Towards a “standard” salmon stock monitoring programme

Examples from the Scorff (Brittany, France) and Frome (Dorset, UK)

Cefas

INRA
SCIENCE & IMPACT

Game & Wildlife
CONSERVATION TRUST

france (manche channel) england
interreg

European Union
European Regional Development Fund

Ibbotson

Bagliniere

Nevoux

Gregory

Beaumont

Rivot

MorFish

Monitoring for Migratory Fish

Prevost

Jeannot

Roberts

Roussel

Lauridsen

Riley

Scott

www.morfish.org.uk

Cefas

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

- To share technical expertise:

Monitoring

Modelling

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

- To share technical expertise:

Monitoring

Modelling

- To make recommendations based on shared experience

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Monitoring

Aim: to collect data on stage-specific stock size(s)

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Monitoring

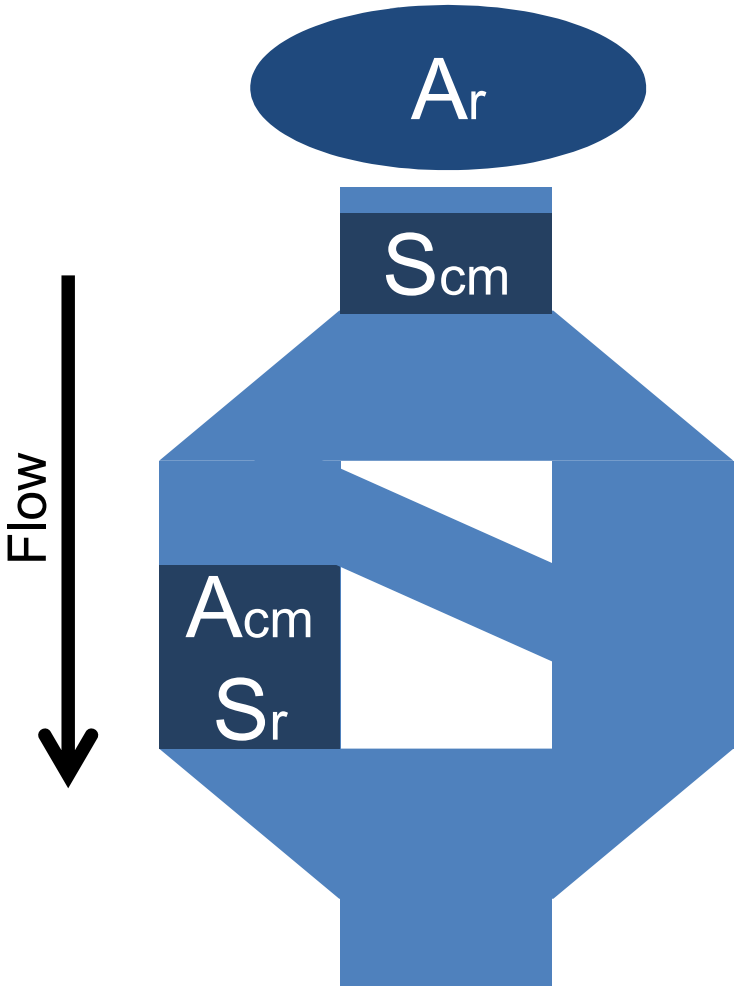
Aim: to collect data on stage-specific stock size(s)

Method	Pros	Cons
Active trapping		
Passive counting		
Combo		

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Monitoring: Scorff



Smolt captured & marked in S_{cm} trap

Smolt recaptured in S_r trap

Adults captured & marked in A_{cm} trap

Adults recaptured at spawning grounds (A_r)

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

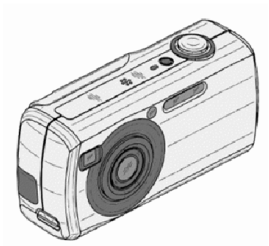
Monitoring: Pros & Cons

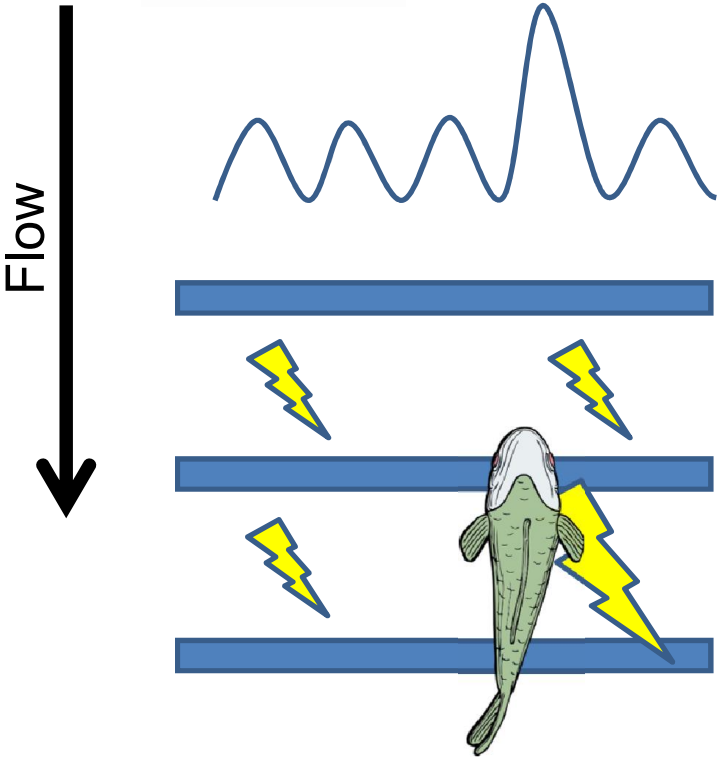
Method	Pros	Cons
Active trapping	Yields biological data	Labour-intensive
	Individual data	Potential sampling error
		May impact fish survival

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Monitoring: Frome adults





Fish detected on resistivity counter

Waveform analysis to species

Each waveform verified by video or camera

Regular system calibration tests

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

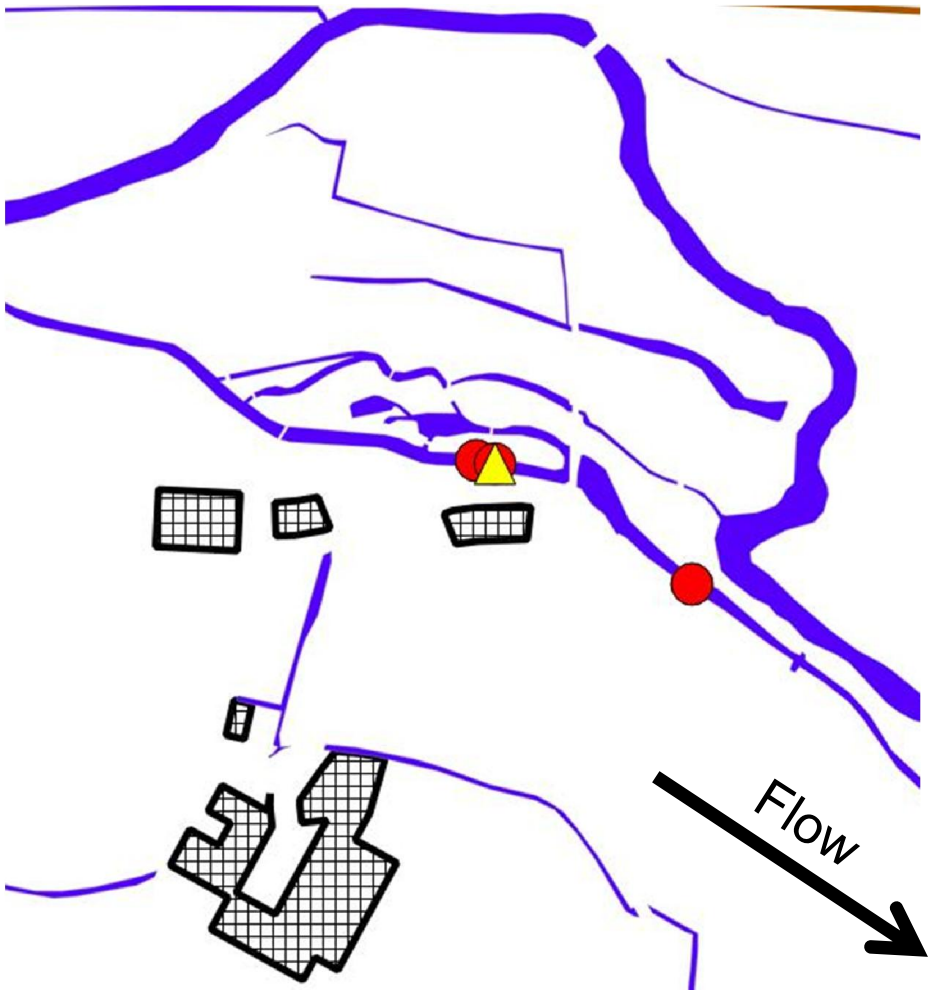
Monitoring: Pros & Cons

Method	Pros	Cons
Active trapping	Yields biological data	Labour-intensive
	Individual data	Potential sampling error
		May impact fish survival
Passive counting	Automatic counting	Labour-intensive
	Reduced sampling error	Precludes biological data
		No individual data

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Monitoring: Frome smolts



Autumn: 10,000 parr PIT tagged

Spring: smolt migration

- Smolt detected on first PIT readers
- Smolt trapped in Rotary Screw Trap
- Smolt detected on second PIT reader

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Monitoring: Pros & Cons

Method	Pros	Cons
Active trapping	Yields biological data	Labour-intensive
	Individual data	Potential sampling error
		May impact fish survival
Passive counting	Reduced sampling error	Labour-intensive
	Automatic counting	Precludes biological data
		No individual data
Combo	Yields biological data	High initial PIT tagging effort
	Reduced sampling error	May impact fish survival
	Individual data	
	Less labour-intensive	

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Monitoring: Pros & Cons

Method	Pros	Cons
Active trapping	Yields biological data	Labour-intensive
	Individual data	Potential sampling error
		May impact fish survival
Passive counting	Reduced sampling error	Labour-intensive
	Automatic counting	Precludes biological data
		No individual data
Combo	Yields biological data	High initial PIT tagging effort
	Reduced sampling error	May impact fish survival
	Individual data	
	Less labour-intensive	

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Modelling

Aim: to use monitoring data to estimate stage-specific stock size(s), vital rates and their uncertainties

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Modelling

Aim: to use monitoring data to estimate stage-specific stock size(s), vital rates and their uncertainties

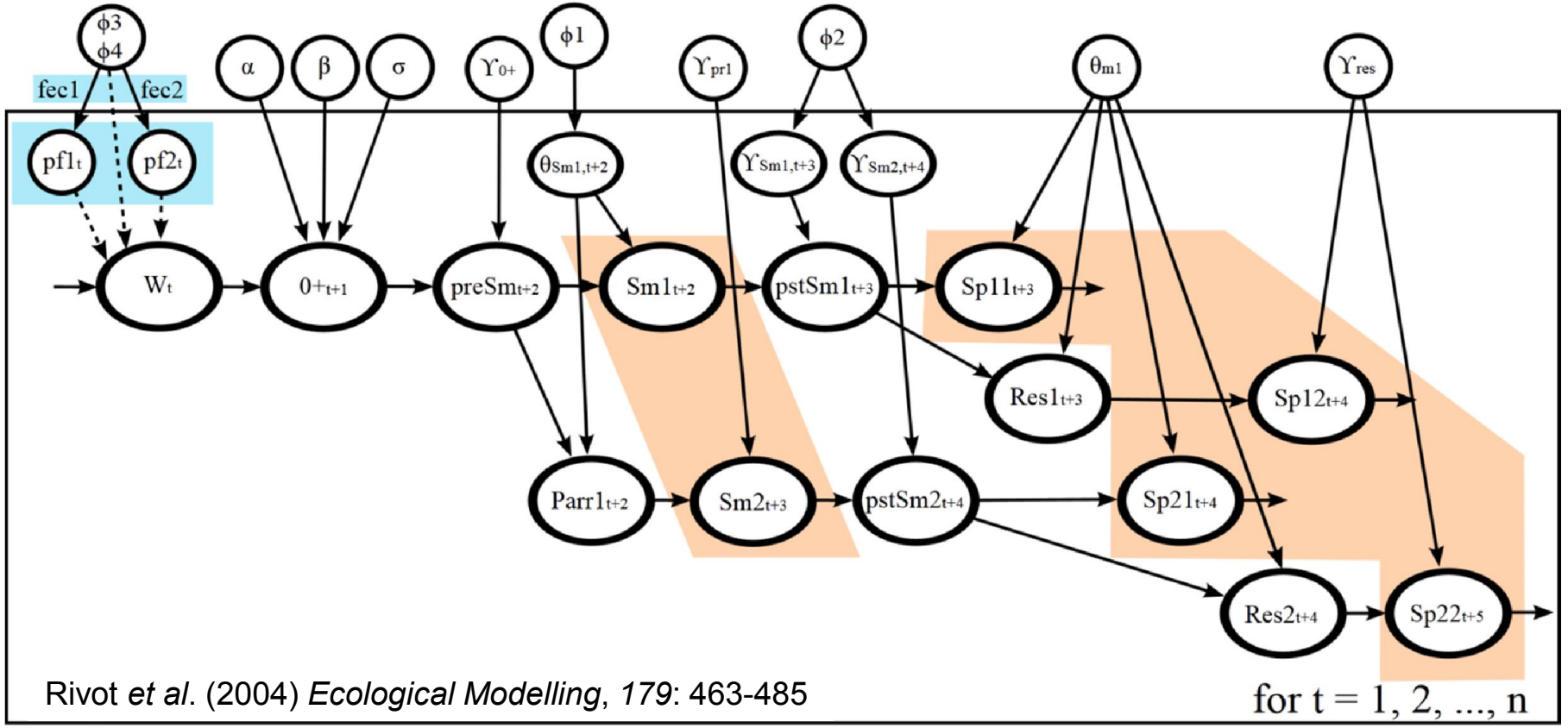
Method	Pros	Cons
SLC model		
Classical CMR		

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Modelling: INRA

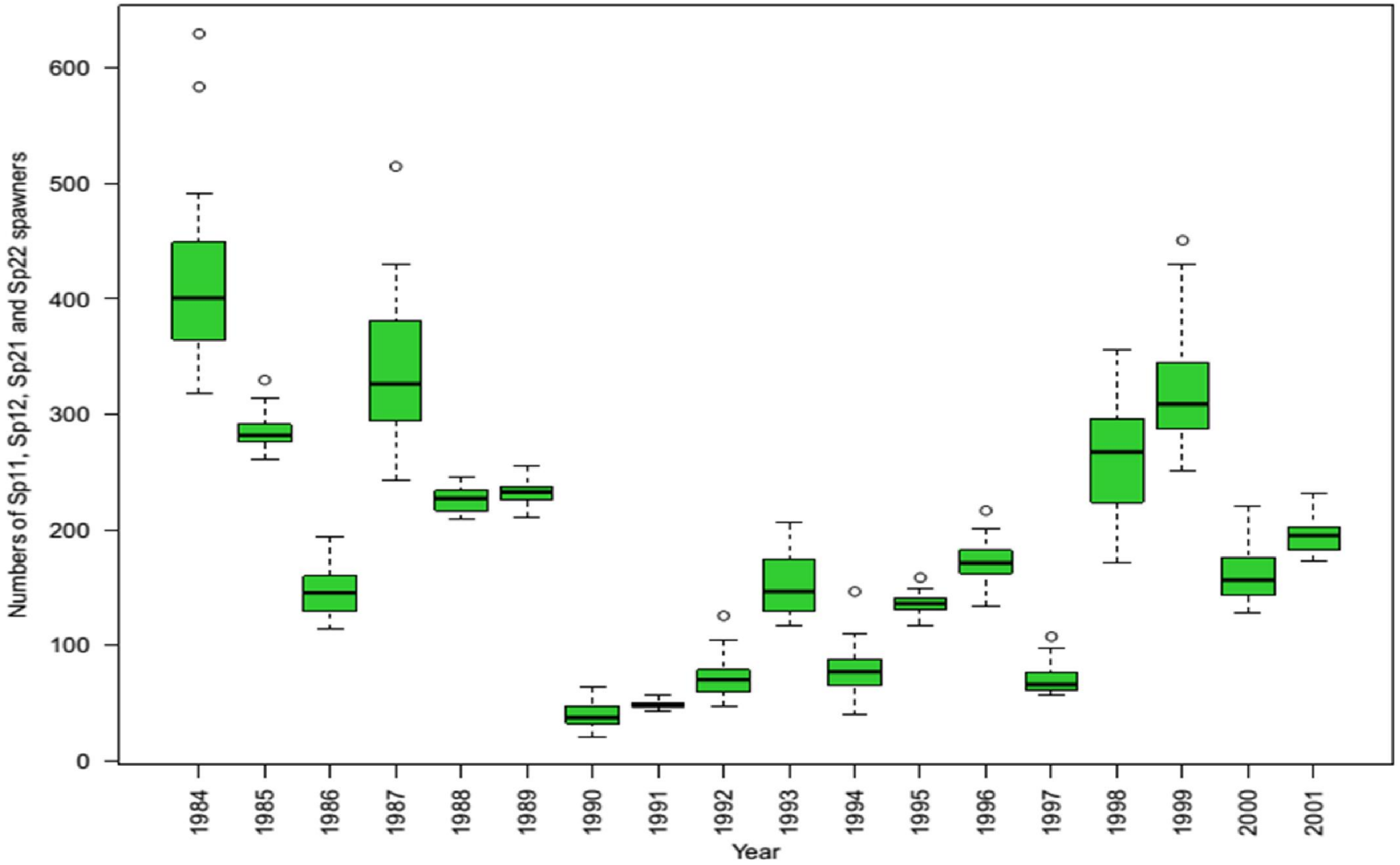
Salmon Life Cycle model (Rivot *et al.*, 2004)



Rivot *et al*. (2004) *Ecological Modelling*, *179*: 463-485

Modelling: INRA

Salmon Life Cycle model (Rivot *et al.*, 2004)



Modelling: Pros & Cons

Method	Pros	Cons
SLC model	Uses monitoring data for all life stages	Technical proficiency needed to adapt, fit and extend
	Uncertainty integrated across all life stages	Computationally demanding
	Permits missing values	No closed solution
	Estimates unmonitored life stages & vital rates	
	Uses Capture-Mark-Recapture data efficiently	

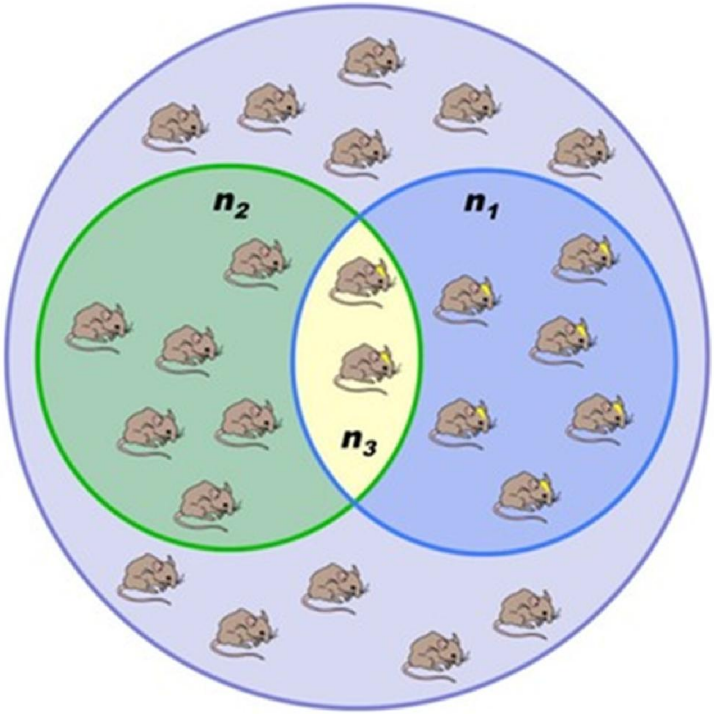
INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Modelling: GWCT

Game & Wildlife CONSERVATION TRUST

Chapman-Petersen estimators



$$N = \frac{(n_1 + 1)(n_2 + 1)}{(n_3 + 1)} - 1$$

$$\frac{(8 + 1)(8 + 1)}{(2 + 1)} - 1 = 26$$

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Modelling: Pros & Cons

Method	Pros	Cons
SLC model	Uses monitoring data for all life stages	Technical proficiency needed to adapt, fit and extend
	Uncertainty integrated across life stages	Computationally demanding
	Permits missing values	No closed solution
	Estimates unmonitored life stages & vital rates	
	Uses Capture-Mark-Recapture data efficiently	
Classical CMR	Simple estimation	No missing values allowed
	Mathematical solution	Estimate for single life stage
	Known properties	No vital rate estimates

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Modelling: Pros & Cons

Method	Pros	Cons
SLC model	Uses monitoring data for all life stages	Technical proficiency needed to adapt, fit and extend
	Uncertainty integrated across life stages	Computationally demanding
	Permits missing values	No closed solution
	Estimates unmonitored life stages & vital rates	
	Uses Capture-Mark-Recapture data efficiently	
Classical CMR	Simple estimation	No missing values allowed
	Mathematical solution	Estimate for single life stage
	Known properties	No vital rate estimates

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

Verdict

Monitoring: **Active-Passive combo**

– Example: Frome smolt monitoring

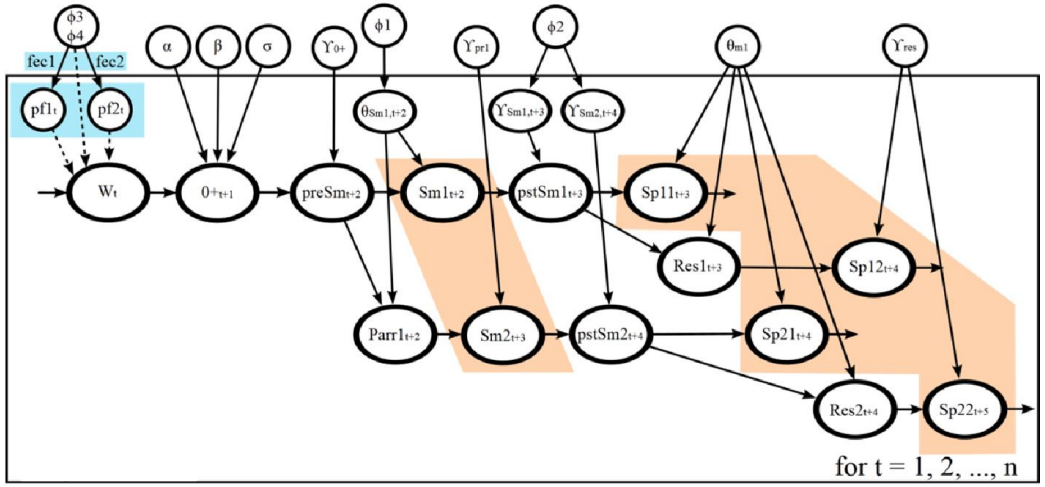
Modelling: **Salmon Life Cycle model**

– Example: Rivot *et al*. 2004, INRA

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST

A “standard” salmon stock monitoring programme



More info: www.morfish.org.uk; sgregory@gwct.org.uk

Collaboration: Jean-Luc Bagliniere, Bill Beaumont, Stephen Gregory, Anton Ibbotson, Nicolas Jeannot, Rasmus Lauridsen, Marie Nevoux, Etienne Prevost, Bill Riley, Etienne Rivot, Dylan Roberts, Jean-Marc Roussel, Luke Scott

INRA SCIENCE & IMPACT

Game & Wildlife CONSERVATION TRUST