8 weeks with CASAL2

October 6, 2018

What is CASAL2?

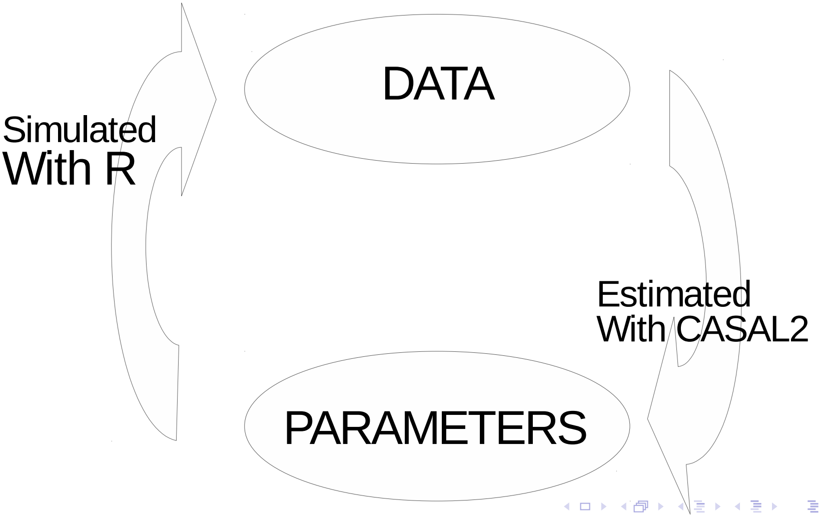
- a C++ software to represent the dynamics of a fishery
- the dynamics of the fish population is deterministic
- CASAL2 implements discrete models: it does not have a concept of continuous times (natural mortality are not rates)
- models are not fitted to catch: catch is an input to the model
- fishing effort is not used to estimate fishing mortality, instead it uses exploitation rates (U=log(1-F))
- models can be fitted to abundance surveys, age-frequencies, and more (tagging data, etc..)

An approach to learning CASAL2

Simulating the dynamics of a fishery and feeding CASAL2 with synthetic data, help us:

- understanding how to use CASAL2 to get the correct parameter estimate
- learn about the limitations of CASAL2

An approach to learning CASAL2



Simulated fishery

- Single species, single area
- age-structured, multiple years
- number of individuals (no somatic growth)
- constant: natural mortality, recruitment, selectivity $(= 1)$
- varying exploitation rate $(0 \leq U \leq 1)$

Synthetic data and parameters passed to CASAL2

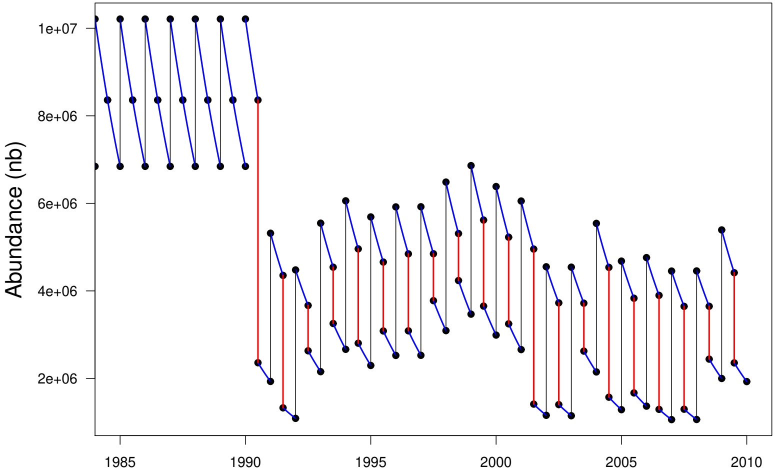
- catch
- age frequency distributions
- abundance survey
- natural mortality
- selectivity
- initial population abundance [sometimes]
- model structure (timing of the removals, the fraction of natural mortality before remove, etc...) [sometimes]

The only thing we are asking to estimate (for the moment) is a single parameter (a constant recruitment): can we estimate that using CASAL2?

Some results

Simulate	**Estimate** recruitment	**Estimate** Initial conditions	**Comments**
Baranov Eq.	not OK	not OK	you can't implement a Baranov eq. in CASAL2, you need to model a pulse fishery
Pulse removal	OK	not OK	CASAL2 assumes un-exploited stock before the start of the data time series
Pulse removal and virgin stock pre-exploitation	OK	OK	Finally a CASAL2 model working! I can estimate a single parameter with CASAL2!

Constant recruitment, variable exploitation rates



Similarity between pulse removal and Baranov

We can write that the number at the end of a year is:

$$(N_0 \times e^{-\frac{M}{2}} - N_c) \times e^{-\frac{M}{2}} \tag{1}$$

Since $N_c = U \times N_0 \times e^{-\frac{M}{2}}$, we can rewrite

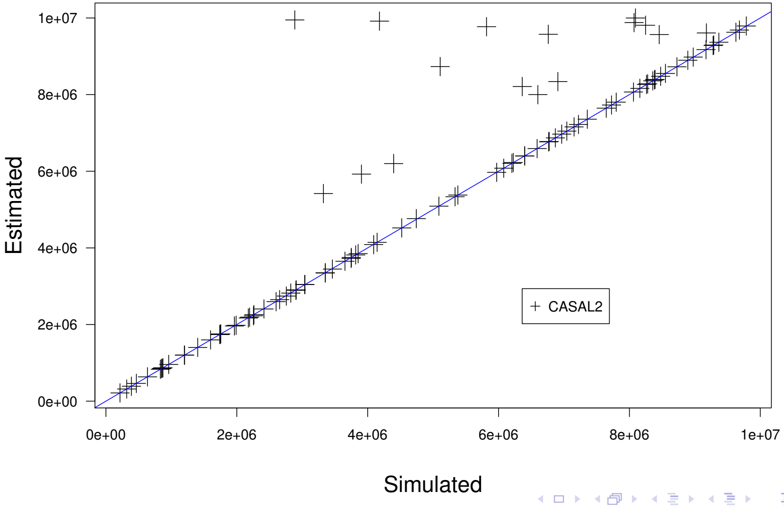
$$N_0 \times e^{-\frac{M}{2}}(1 - U) \times e^{-\frac{M}{2}} \tag{2}$$

And look at this as

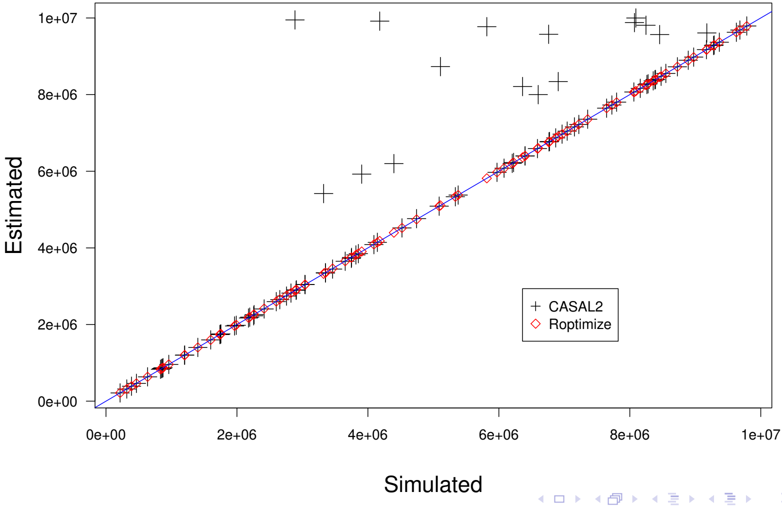
$$N_0 \times e^{-\frac{M}{2}} \times e^{-F} \times e^{-\frac{M}{2}} \tag{3}$$

So $1 - U = e^{-F}$ (Walters and Hilborn, 1992: p.352)

Using CASAL2 to estimate constant recruitment



Using CASAL2 to estimate constant recruitment



Conclusions

- CASAL2 doesn't have (yet) the flexibility to implement any model we want (Baranov equation, delay-difference, survival analysis, etc....)
- being able to implement only pulse removal fishery is fairly narrow in scope and assuming that a fishery was un-exploited before the start of the data time series is even more limiting
- we have to do more work to understand why it is failing (in approx 6-10% of the cases) to converge to the correct recruitment value

Thanks for your attention