Biological Basis of Management Plans

http://www.fisheries.org/afs/docs/fisheries/fisheries_3503.pdf


PERSPECTIVE:
FISHERIES MANAGEMENT

Defining Overfished Stocks:
Have We Lost The Plot?

Ray Hilborn and Kevin Stokes

While concern about overfished stocks has long been an impor-

- ***Policy and Scientific Advice Framework***
- ***Examples of using FLR***
  - ***FLSR*** for fitting stock recruitment relationships
  - ***FLBRP*** for estimating biological reference points

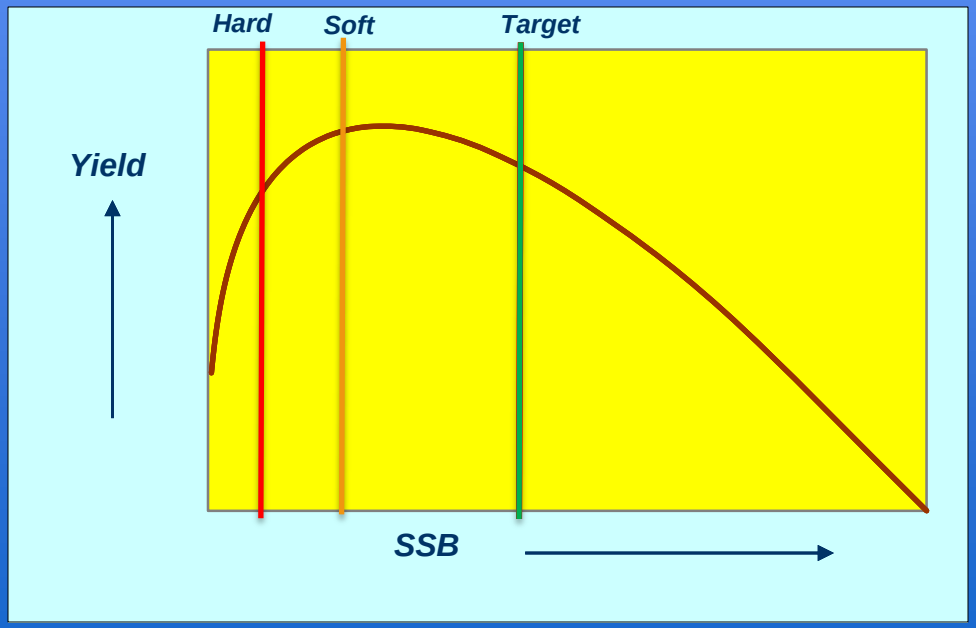
Summary of Talk

- Policy and Scientific Advice Frameworks
- Examples using FLR
  - North Plaice
  - Bluefin Cites
  - Cod

Biomass Reference Points

Formal management strategies tend to be built around three key biomass reference points:

- **Targets** about which the stock is meant to fluctuate
- **Soft limits** below which a formal rebuilding plan be put in place,and
- **Hard limits** where directed fishing should stop



Management Frameworks

Examples of biomass reference points

- PFMC groundfish management plan

  40% of B_0 is the target, 25% of B_0 is the soft limit and formal definition of being overfished, and 10% of B_0 is the hard limit.

- Australia

  target defaults to 1.2 x B_{MSY} (or 48% B_0); the hard limit is half MSY (20% B_0)

- ICES

  B_{PA} & B_{LIM} Set on a stock by stock basis

- ICCAT

  B_{MSY} as a target.

- CITES Bluefin evaluations

  SSB less than 15% of B_0 or B_{max} for a medium productive stock

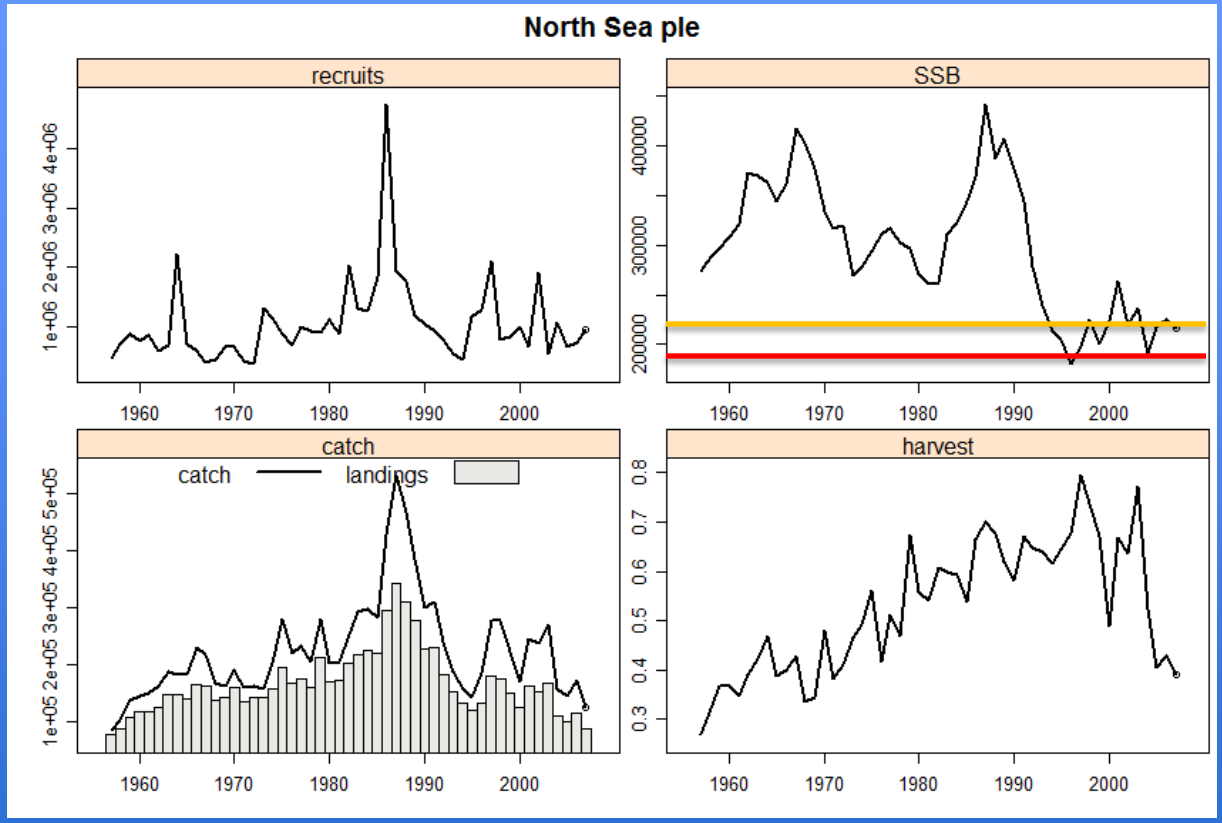
Examples

Using of biomass reference points

- ***North Sea plaice***, advice provided by ICES and managed by EU-Norway
- ***Atlantic Bluefin Tuna*** managed by ICCAT
- ***Cod stocks***, advice provided by ICES, managed by EU, EU-Norway, Norway, Faroes, Iceland, US, US-Canada & Canada

North Sea Plaice

```
>data(ple4)
>plot(ple4)
```



Biomass limits

- B_{LIM} B_{loss} = 160 000 t, the lowest observed biomass in 1997 as assessed in2004
- B_{PA} Approximately 1.4 B_{lim}

Stock Recruitment Relationship

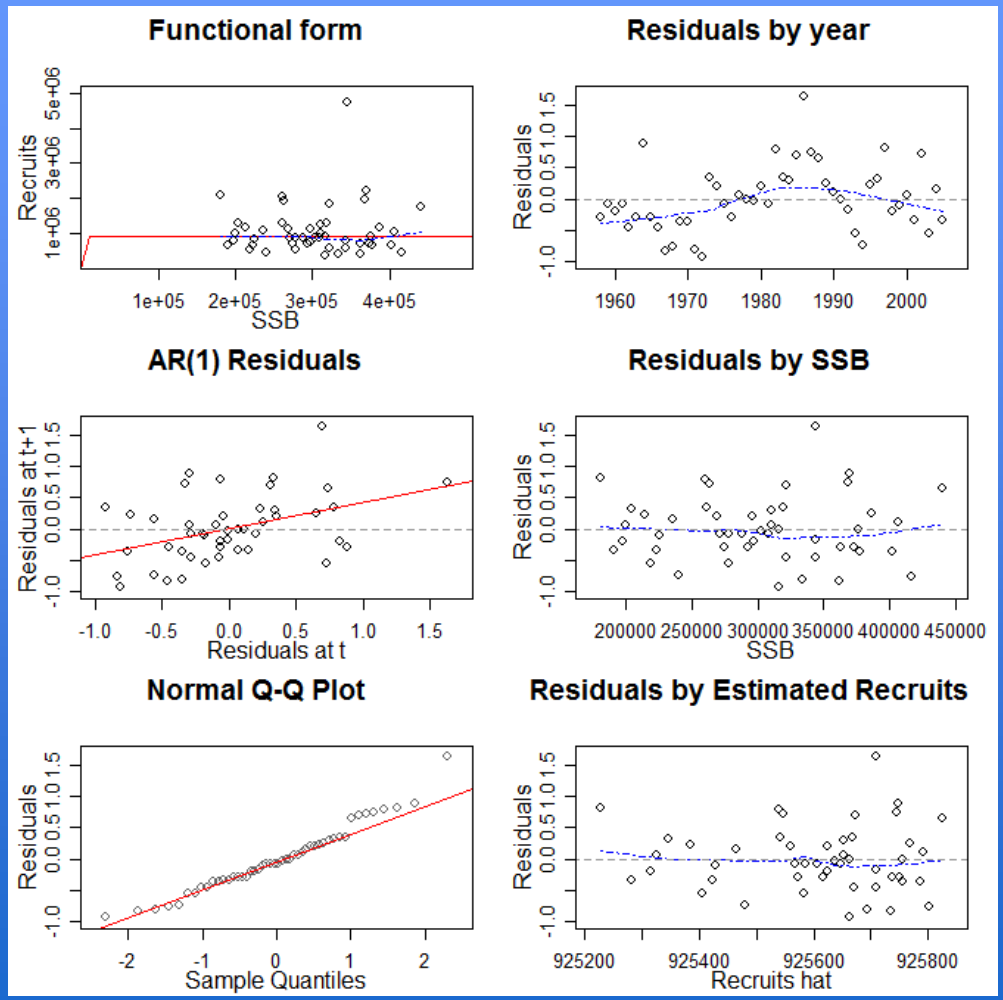
Beverton & Holt

- Constant recruitment?

Fit diagnostics

- Constant recruitment?
- Autocorrelation
- Year effect?

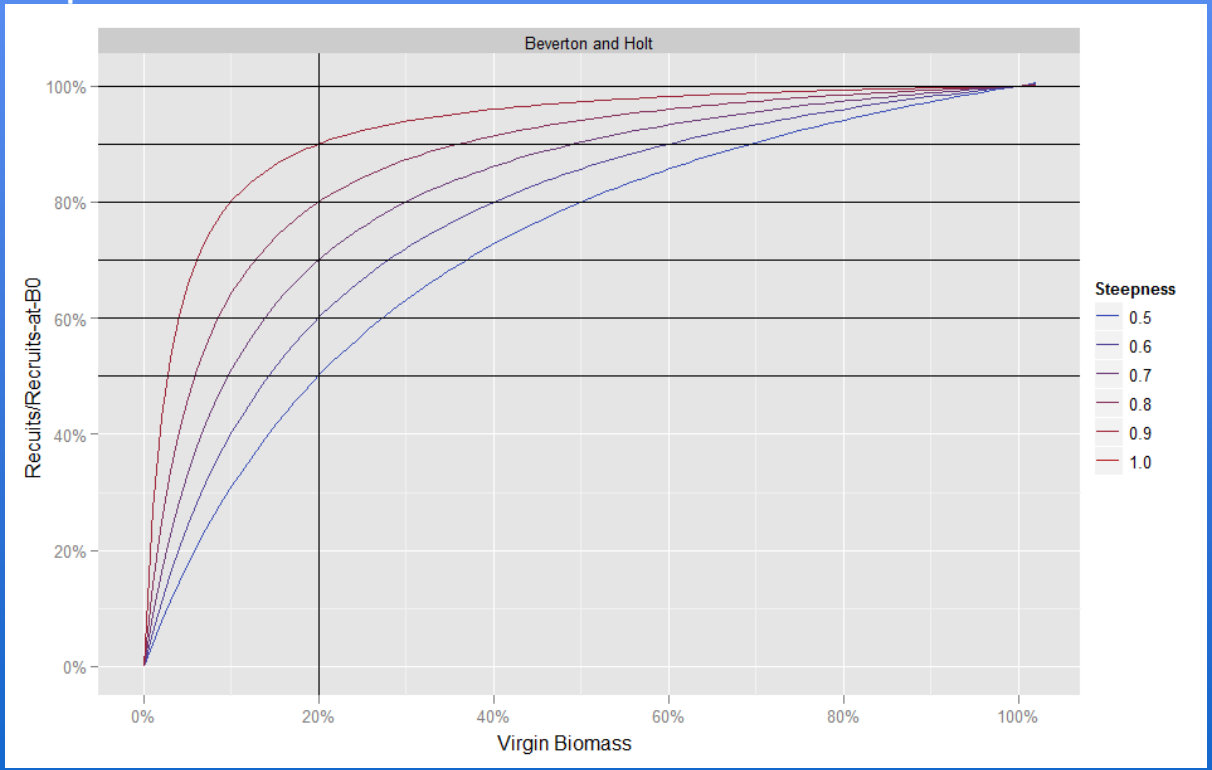
```
>pleSR<-as.FLSR(ple4)
>model(pleSR)<-bevholt()
>pleSR<-fmle(pleSR)
>plot(pleSR)
```



Stock Recruitment Relationship

Steepness & Virgin Biomass

- Easier to get your head around than
- Comparable between Functional forms
- Easier to obtain priors

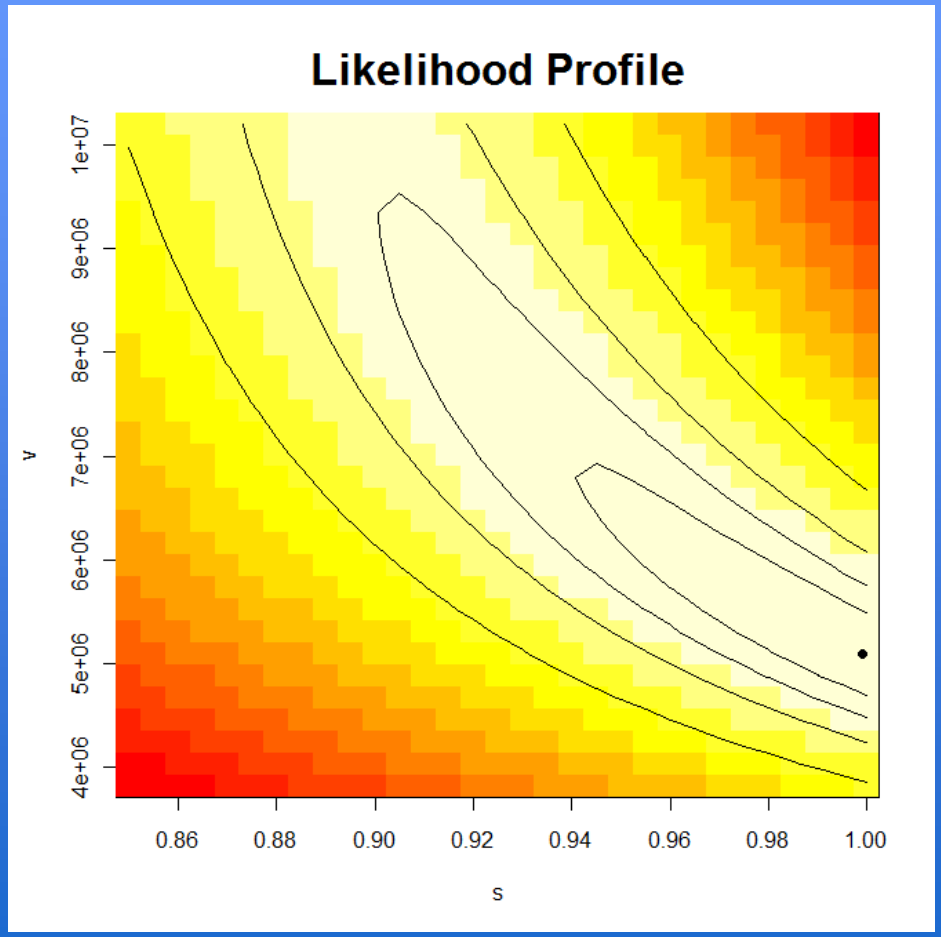


Stock Recruitment Relationship

Constant recruitment?

```
>profile(pleSR)
```

- Looks like B0 is not well estimated
- Steepness is >0.85



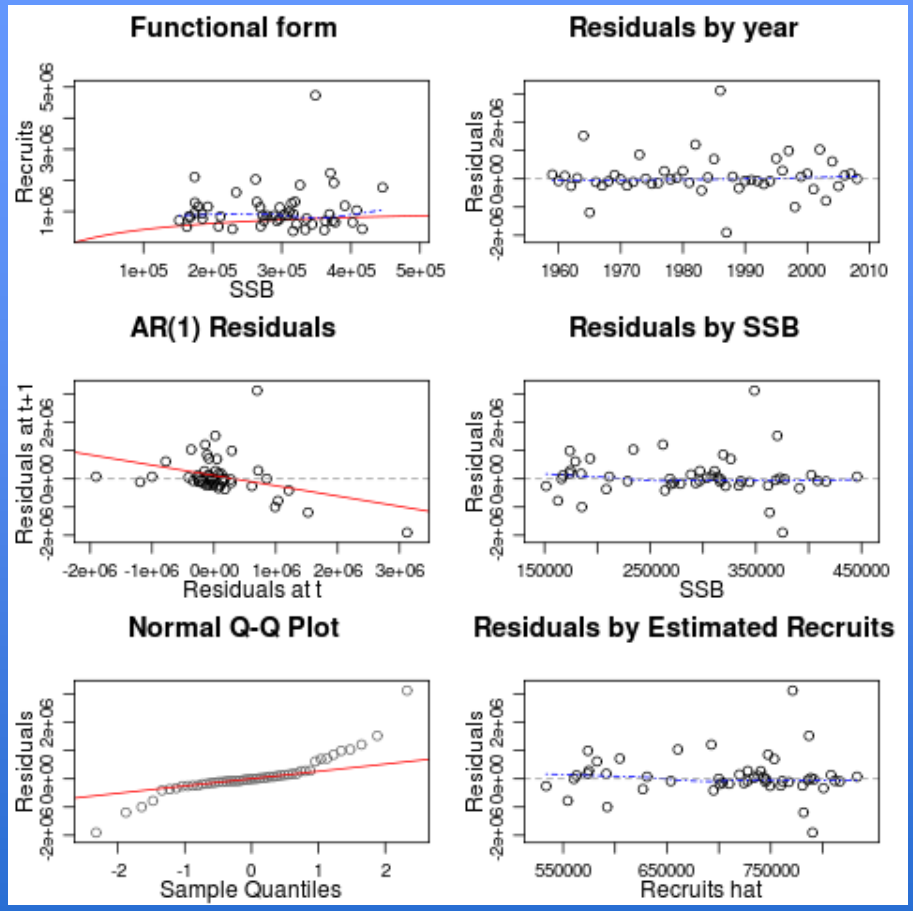
Stock Recruitment Relationship

Beverton & Holt

Autocorrelation

- Better fit?

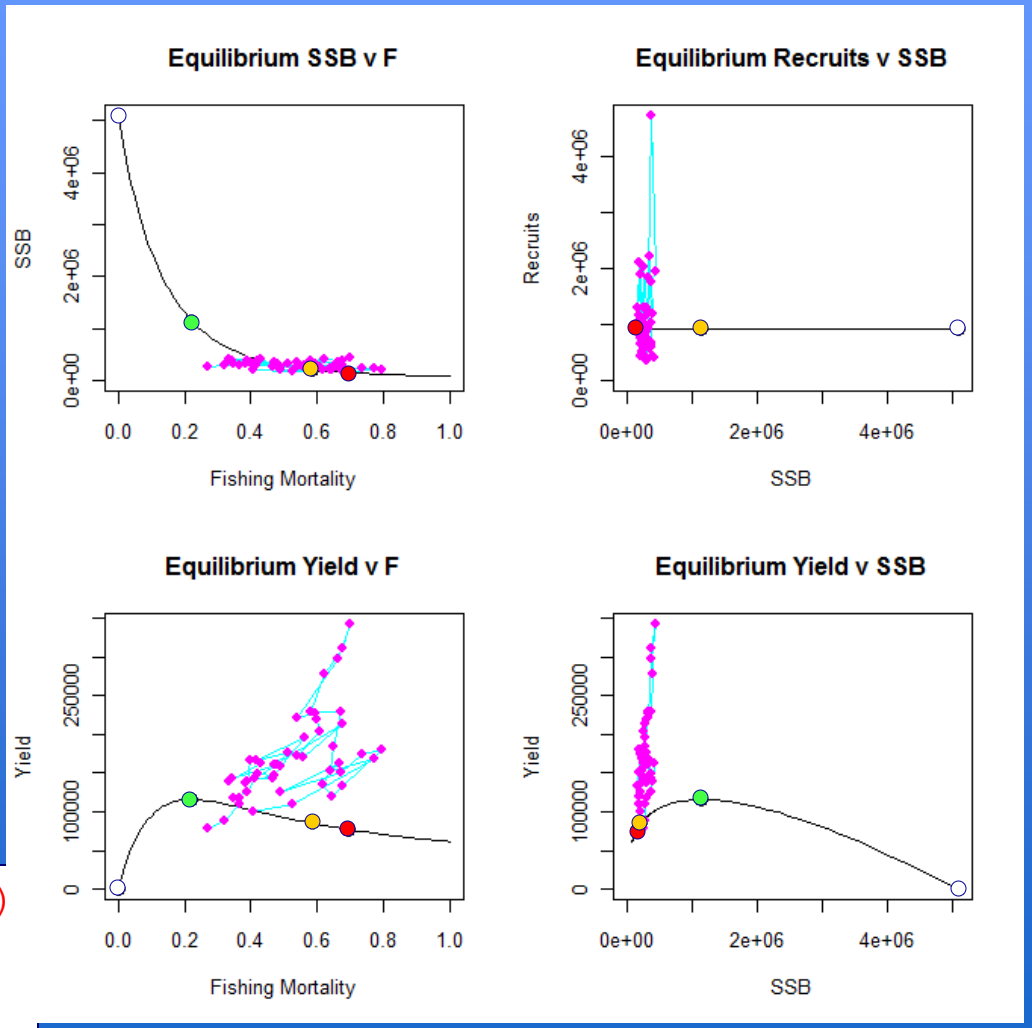
```
>model(pleSR)<-bevholtAR1()
>pleSR<-fmle(pleSR)
>plot(pleSR)
```



Reference Points

Beverton & Holt

- B_0
- B_{MSY}
- B_{PA}
- B_{LIM}



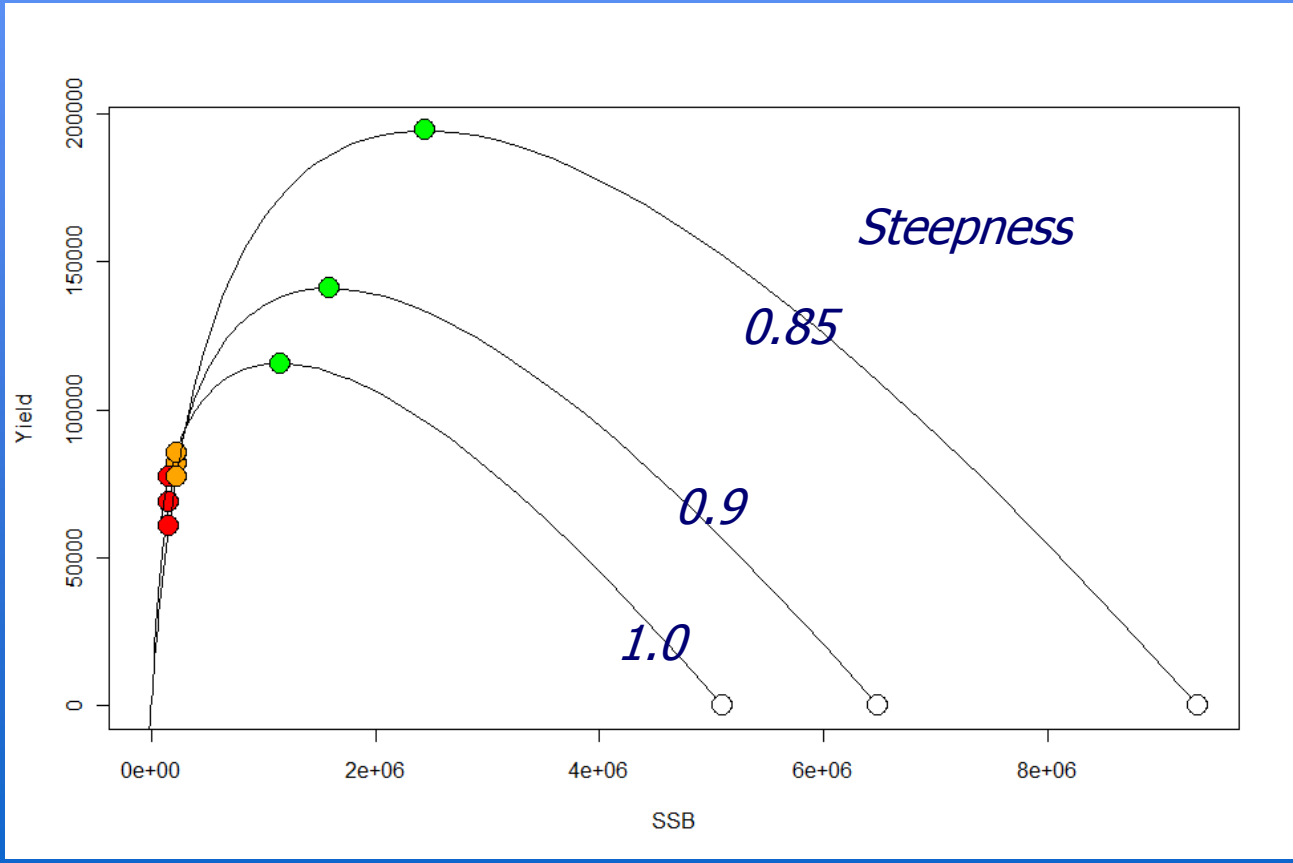

```
> pleBRP<-FLBRP(ple4,sr=pleSR)
> pleBRP<-brp(pleBRP)
> plot(pleBRP,obs=T)
```

Reference Points & Steepness

Beverton & Holt

- B_0
- B_{MSY}
- B_{PA}
- B_{LIM}

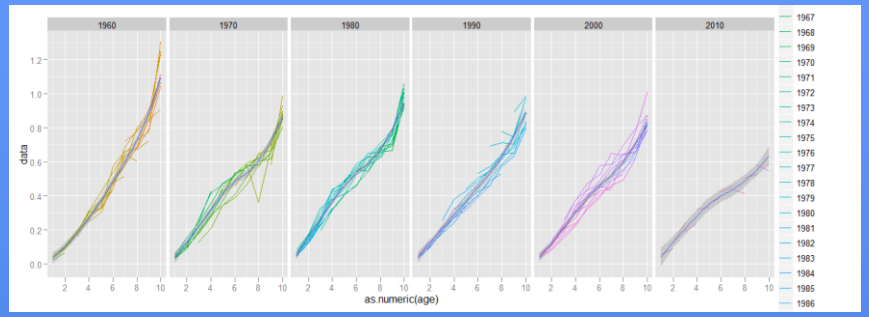
```
> magic()
```

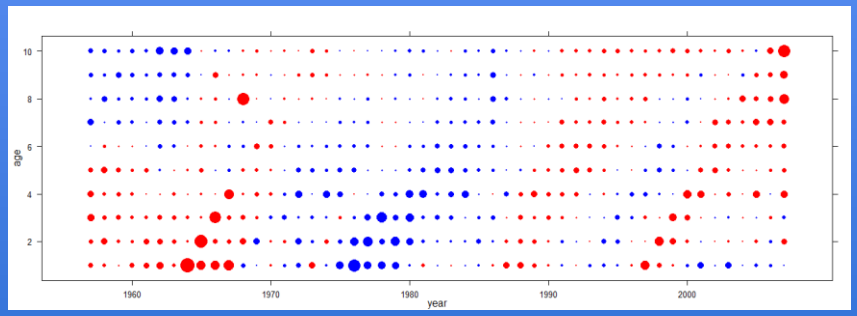


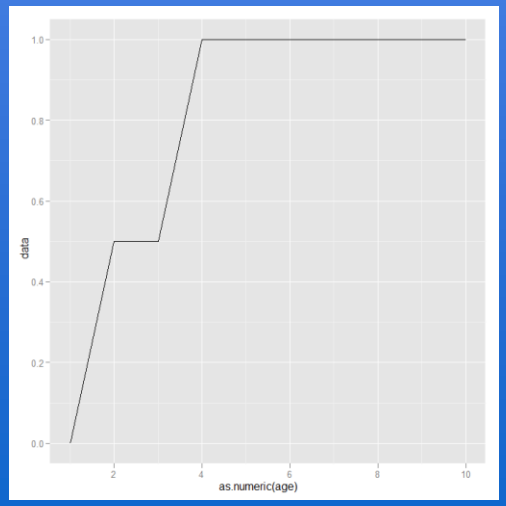
Biology

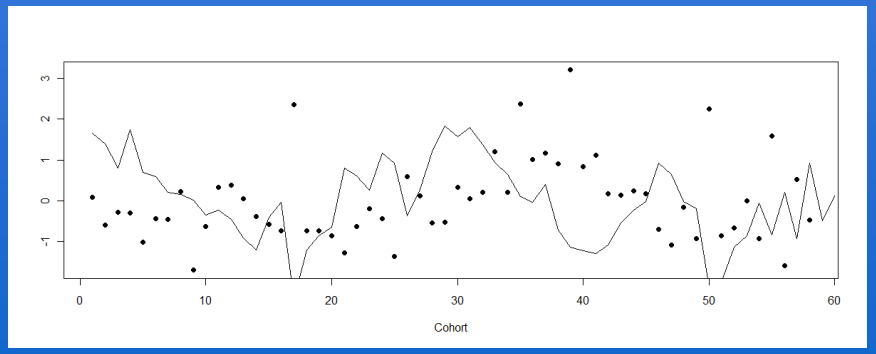
Growth & Maturity

- Mass-at-age
- Cohort effects
- Linked with Recruitment?
- Maturity





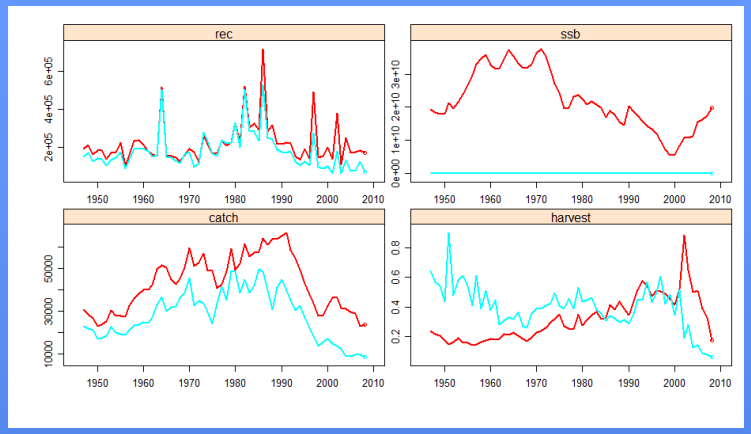


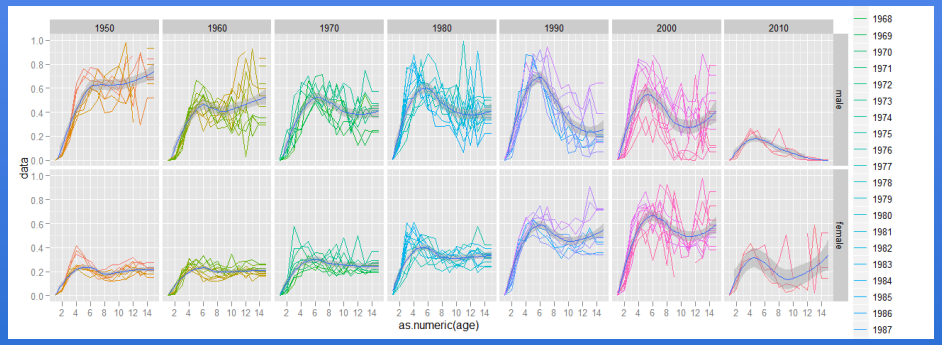


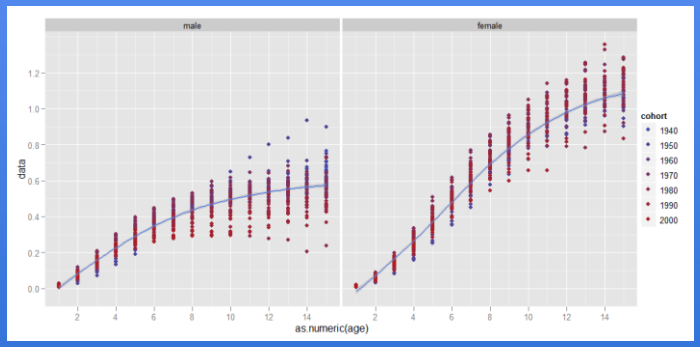
Sexual Dimorphism

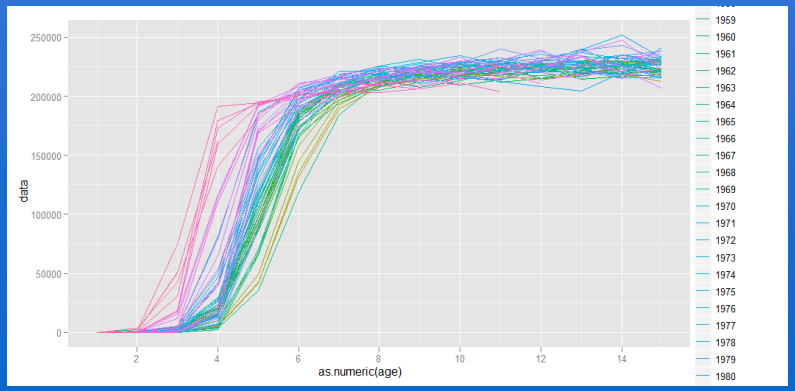
Males & Females

- Growth
- Maturity
- Selectivity










```
> magic()
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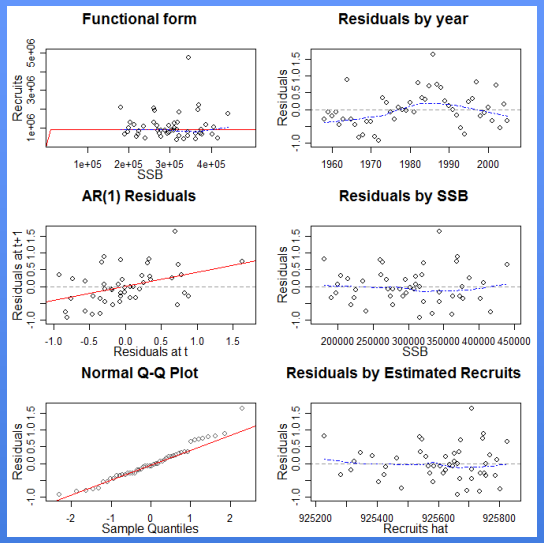
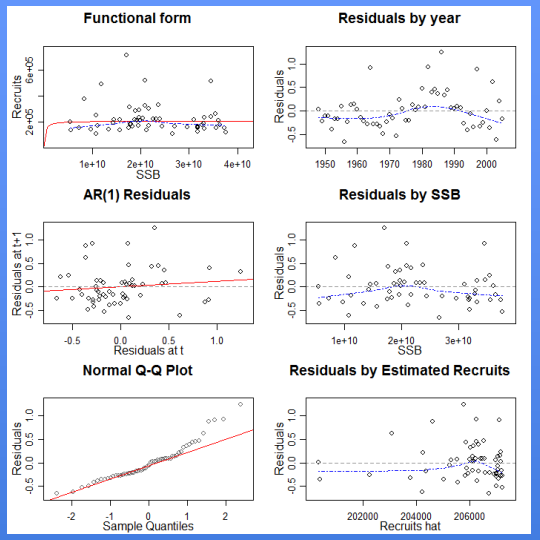
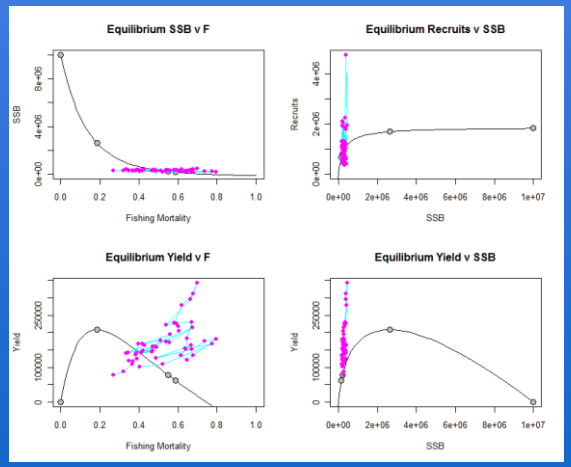
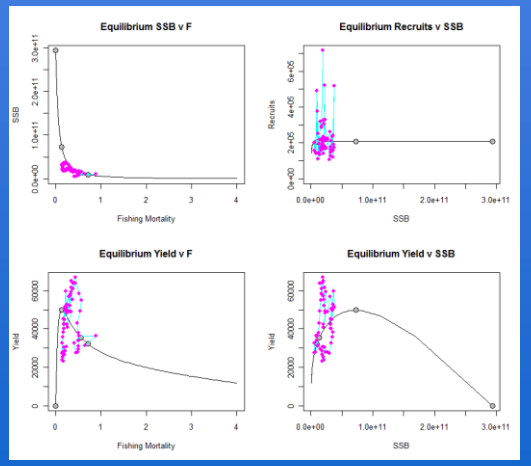
Sex Aggregated v. Male/Female

- Stock recruitment
- Reference points










```
> magic()
```

Cites Bluefin Evaluations

"A general guideline for a marked historical extent of decline is a percentage decline to 5%-30% of the baseline, depending on the biology and productivity of the species. Productivity is the maximum percentage growth rate of a population. It is a complex function of reproductive biology, fecundity, individual growth rates, natural mortality, age at maturity and longevity. More-productive species tend to have high fecundity, rapid individual growth rates and high turnover of generations."

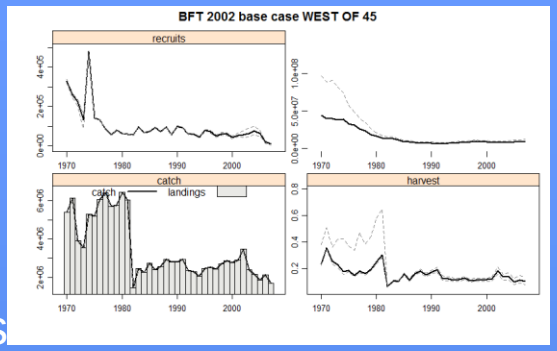
Application of decline for commercially exploited aquatic species for CITES is stated as follow

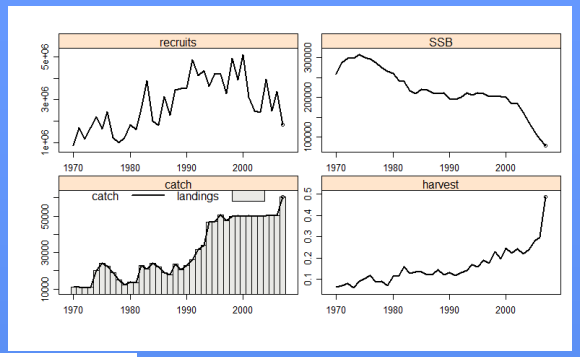
"*In marine and large freshwater bodies, a narrower range of 5-20% is deemed to be more appropriate in most cases, with a range of 5-10% being applicable for species with high productivity, 10-15% for species with medium productivity and 15-20% for species with low productivity. Nevertheless some species may fall outside this range. Low productivity is correlated with low mortality rate and high productivity with high mortality. One possible guideline for indexing productivity is the natural mortality rate, with the range 0.2-0.5 per year indicating medium productivity.*"

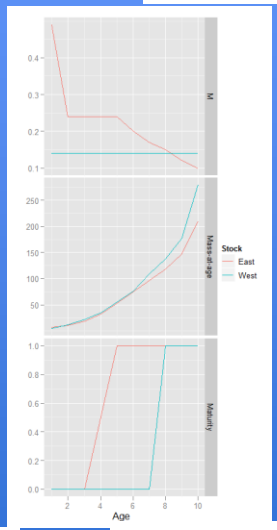
Bluefin

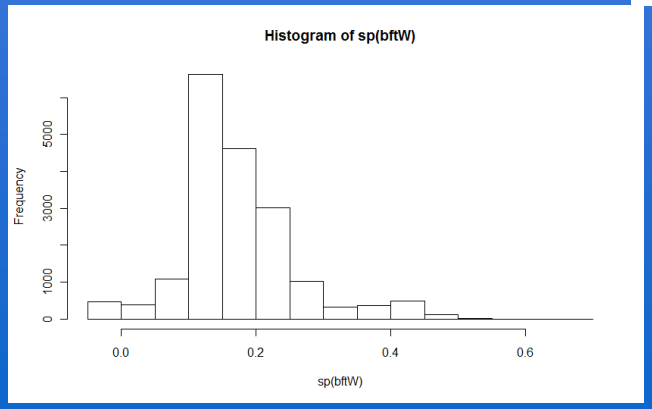
Stocks

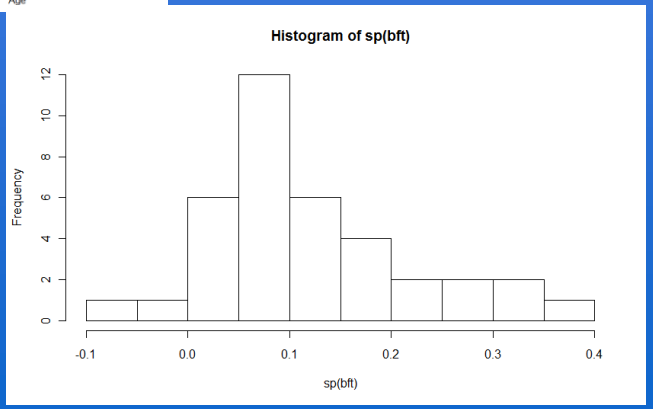
- Historic status
- Biological characteris
- Productivity







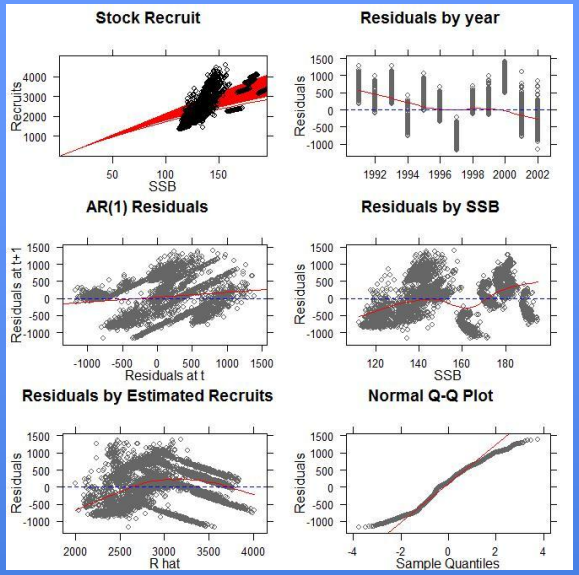


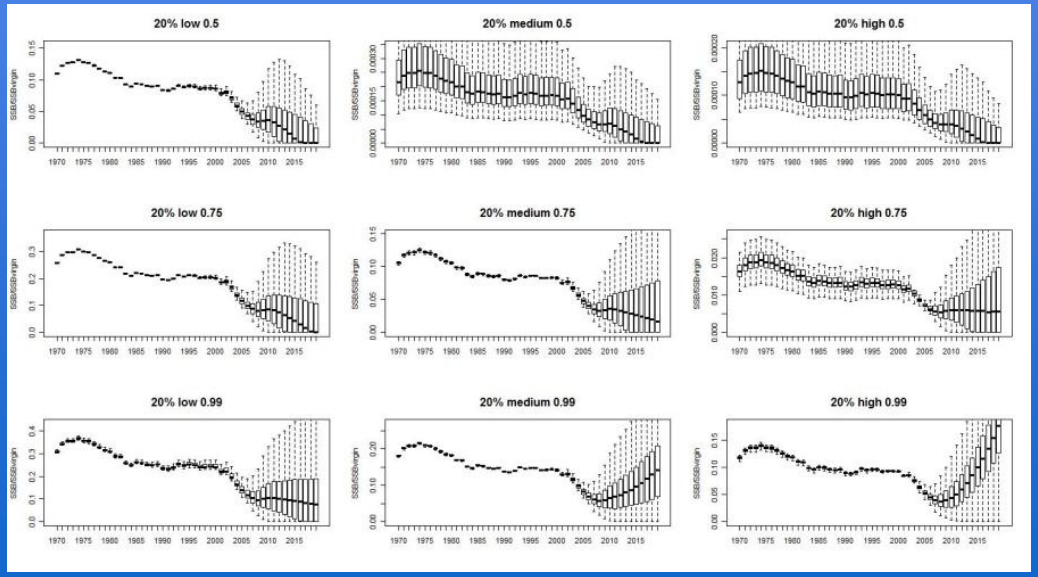


Bluefin Evaluations

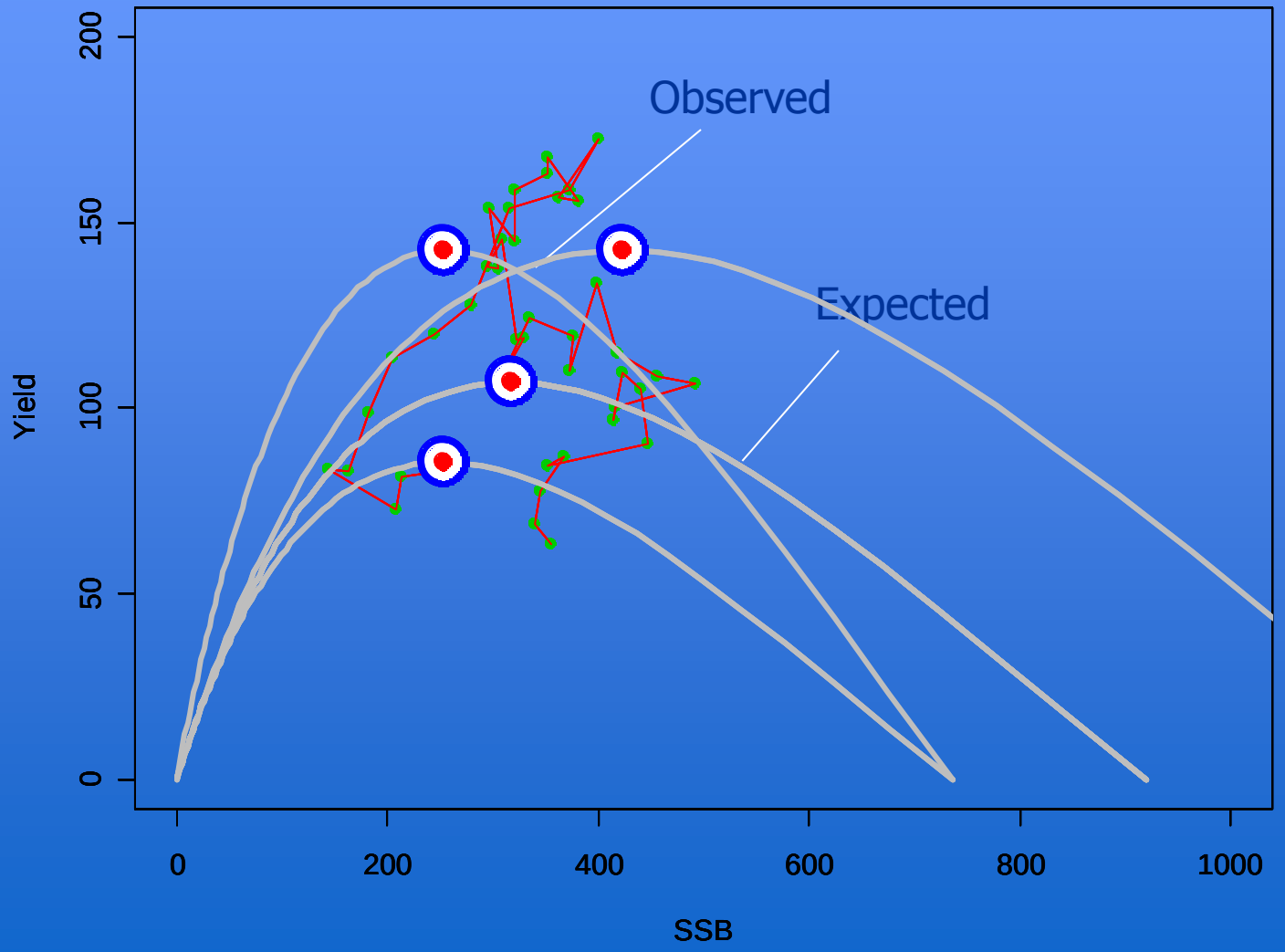
Stocks

- Stock Recruit
- Projections





Target Reference Point?



Meta-analyses & Priors

Provides consistent estimates of parameters and uncertainty across stocks

- Better precision
- Consistent estimates of uncertainty
- Effect of temperature