovery took place, recovery period, and numbers recovered in a stratum.

For each scenario, 40 realizations were made. Assessments can me made with and without the tagging data supplied. The corresponding 40 datasets (ASCALA, .frq and .tag files) are in separate folders (MWG_x, x = 1-40) in the directories 1Fx1R (i.e 1 fishery x 1 region), 2Fx1R and 4Fx2R. Current plans are to start generating and analysing data sets for more complex scenarios (more fishery/regions, variation in growth, changes in catchability and selectivity, etc.) this month. These could also be sent out if scientists wish to analyse more informative datasets prior to SCTB16. At a minimum, the scenarios will include 7 fisheries by 7 regions with seasonal changes in catchability, and 16 fisheries by 7 regions with more noise and variability in different components.

For assessment results, scientists are asked to estimate trends in total and spawning biomass, in the presence and absence of exploitation, as well as recruitment and overall fishing mortality (catch/biomass) by quarter if possible. If this cannot be done, scientists are asked to estimate total biomass, averaged over the first and last three quarters. The later points, termed B_o and $B_{current}$, can serve to assess fishery impacts ($B_{current}/B_o$). Scientists are also asked to estimate natural mortality (M), maximum sustainable yield (MSY), overall F at MSY, biomass at MSY and spawning biomass at MSY. These points are used as indicators of over-fishing ($F_{current}/F_{msy}$, $B_{current}/B_{msy}$), occasionally using proxies when the MSY can't be quantified with certainty (F_{msy} = 0.8 $M_{average}$, and B_{msy} = 0.4 B_o).

I would urge all scientists to start doing assessments as soon as possible. I've already analysed these data sets with MFCL, and got some coherent results, despite the fact that the data sets are fairly uninformative. However you may still detect problems I've missed, and if so, please let me know asap so I have time to generate and broadcast corrected datasets.

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