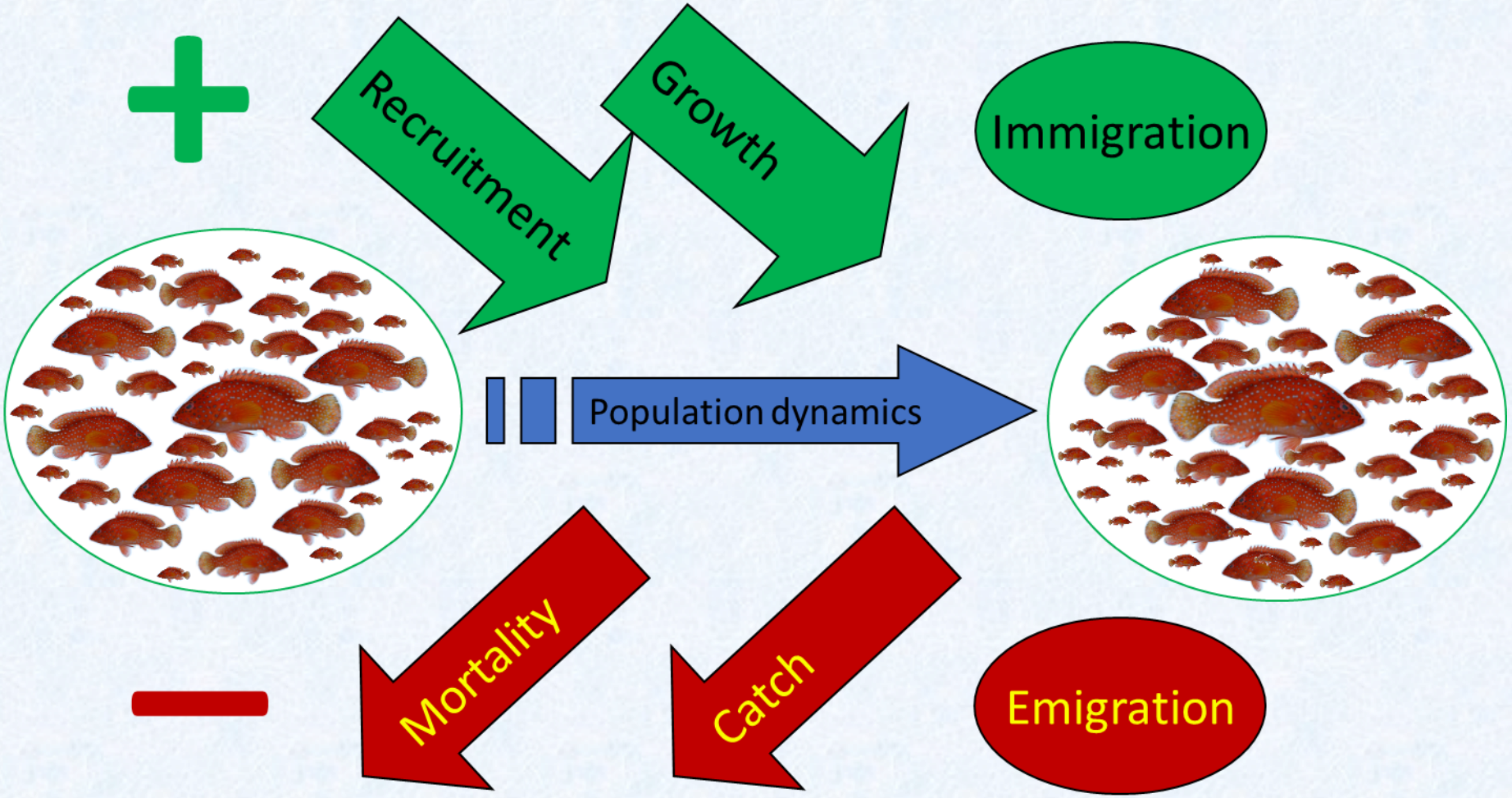
Quantitative assessments (Tier 1)



IRG – Indigenous Capacity Building, FRDC Project 2017/069

Quantitative assessment outputs

- Estimate the current state of the stock
  - What is the current stock size?
  - How does that compare to a previous stock size?
- Determine an appropriate fishing mortality rate
  - What is the current fishing mortality ?
  - What fraction of the stock can be harvested sustainably over the long term?
  - What is the certainty around that determination?

Equations inside an assessment

Don't be scared!

- Population size $N_{y+1}=N_{y,a-1}e^{-Zy,a-1}$
- Spawning biomass $B_y = \mu\Sigma f_{y,a} w_{y,a} N_{y,a} e^{-Zy,a/2}$
- Mortality $Z_{y,a} = M + S_a F_y$
- Catchability $S_{y,a}=(1+e^{-\ln 19(Ly,a-L50)/(L95-L50)})^{-1}$
- Recruitment $N_a=R_0 e^{-(a-1)M} e^{\varepsilon a}$
- Growth $L_t=L_{inf}(1-\exp^{-k(t-t0)})$

At best:

Look for the equals sign "="

Try to understand the big "parameters" either side

Common Fisheries Parameters

Parameter	Meaning
B	Biomass
S	Stock
R	Recruitment
F	Fishing Mortality
M	Natural Mortality
Z	Total mortality
C	Catch
E	Effort (or Exploitation)
CPUE	Catch pre Unit Effort
CV	Coefficient of Variation

Parameter	Meaning
N	Number
A	Age
L	Length
W	Weight
t	time
MSY	Maximum Sustainable Yield
MEY	Maximum Economic Yield
RBC	Recommended Biological Catch
TAC	Total Allowable Catch

How does it work?

- Model fitting
  - The answer won't be right, but is it close enough?
- Compare model outputs with things that can be measured
- Repeatedly change and re-run the model until you get the best match between outputs with things that can be measured (eg CPUE)

But how do you know it works?

- Is it a good assessment?
  - How well does it fit the data?
  - Check the diagnostics
    - Catch (retained / discarded)
    - Catch rate
    - Length frequency (retained / discarded)
    - Age frequency
    - Selectivity
    - Biologicals (growth, weight, size)
- Sensitivity testing
  - Do the assumptions make sense
  - Where do we need to improve parameter estimates

Data-rich assessment

Example - Tropical Rock Lobster
(Plaganyi et al. 2018)

Tropical Rock Lobster 2018 Assessment Summary

CSIRO – Plaganyi et al. (2017)

Éva Plagányi, Darren Dennis, Rob Campbell, Mark Tonks, Mick Haywood, Roy Deng, Nicole Murphy, Kinam Salee (2017) Torres Strait rock lobster (TRL) fishery surveys and stock assessment: AFMA Project 2016/0822. March 2017 Progress Report.

Always look at the data!!

Understand model inputs

- Catch and effort data
  - Spatial and temporal patterns
  - Fleet dynamics
- Length frequency distribution series
- Catch rate series
- Fishery-independent data

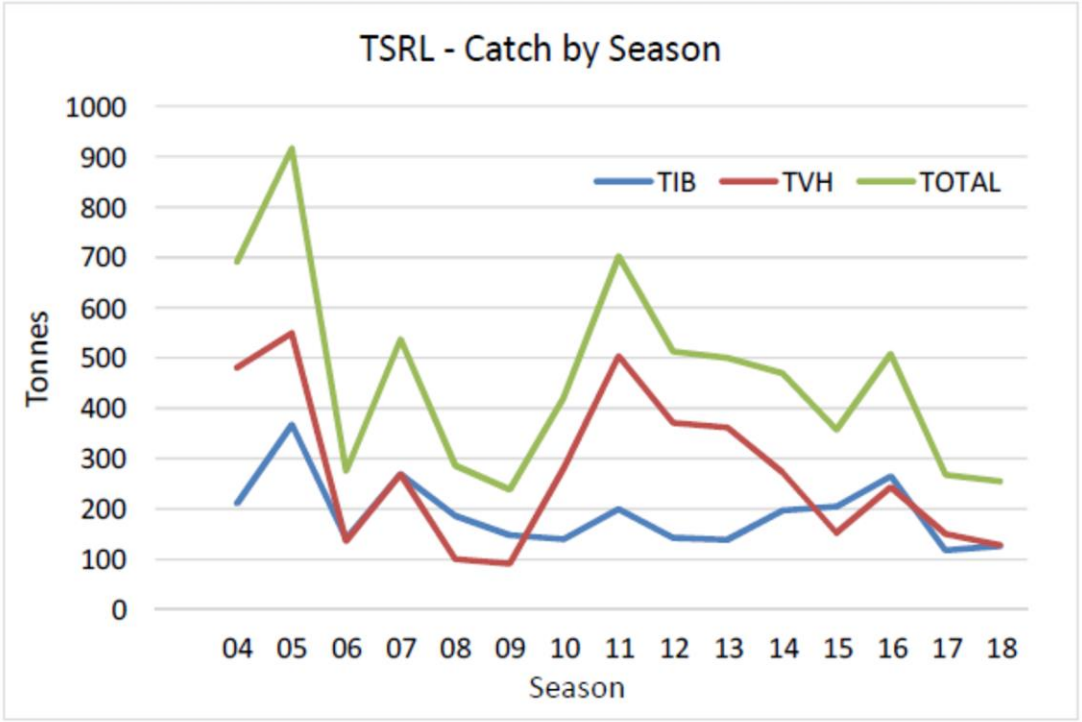
Understand model assumptions

Ask questions - fishermen, scientists

TRL – Catch and Effort data

Do the inputs look right?

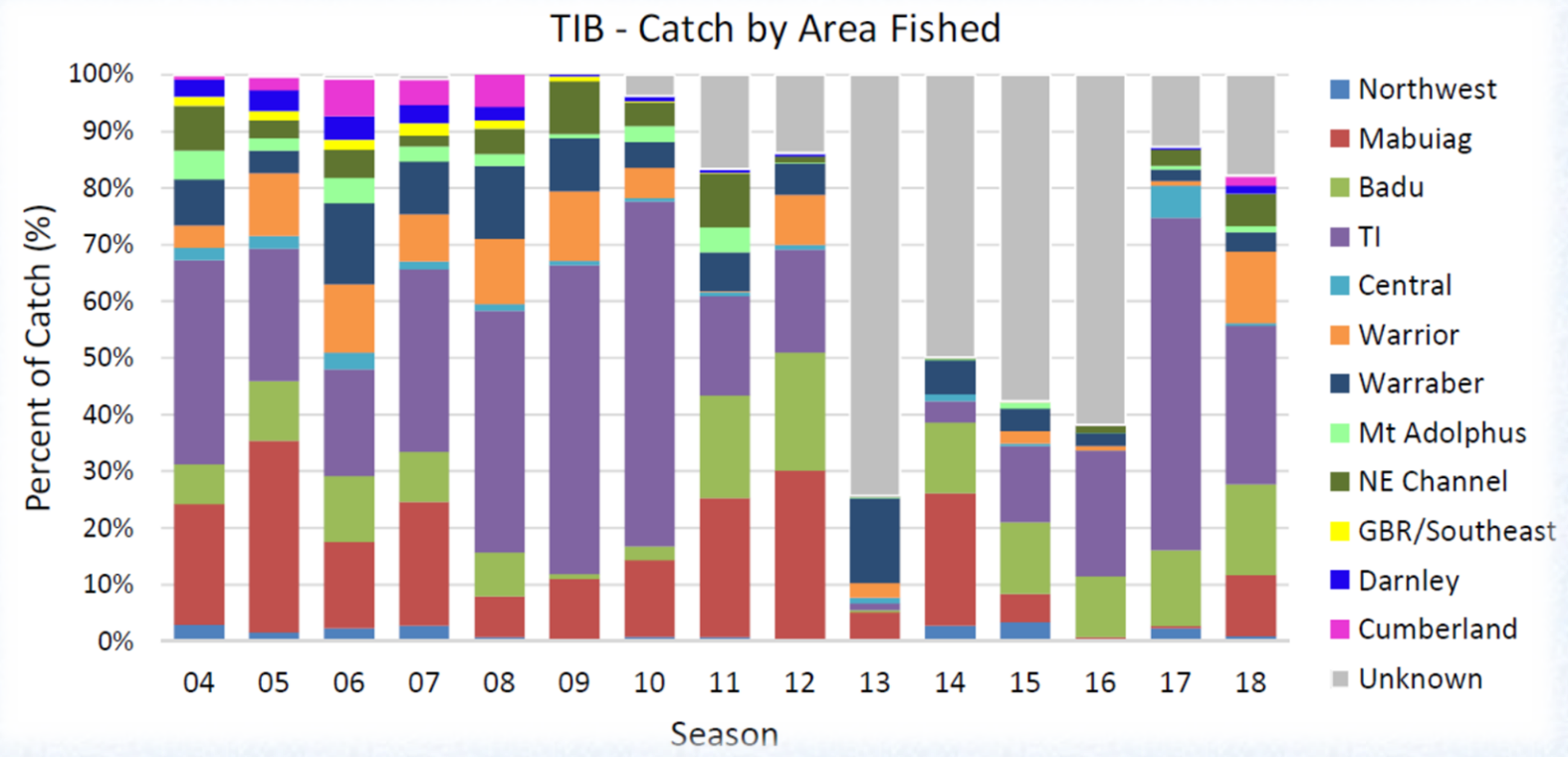
- Logbook CPUE



TRL – Catch and Effort data

Do the inputs look right?

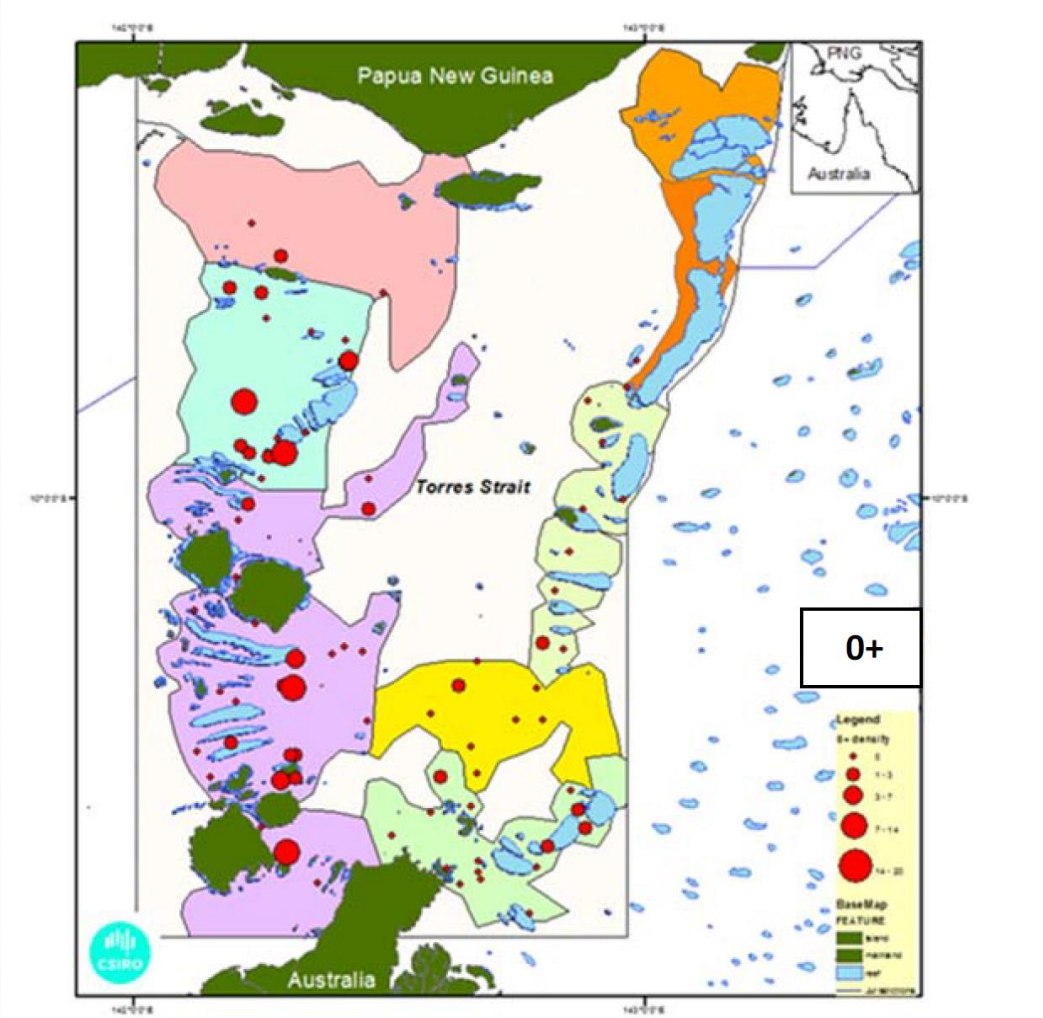
- Logbook Catch by area



TRL – Fishery-independent data

Surveys

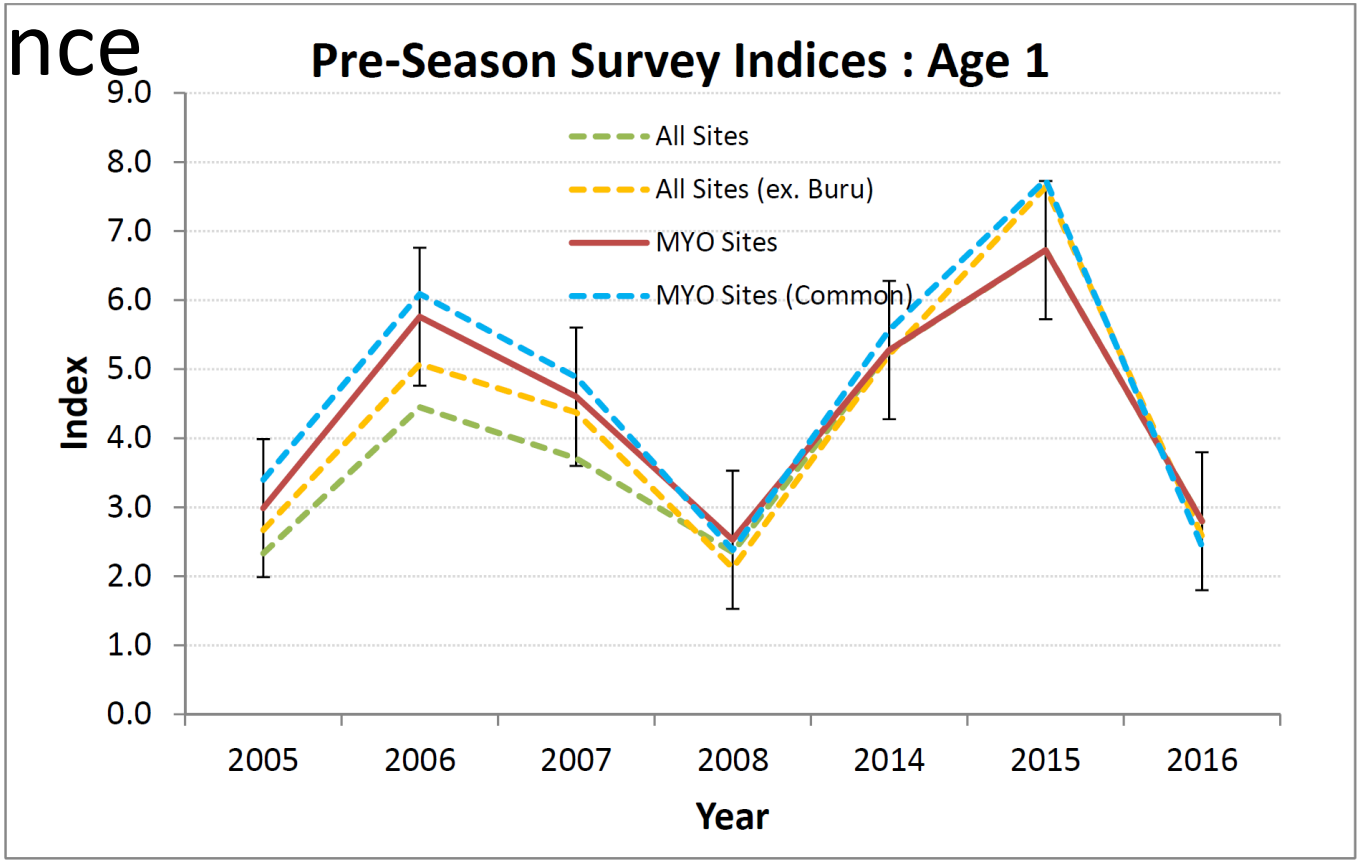
- Abundance indices



TRL – Fishery-independent data

Surveys

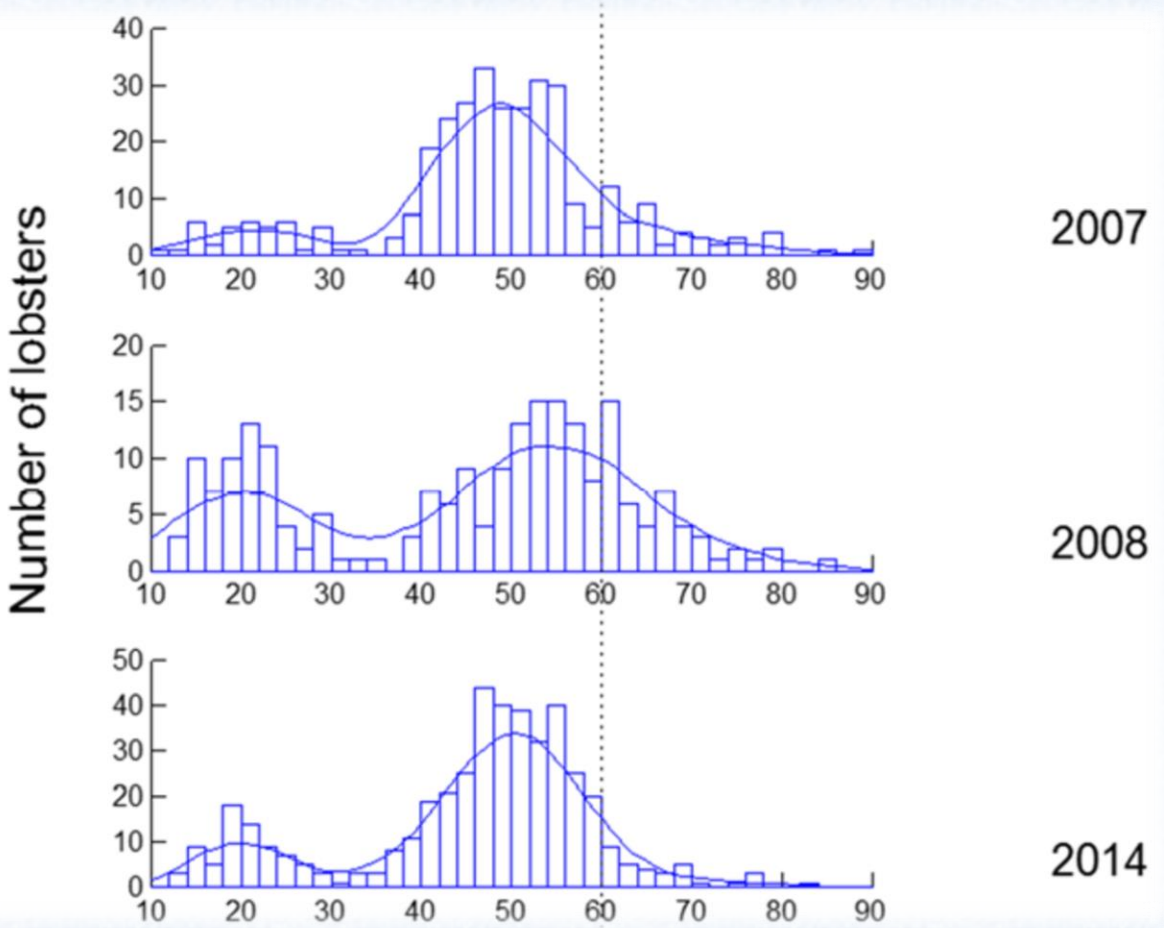
- Abundance indices



TRL – Fishery-independent data

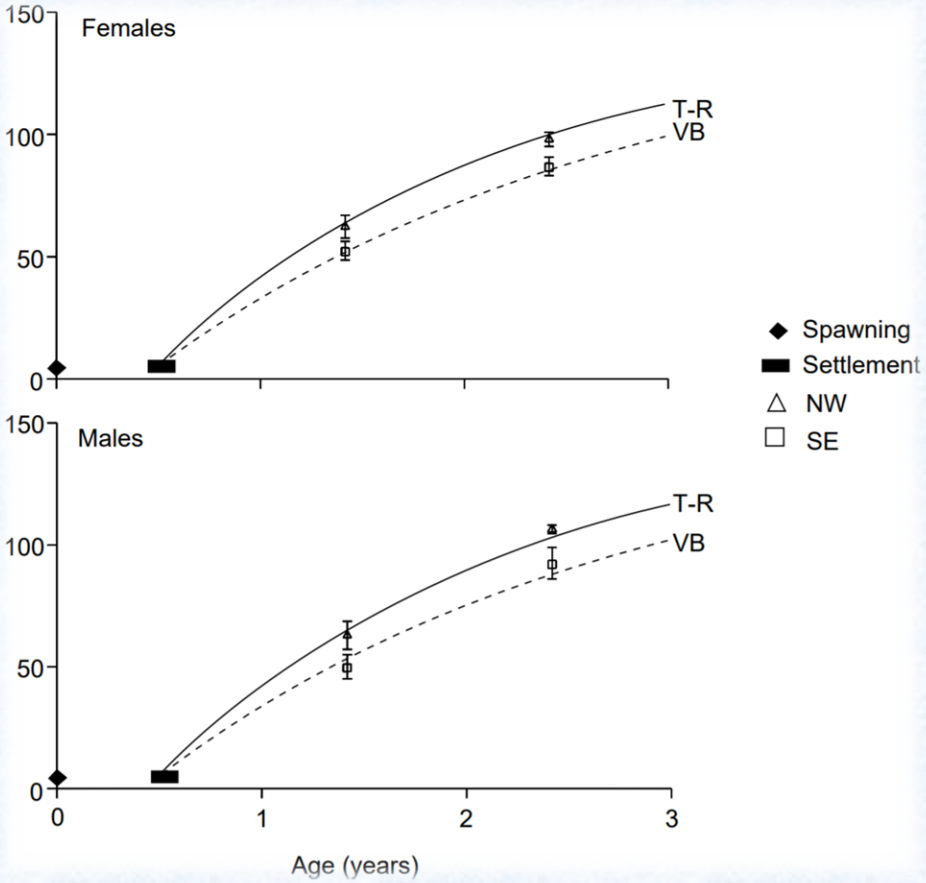
Surveys

- Size-frequency



TRL – Biological data

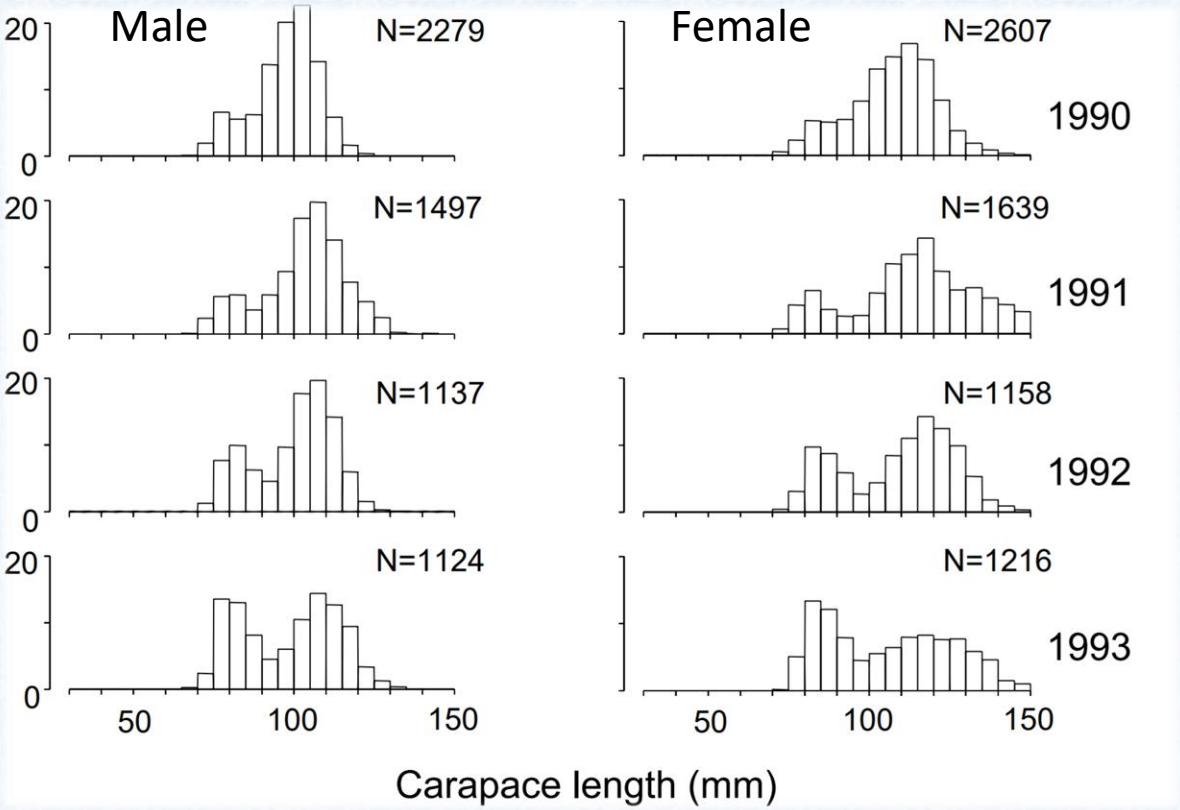
- Growth curves



Skewes et al. 1997.
Growth of rock lobsters in Torres Strait

TRL – Biological data

- Length frequency



Skewes et al. 1997. Growth of rock lobsters in Torres Strait

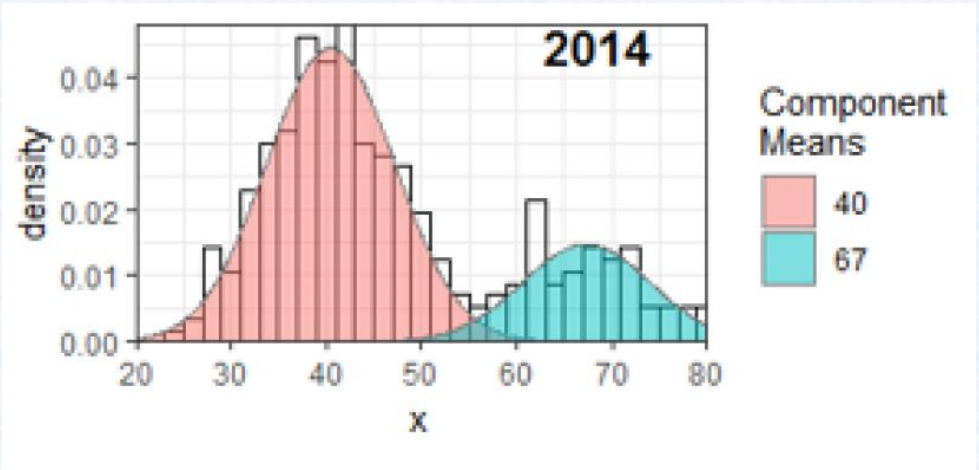
fishwell
CONSULTING

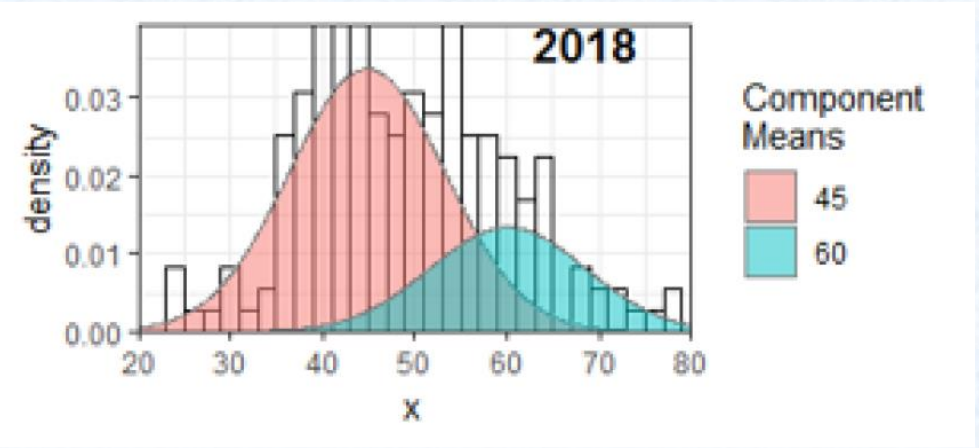
Look at model fits to the data

- Within confidence limits?
- Outliers?
- Are trends consistent?
- Things that don’t look right

Look at model fits to the data

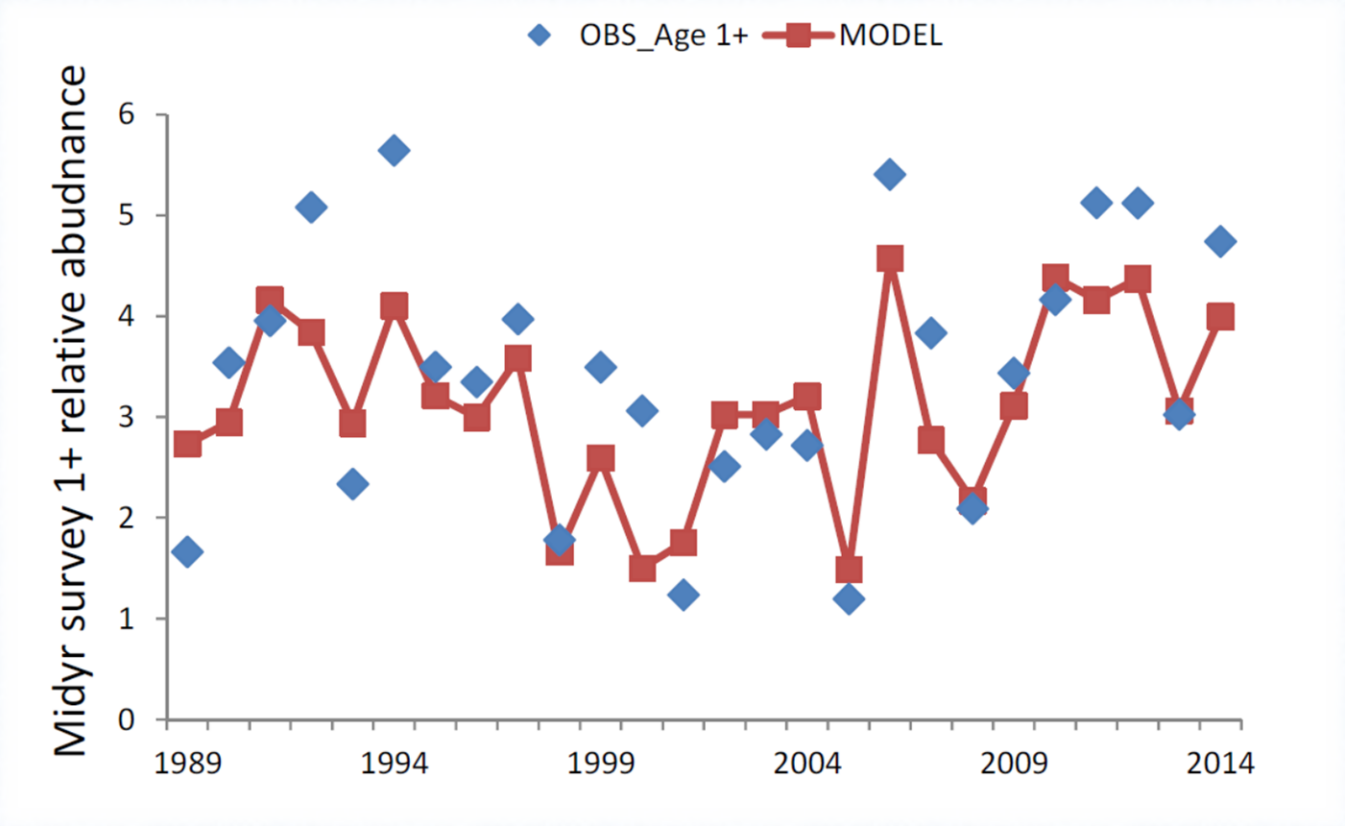
- How well does the model fit the data?
- Good fit
- Poor fiit





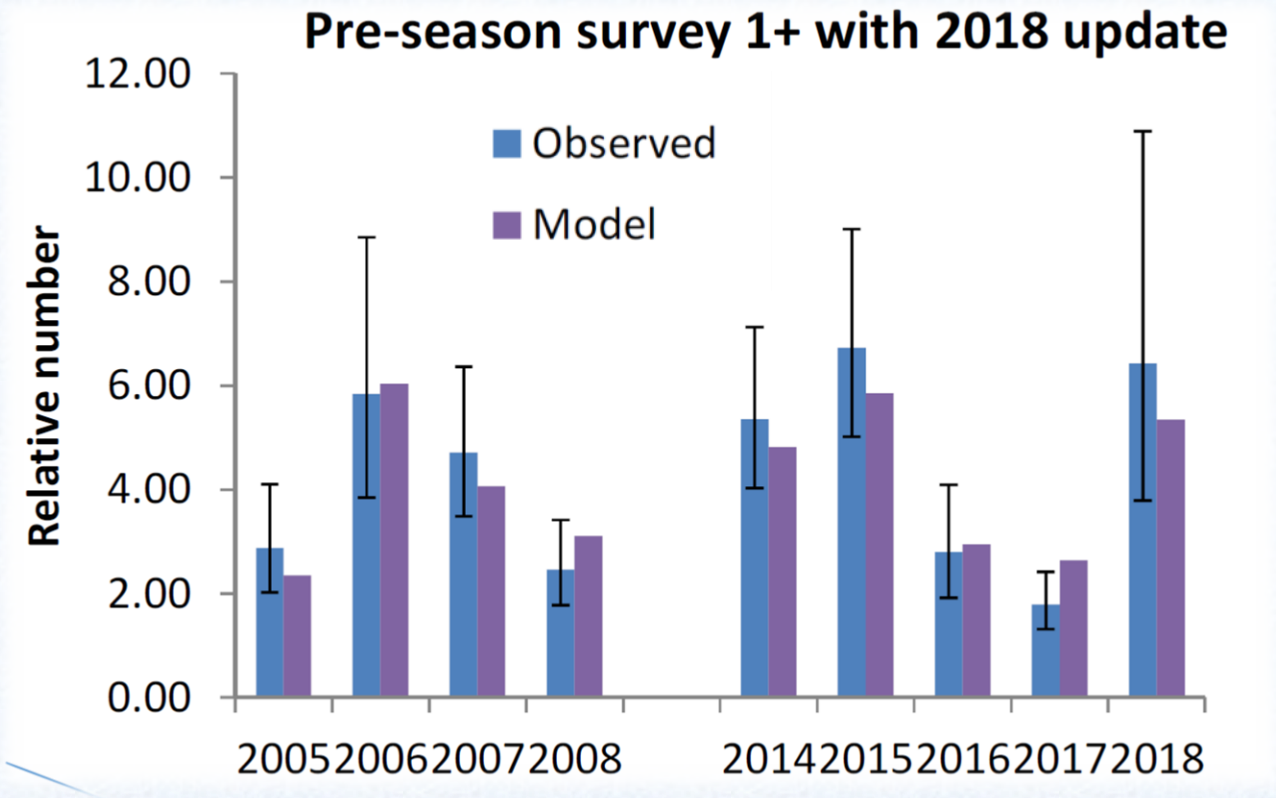
Look at model fits to the data

- How well does the model fit the data?



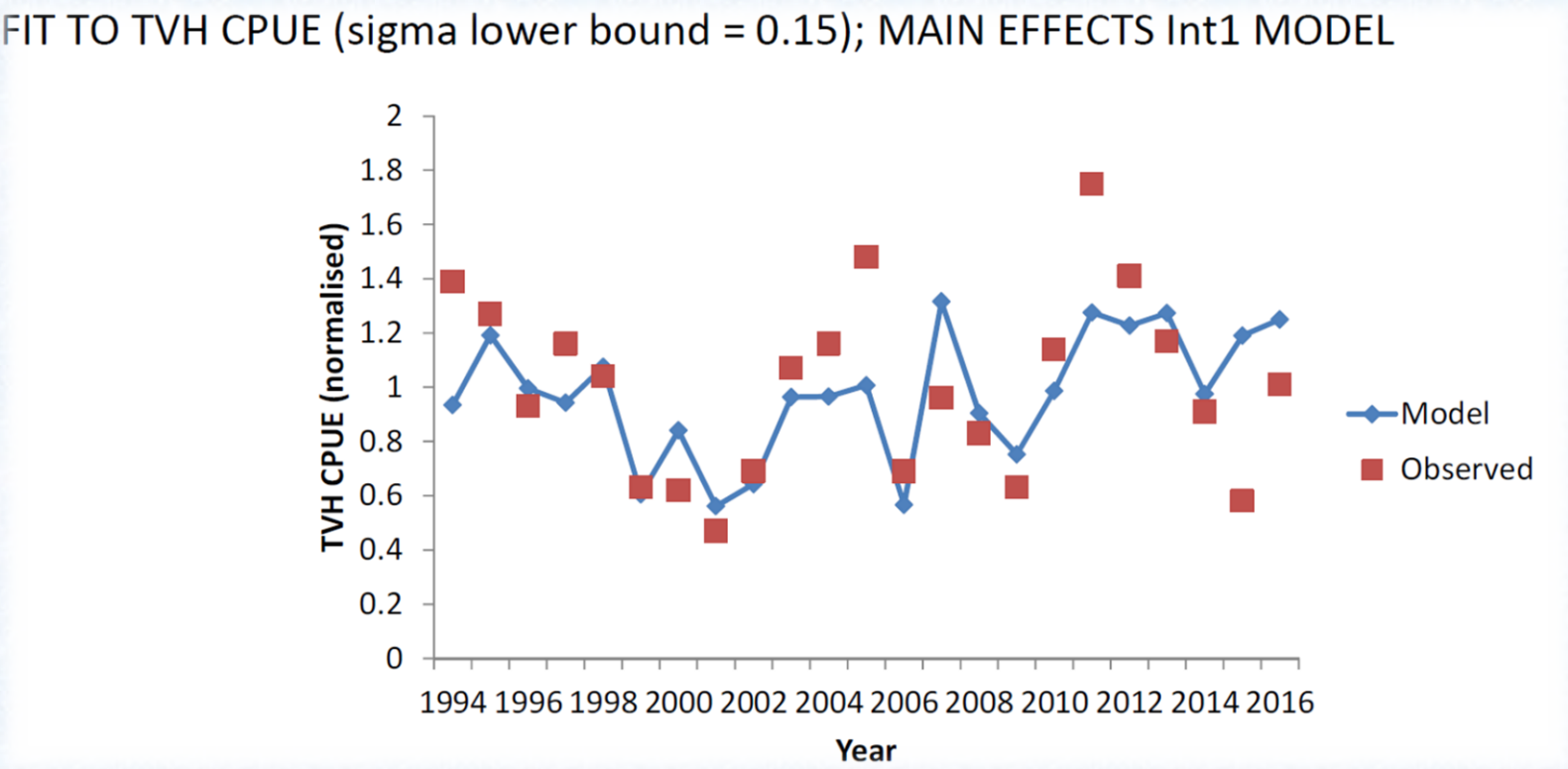
Look at model fits to the data

- How well does the model fit the data?



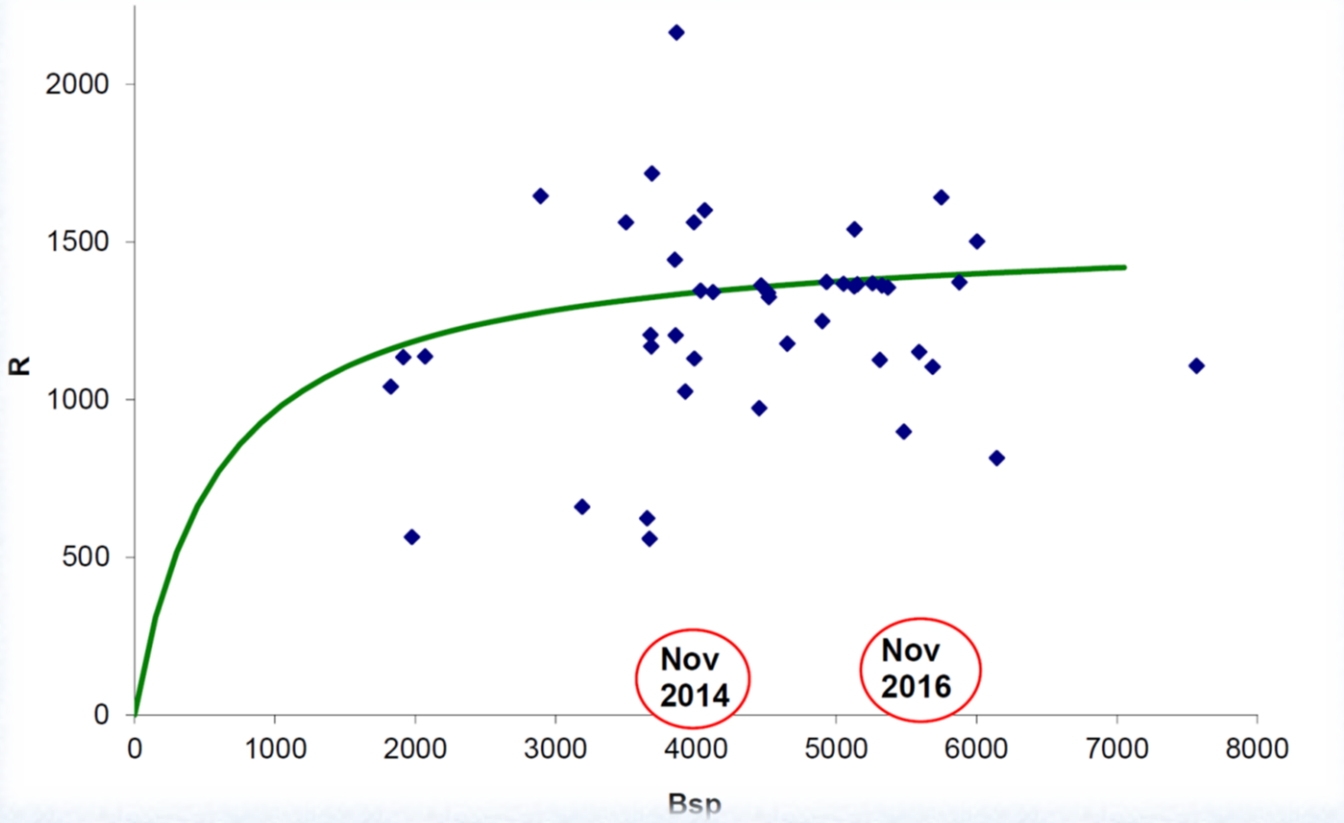
Look at model fits to the data

- How well does the model fit the data?



Look at model fits to the data

- How well does the model fit the data?
- Why doesn't it fit as well as it could?

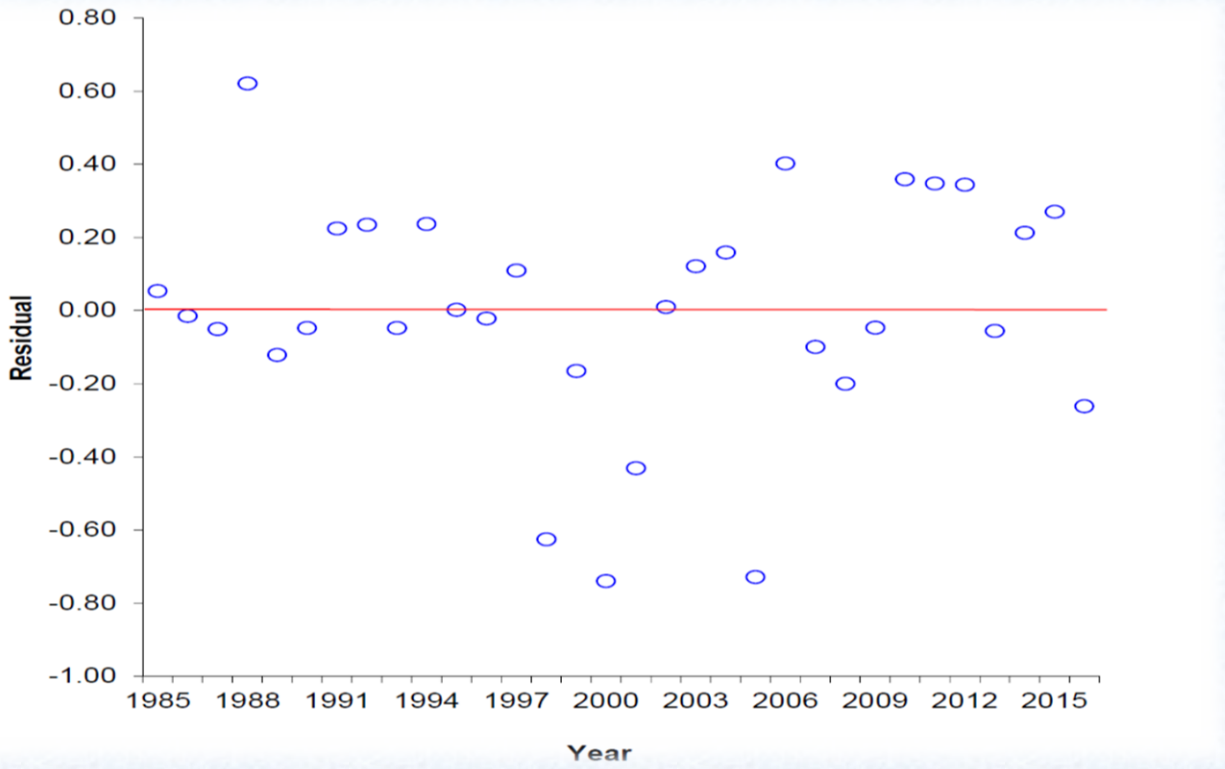


Look at the model outputs

- Indicator trends – does it make sense
  - Biomass
  - Recruitment
- Change from previous years
- Do some quick and dirty checks
  - EG. Last year we caught 450 t, why is model saying total biomass is only 700?
  - If there was high recruitment last year – why aren't there any little ones in the length frequency?
- Sensitivity tests

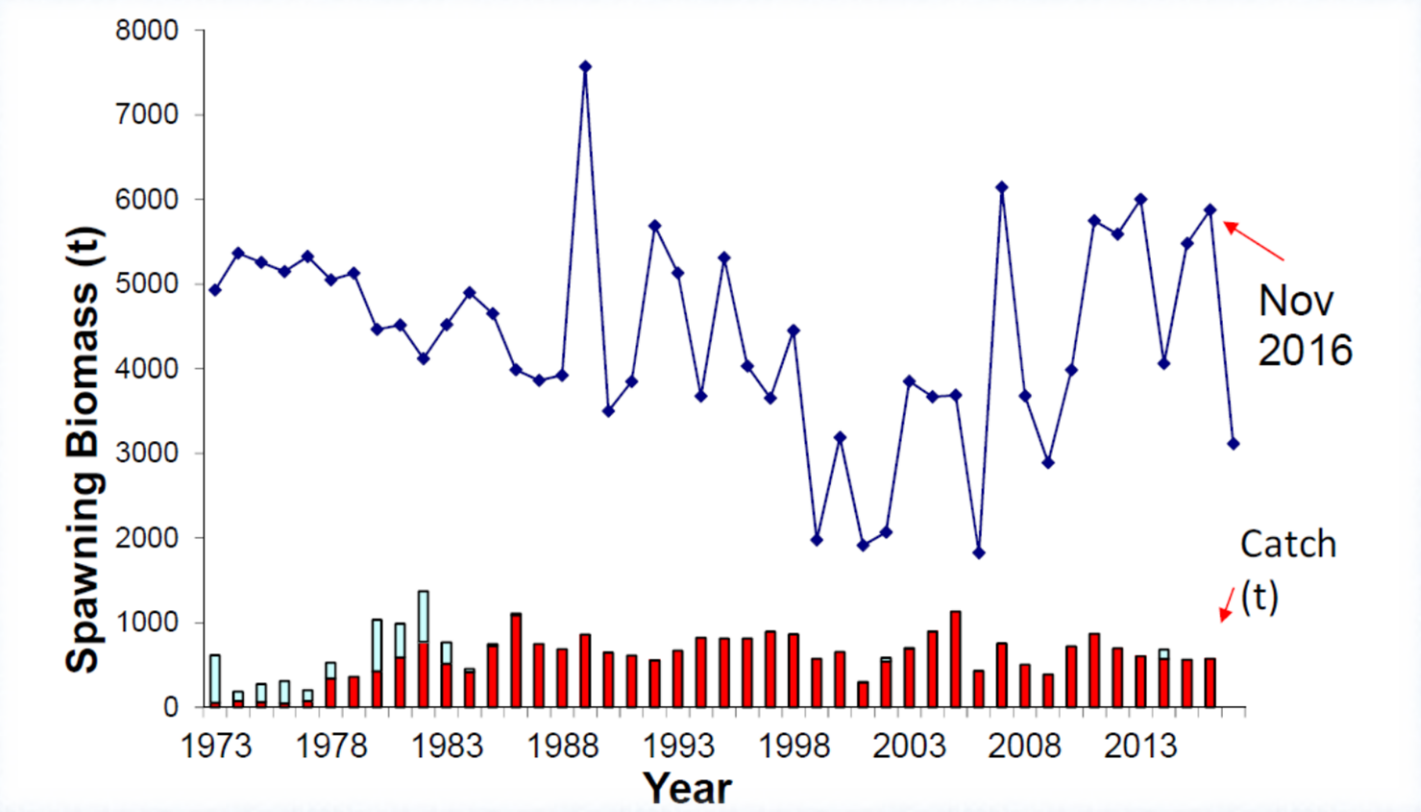
TRL – plots of residuals

- Recruitment
- Annual recruitment compared to the average



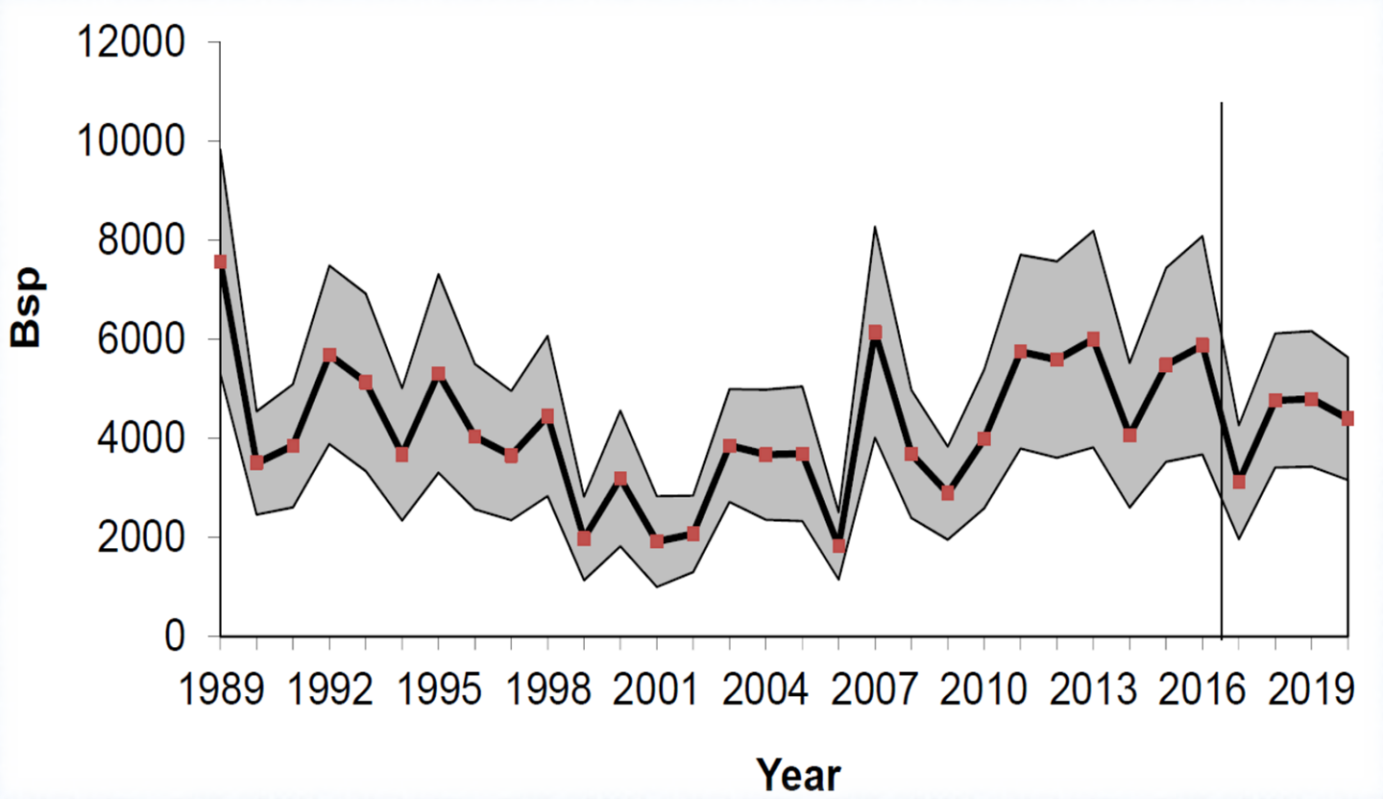
TRL – Model outputs

- Model trajectories of Spawning Biomass



TRL – Model outputs

- Model trajectories of Spawning Biomass (with 90% confidence intervals)



TRL – Model outputs

- Summary of model parameter estimates

	(a) Reference Case		
Parameter	**Parameter**	**Value**	**90% CI**
B(1973) ^{sp} (tons)	4947	3497	6397
M	0.69	0.56	0.82
h	fixed 0.7		
Sel (age 1+) 1973-1988	0.44	0.24	0.63
Sel (age 1+) 1989-2001	0.16	0.14	0.19
Sel (age 1+) post2002	0.02	0.00	0.03
Recruitment residuals (1985-2016)		32 parameters	
Model estimates and depletion statistics			
B(2016) ^{sp} (tons)	5877	3671	8083
RBCprelim(2017) model	495	315	676
RBCforecast(2018) mode	758	546	970
Current Depletion (Nov) *B(2016) ^{sp} / B(1973)sp*	1.19	0.84	1.55
Bexp(2016) (tons)	6306	4179	8432
No. parameters estimated	37		
'-lnL:overall	**-182.974**		
AIC	**-291.948**		

Ian Knuckey

ian@fishwell.com.au

www.fishwell.com.au

http://www.youtube.com/user/FishwellConsulting