February 13, 2014

Brett,

I think the thing that is really complicating the BC analysis is the strong cost gradient with distance from population centers, such that anglers from any center have to choose between less frequent (and more costly) fishing far from home vs going to low cost nearby lakes and accepting low catch rates due to high efforts close to home. This notion of within-season closed periods to increase vulnerable numbers may be a way to break through that problem by managing some accessible lakes so as to offer less frequent but better fishing within each season. The critical data that we need to get is on how fast the vulnerable pool increases after a depletion opening, i.e. we need to run "Askey" fish downs followed by different closed periods. Just showing that cpue drops to near zero after only a small portion (vulnerable stock) of the stock has been caught does not demonstrate how quickly (or whether) the remaining fish will become vulnerable, and the methods for getting v1 that Sean used may have given values way too low.

If you are thinking about experiments to measure v1 by doing multiple Askey-depletions through a season with different recovery times between depletions, there is that nasty problem with our RBT lakes that catchability has strong seasonal intrinsic variation due to things like avoiding warm surface waters and post-spawning changes in activity and feeding. We need to figure out how to control for those effects...

There is another thing to consider. Mike's bass experiment shows that the vulnerable stock proportion (initial V) may differ dramatically for different gear types; in his bass experiment, only a small pool of fish was vulnerable to active lures (ratl-traps, kind of a nasty rappala with big treble hooks, seems to anger bass when dragged by them), but apparently all fish were vulnerable to plastic worms that are more like natural foods. He got slower depletion with the worms, but didn't run the experiment long enough to see whether there is a recovery in the vulnerable abundance with respect to the active lures. There may be an opportunity to keep catch rates up longer, or provide pulsed opportunities to get high cpue, in RBT stocks lakes that get a lot of pressure, just by restricting allowable gear type.

I'm not sure what all came out in Hilary et als latest (2013) paper discussing hyperstability, can't download a copy of it here. Can you send me a copy? If she has shown strong hyperstability instead of the hyperdepletion expected from limited vulnerability exchange, I suspect that has to have been caused by effort sorting, i.e. anglers with low q dropping out when cpue is low, which is actually evidence for the need to provide higher cpue to keep those low q anglers going out.

Carl

February 12, 2014

Ed,

It is quite simple to explore long term implications of alternative rotation policies given any particular effort response model, simply by tabling the relationship between end-season abundance and initial abundance, i.e. predict the relationship between net fishery-induced mortality rate and abundance. Then that relationship can be plugged directly into any long term population model, without bothering to repeat the daily calculations for each simulation year. For catch-release situations, and with likely strong effort responses, I think the basic result would likely be to essentially eliminate any risk of recruitment overfishing. But you can easily check this.

I think the most interesting and really challenging problem is how to solve the optimization problem posed by your second and third extensions, i.e. given a heterogeneous angler population with respect to valpower (or quit-fishing cpue for a linear utility function that goes to zero at nonzero base cpue--new model version with a tab for this attached), and a heterogenous regional collection of fishing locations (lakes, etc), what is the optimum proportion of locations to assign to each rotation scheme so as to maximize total utility over the angler population? That is, what is the optimum portfolio of regulations for the region as a whole? Note that solving this problem should greatly reduce or eliminate the "muting" of value that you mention in your second point. I think this is basically the problem that Tom Carruthers has been trying to solve for BC trout lakes with the added complexity of angler populations from multiple regional centers (cities, towns) who access lakes that differ greatly in access cost (travel time), right Brett? I don't know how that work has gone, but I think the rotation option (like access/effort limitation) would have a huge impact on the solution.

An interesting thing you can see in the "linear util" version of the model is that the cpue below which utility is zero (cpuebase) does not have a strong effect on the ordering of rotation policies unless it is very small (<2), equivalent to valpower=1. I think this means that open-every-day policies are only optimum for a small fraction of regional locations, since I think that only a small fraction of anglers are still willing to go out even when the cpue is very low. The big issue then is whether there really is a vulnerability exchange process , because the optimum shifts to fishing all the time of the vone, vtwo parameters are high.

Carl

February 12, 2014

Guys,

I dawned on me that it is not necessary to use Solver to search for optimum open-closed rotation patterns for the model I sent this morning, because relatively few rotation patterns would actually be practical to implement.  Each pattern is characterized by a number of days open, then how long the fishery is closed until the next opening (remainder of the week, two weeks, remainder of the month).  So I listed these rotation patterns (and the open-all-the-time pattern), and set up a choose function to pick the pattern for each simulation.  I then tabled the resulting total values by pattern number, making it really easy to compare values for different rotation patterns.  So if you change parameters in the “selected sequences” tab of the attached, the whole table of values and the bar chart will be immediately updated, making it trivial to see how the various parameters affect the best rotation.  It is interesting that the ranking of options is really sensitive mainly to the value function power, and a bit to the effort response if high cpue is needed to keep people fishing, but not sensitive to the “biology” parameters for vulnerability exchange and fate of captured fish.

Mike,

It also occurred to me that you can estimate the initial vulnerable numbers of bass to your two gear types just by doing a Leslie depletion analysis of cpue for each type vs cumulative catch.  A very simple version of that is on the “bass” tab, using only the initial and final cpues and the final cumulative catches (should do this using the daily cpue and daily cumulative catch).  This assumes that the fishing experiment was over a short enough period of time for the vulnerability exchange process not to have had a big effect.  To my surprise, the estimate of initial vulnerable number for the plastic worms is estimated by the Leslie method to be around 386 fish, remarkably close to the total number of tagged fish to start with.  This indicates that there might even be a vulnerability exchange process for the worms, or that the process is so fast as to act as though it wasn’t occurring.  The ratl-trip initial vulnerable numbers estimate is about 100, just as you would expect from the rapid cpue depletion.  Note you can quickly check for violation of the Leslie closure assumption just by plotting the Leslie estimates (-intercept/slope of cpue vs cumulative catch K) with increasing numbers of days included in the regression; if there was much exchange, the Vo (No) estimates should increase progressively over days.

Carl

February 12, 2014

Guys,

Here’s a more realistic version of that inseason optimization model, with weekday/weekend differentiation of maximum effort (important in BC trout situations, probably much less in Florida) and incorporating Brett’s suggestion that the unregulated effort dynamics ought to be included in the calculation.  Effort is modeled now using a logit choice function for shutting down effort when cpue drops to around a level “cpuehalf” where most fishermen would quit or go elsewhere.  The effort response doesn’t seem to matter unless cpuehalf is high (on order 10 for the example q and N parameters), in which case the optimum solution appears to switch from periodic to continuous fishing, i.e. it isn’t worth having recovery closures if effort falls off anyway whenever cpue drops a lot.

Carl

February 11, 2014

The 10/0 split is just to represent closing for a series of days (0), then opening and expecting high effort (and cpue) during that open day.  Could use any values for the effort during openings.  Yes, valpower >>1 is critical for it to be optimum to pulse fish with just occasional open days.  The whole idea of the power value measure is to get away from the old cpue x effort or power<1 (saturating) assumption that has dominated thinking about stocking programs and effort regulation, and have  resulted in badly degraded (always low cpue) sport fisheries.

CJ

February 11, 2014

Brett,

A bit of background on the message I just cc’ed you.  Mike has been doing experimental fishing on a set of small bass lakes (20ha) that are on private land.  They go out with electrofishing and pit tag as many fish as possible, then fish experimentally hard enough to deplete the vulnerable numbers when they fish Monday-Wednesday each week for a month.  This year he wants to use more lakes, and do the fishing over a longer period like three months.  I pointed out that his original one-month design does not allow estimation of the movement rate of fish into the vulnerable pool, and he needs to have longer closed periods between fishing bouts in order to “see” how fast fish become vulnerable.  This led to a discussion of the possibility of using within-season rotating closures to allow the vulnerable fish pool to recover so as to generate fewer days of fishing with higher cpues, which anglers that get no satisfaction when cpue is low would probably prefer.  So this is like the concept of limiting effort on some lakes, but could be applied more widely.  I’ve never heard of anyone suggesting such a policy, have you?

Carl

February 11, 2014

Guys,

Just for fun, I modified the daily vulnerability exchange model to allow the evolutionary Solver to search for optimum opening patterns, assuming these patterns are repeated every 30 days (every month).  I asked it to maximize the sum of 100 daily utility or value contributions, each set to cpue^power, where power<=1 implies fishermen satisfaction for cpue is either proportional to cpue or less, power>1 implies fishermen are not happy unless cpue is higher.  For power=1, Solver says to just leave the fishery open every day.  For power=2, it says to fish about one day a week, and for power=3 it says to cut way back to fish only 1 or 2 days per month.  Note I’m using rainbow trout vulnerability exchange rates, so faster exchange would imply having more frequent openings for power > 1.  But in terms of your planning for testing different open-closed patterns, it looks like reasonable closed periods between openings are in the 7-21 day range, which should also be OK for estimating the vulnerability exchange rate (recovery rate of vulnerable numbers).

This is neat.  It might just be that closing lakes on weekdays and Sundays might gain nearly as much as severely restricting effort all the time…

Brett: this model looks specifically at catch-release fishing, and puts released fish into a third vulnerability pool (“recovering”, noreactive) from which the fish may move partly back to the vulnerable pool and partly back to the invulnerable pool.  Quite different from our earlier models that assumed fish caught are removed from the system.

Carl