Tagger effects: models to estimate tag loss and mortality for stock assessments

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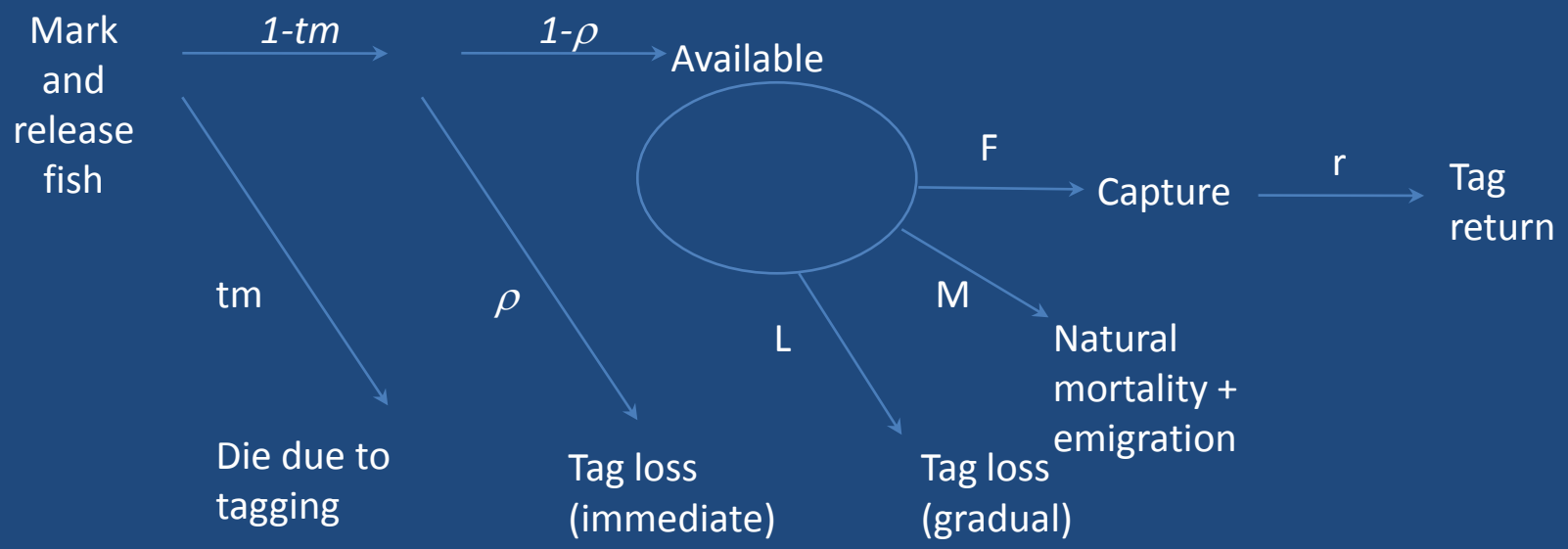
SPC

Introduction

- Some tagged fish lose their tags, and some die
- Treatment during tagging may reduce survival and tag retention
  - Fish ‘hit side of boat’ – x% of fish die?
  - Tag ‘badly placed’ – y% of tags lost?
  - Tagged by Joe Bloggs – z% fewer tags returned?
- By understanding these ‘tagger effects’, we can
  - Change tagging practices and increase effective releases
  - Estimate the effective number of released tags
  - Allow for these effects in stock assessments
  - Make fun of people with low tag return rates
- This study investigates factors that affect tag return rates, using data from:
  - Indian Ocean: RTTP
  - Pacific Ocean: PTTP, RTTP, SSAP

Fate of tagged fish



Base vs extra tagger effects

- Total tagger effect = tag loss + tagging mortality
- Total tagger effect = ‘base’ + extra effects
- The ‘base’ level of tagger effect
  - Tags applied well to fish in good condition by the best taggers
- Extras
  - Everything less than ideal

Extras 1: Fish get hurt (‘Condition’)

- Impact
  - Hit side of boat
  - Dropped on the deck
- Observed damage
  - Damaged mouth
  - Damaged tail
  - Damaged eye
  - Bleeding (depending where from)
  - Bitten by shark (cookie cutter)
- Tagged too slow

Extras 2: Tagging quality

- Bad placement
  - Too low
  - Too high

Extras 3: not all taggers are equal

- Ability and experience
- Confounded with
  - Speed
  - Fish treatment
  - Tag placement
  - Abilities of other team members
- Conventional & archival skill are not the same

Other effects

- Release event
  - The key to the analysis
  - This factor combines all time & location effects
  - Estimates a parameter for each release event

- Event 1, location 1, time t1
  - 1000 releases
  - 500 recoveries

- Event 2, location 2, time t2
  - 1000 releases
  - 5 recoveries

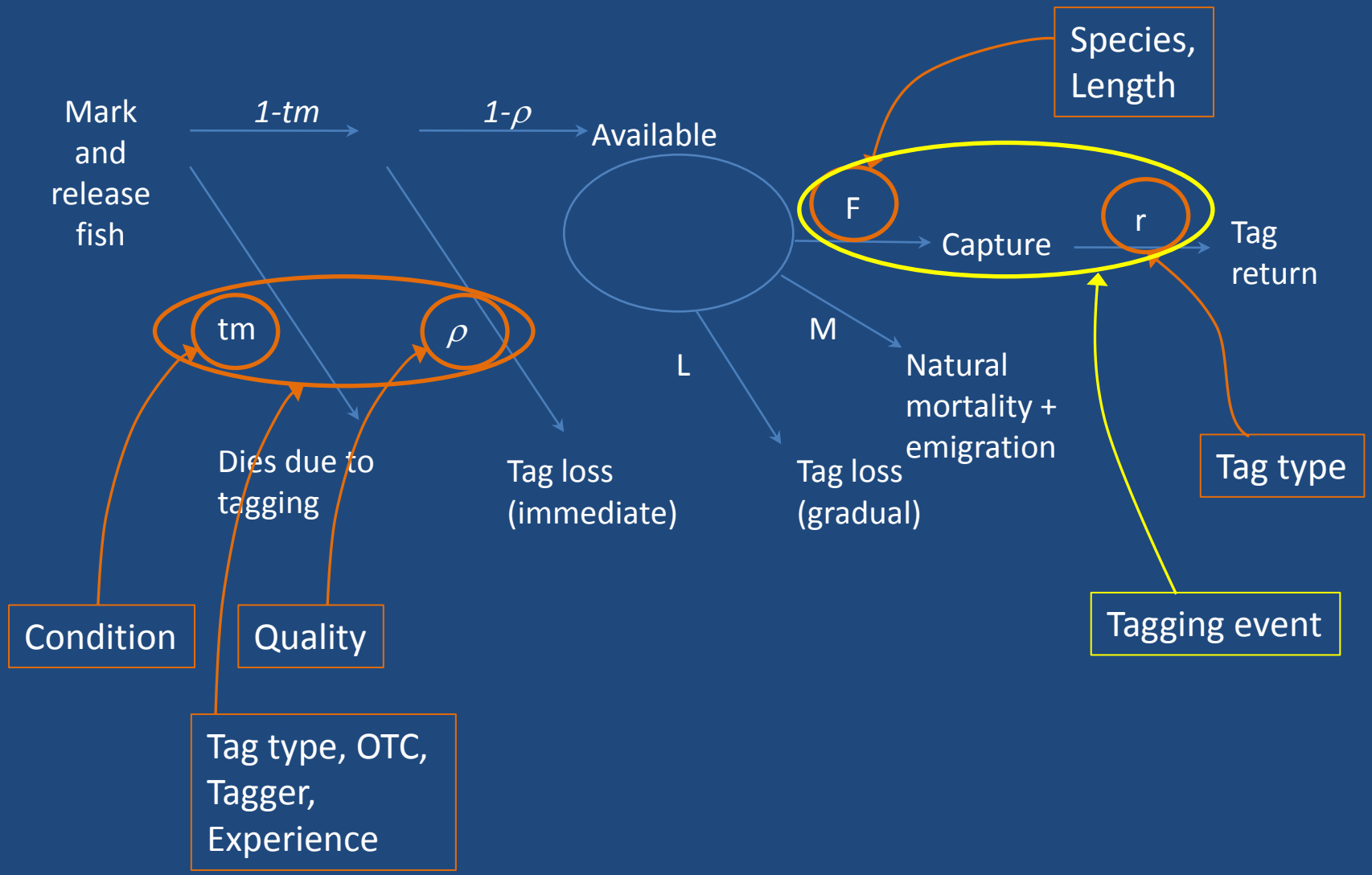
Other effects

- Species
- Size
- OTC
- Tagging cradle (bow / stern)

The tag itself

- Tag type
  - Archival
  - Conventional
    - Tag material
    - Tag size & colour
    - Single or double

Fate of tagged fish



Analysis approach

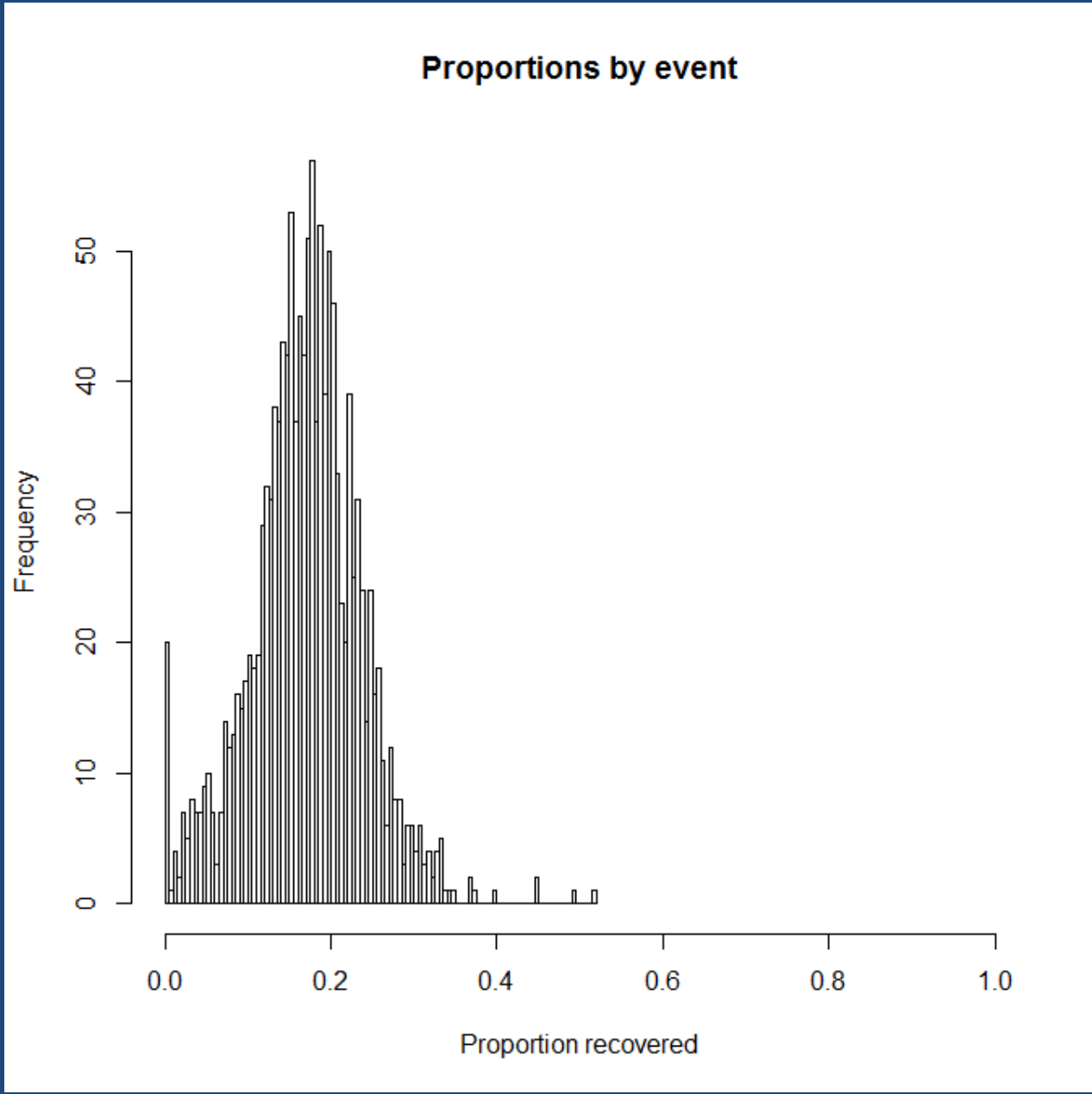
$$Recovery \sim \beta_{release\_event} + \beta_{condition} + \beta_{quality} + \beta_{tagger} + \beta_{experience} + \beta_{OTC} + \beta_{tag\_type} + \beta_{species} \cdot \beta_{size}$$

- A tag is recovered, or not
- Binomial response, logit link
- Generalized linear model in R (glm)
  - All effects are fixed effects
  - Alternative version with random effects on release event also interesting but...

Data

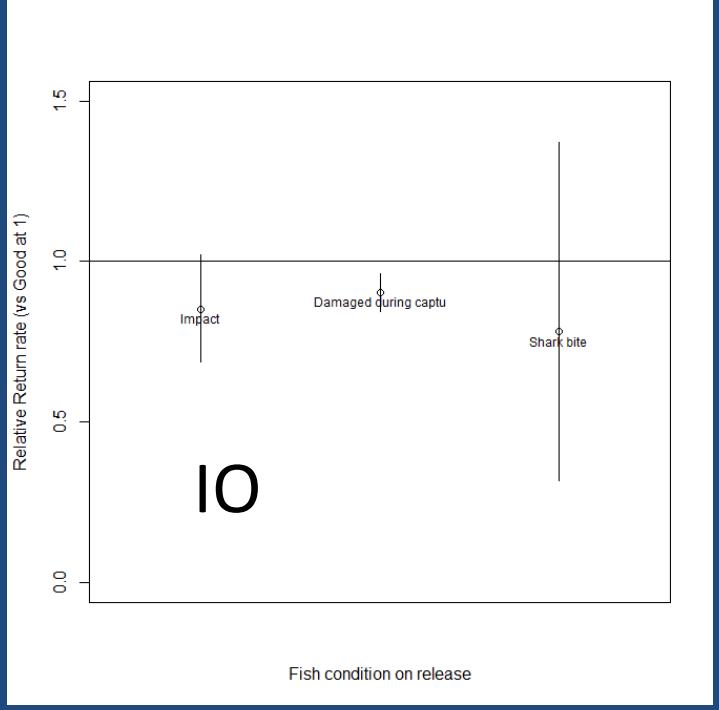
- Indian ocean
  - IOTTP releases (168 000)
- WCPO-PTTP 2006-ongoing
  - Releases in Western Pacific (330 000)
- WCPO-RTTP 1988-92
  - 146 000 releases

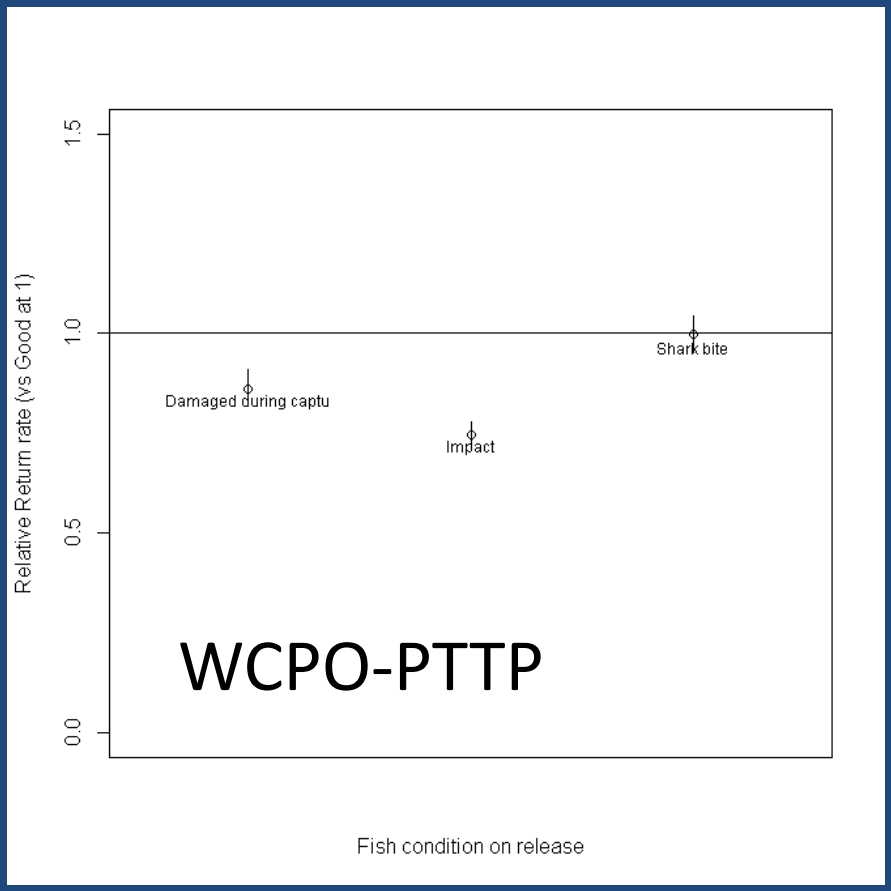
Results

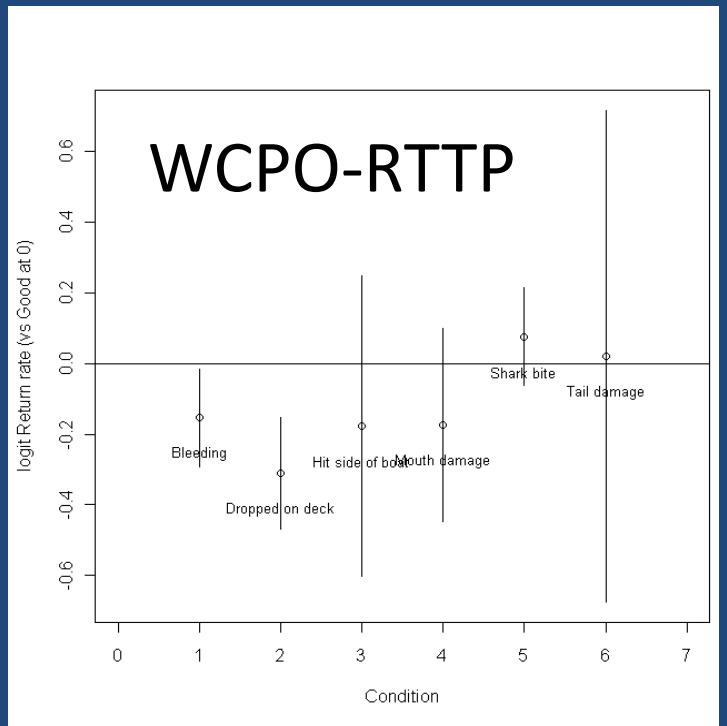

Proportions by event
Frequency
0
10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0
Proportion recovered

Damage

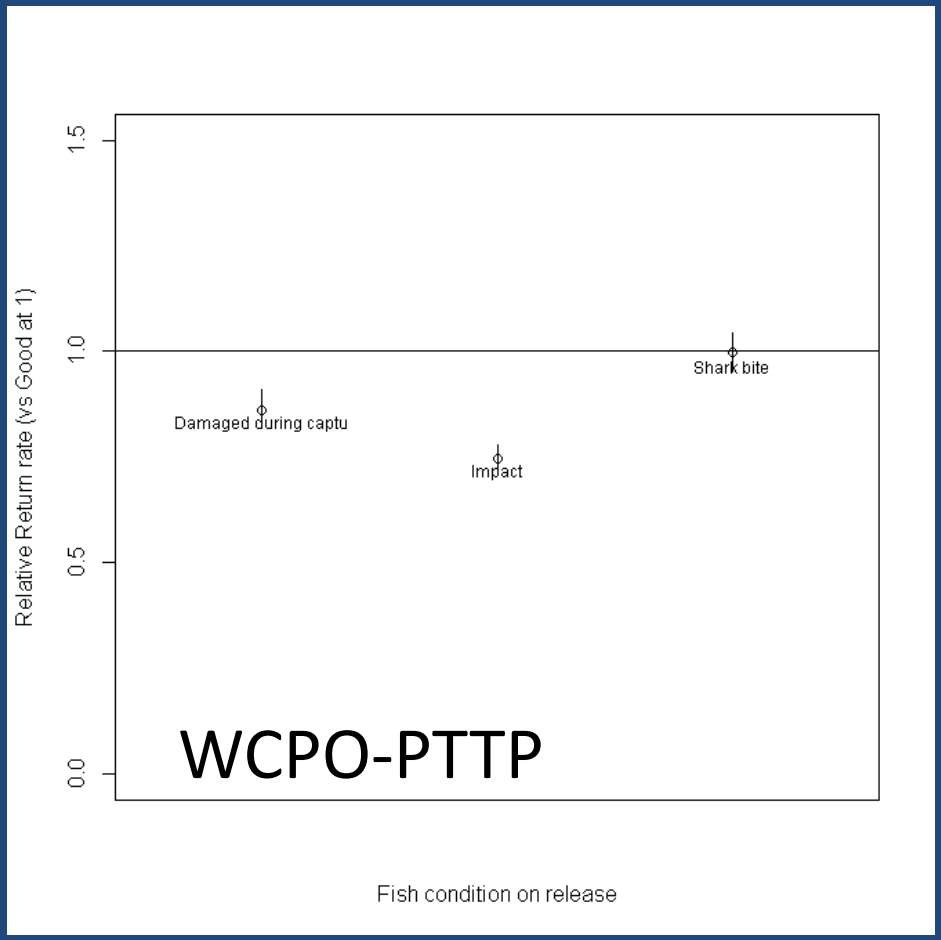
	PTTP	IOTC
Good	95.0%	97.6%
Impact	2.5%	0.6%
Damaged	1.4%	1.6%
Shark bite	1.1%	0.02%
Too slow / other	NA	0.01%

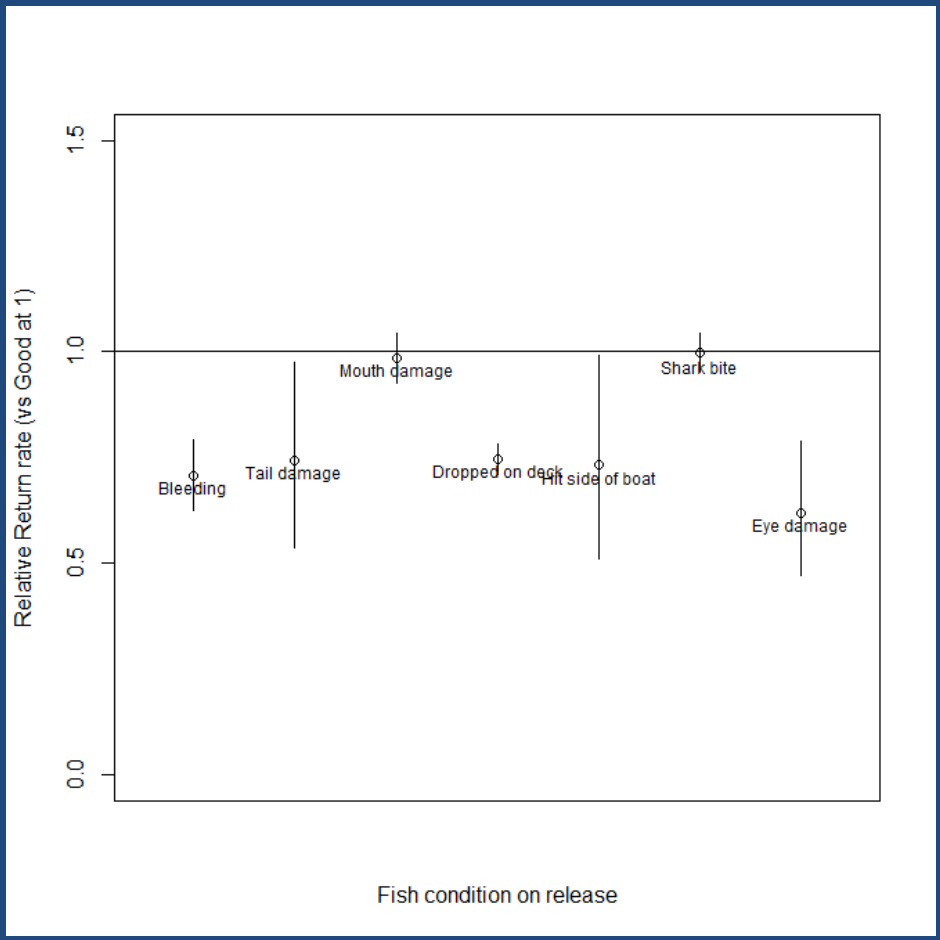




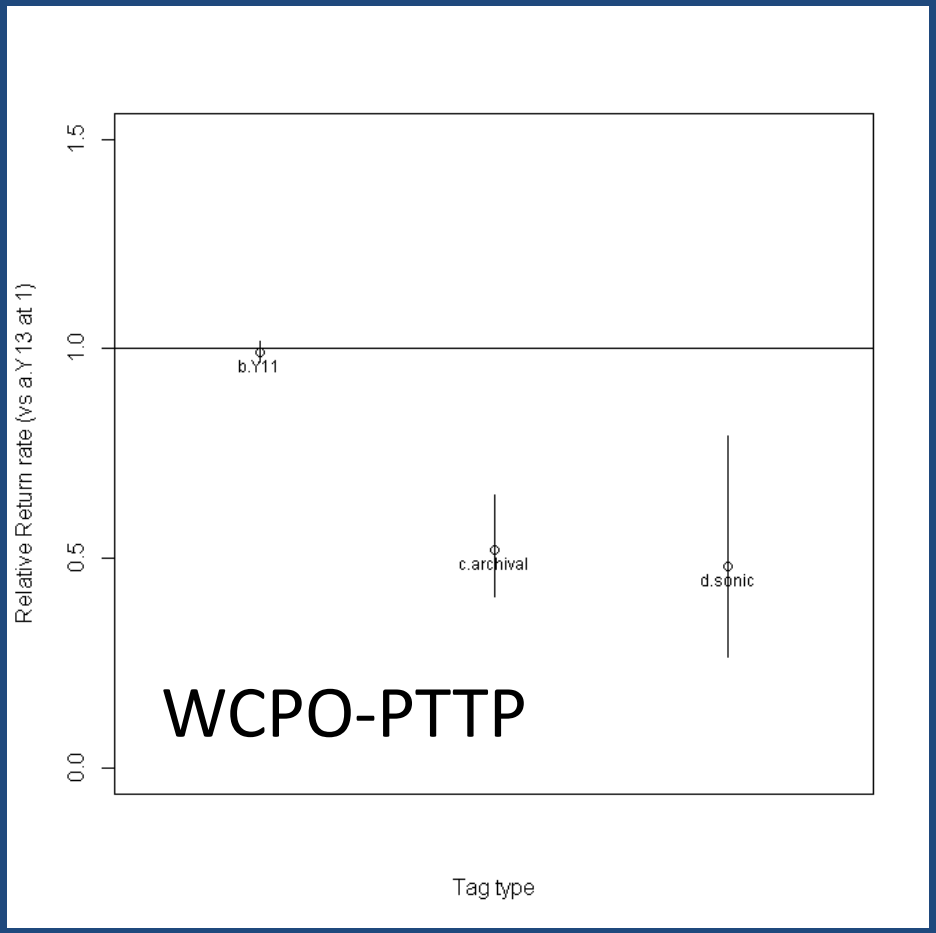


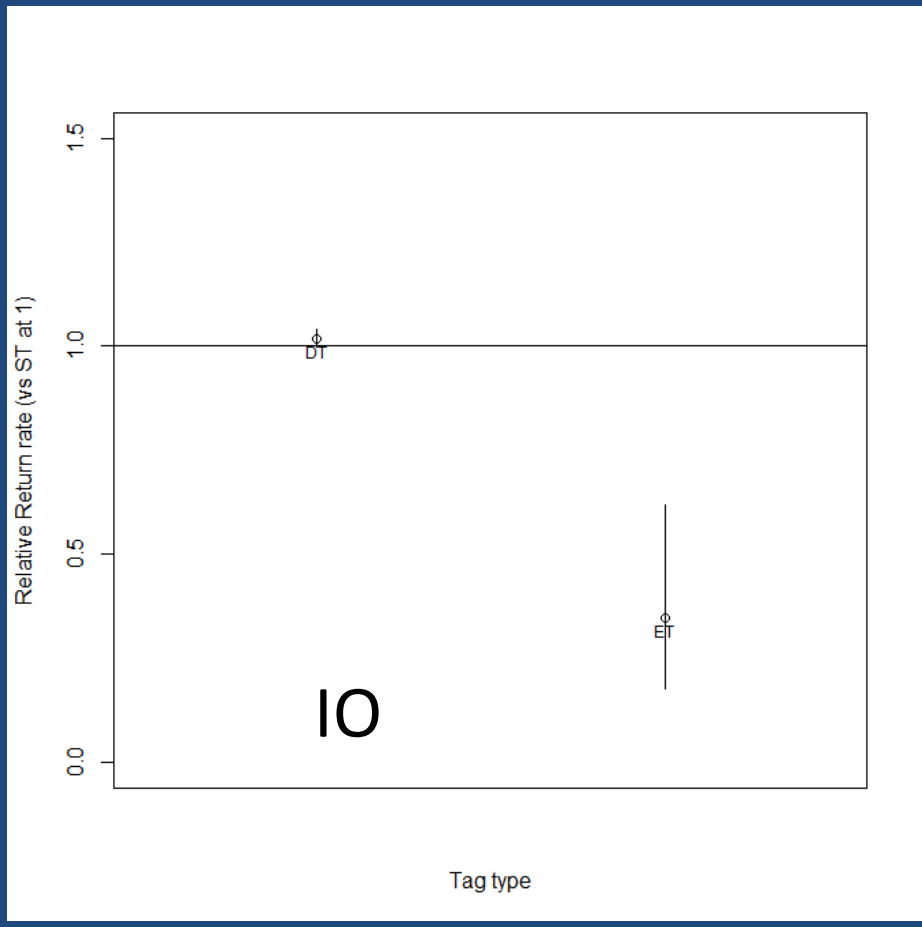
Damage – more detail





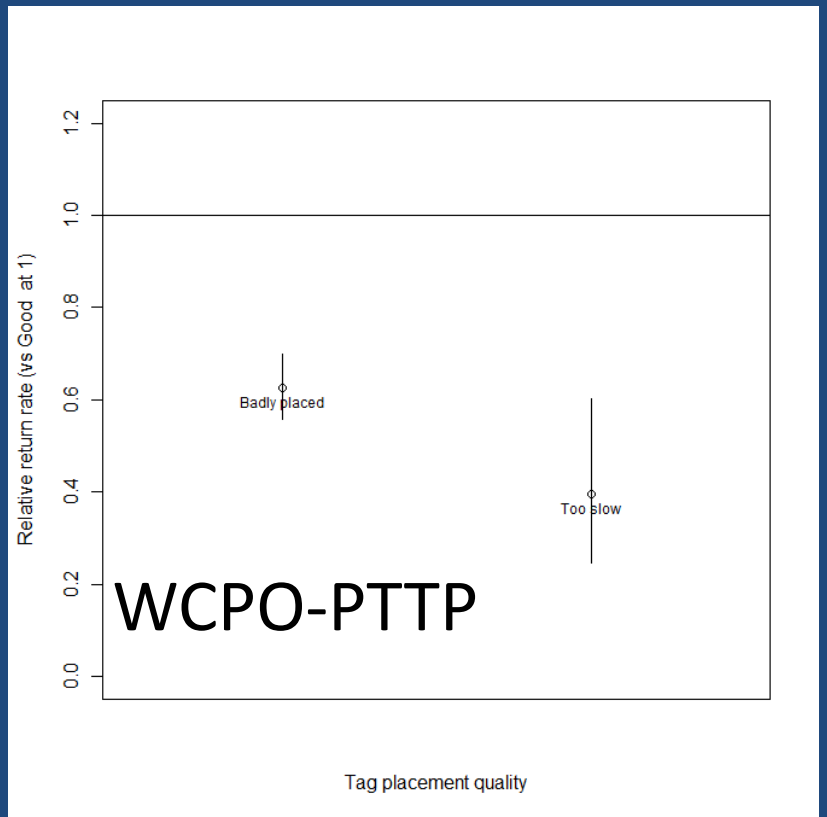
Tag type

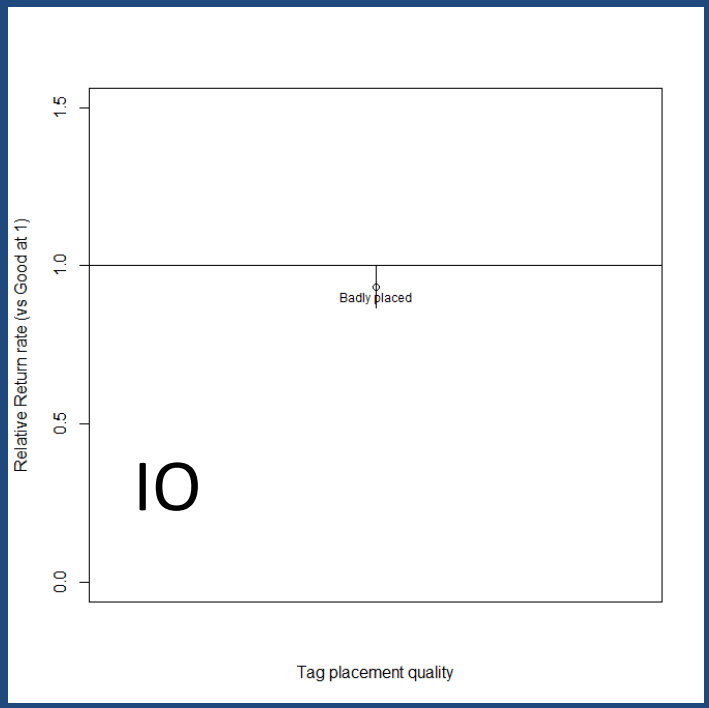

Relative Return rate (vs a.Y13 at 1)
0.0
0.5
1.0
1.5
b.Y11
c.archival
d.sonic
Tag type
WCPO-PTTP

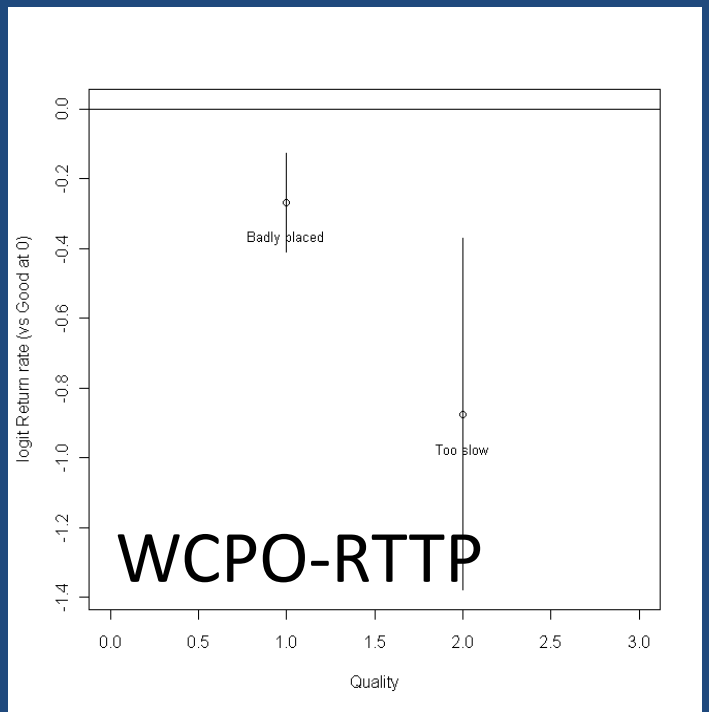

Relative Return rate (vs ST at 1)
0.0
0.5
1.0
1.5
DT
ET
Tag type
IO

	PTTP	IOTC
Good	99%	98.7%
Badly placed	0.73%	1.3%
Too slow	0.08%	NA

Tagging quality

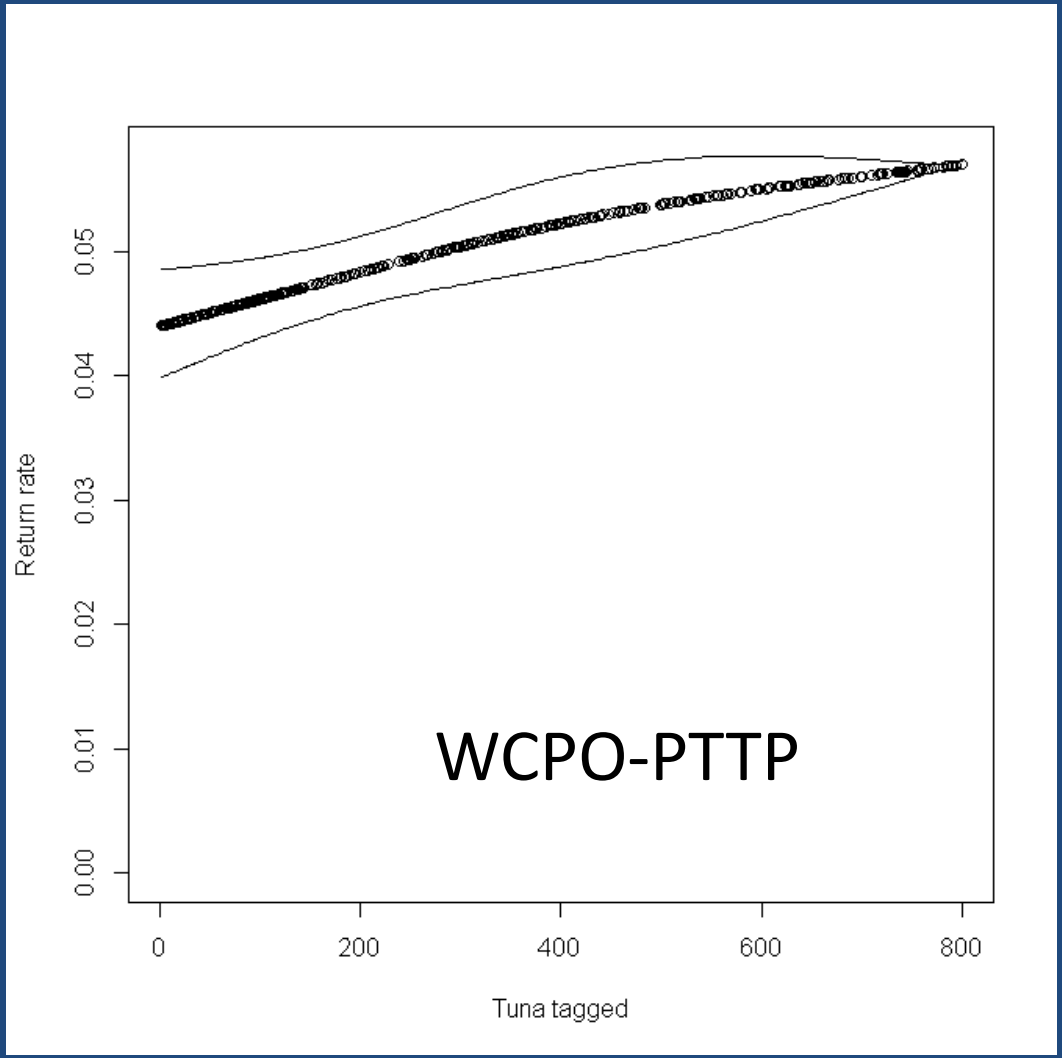




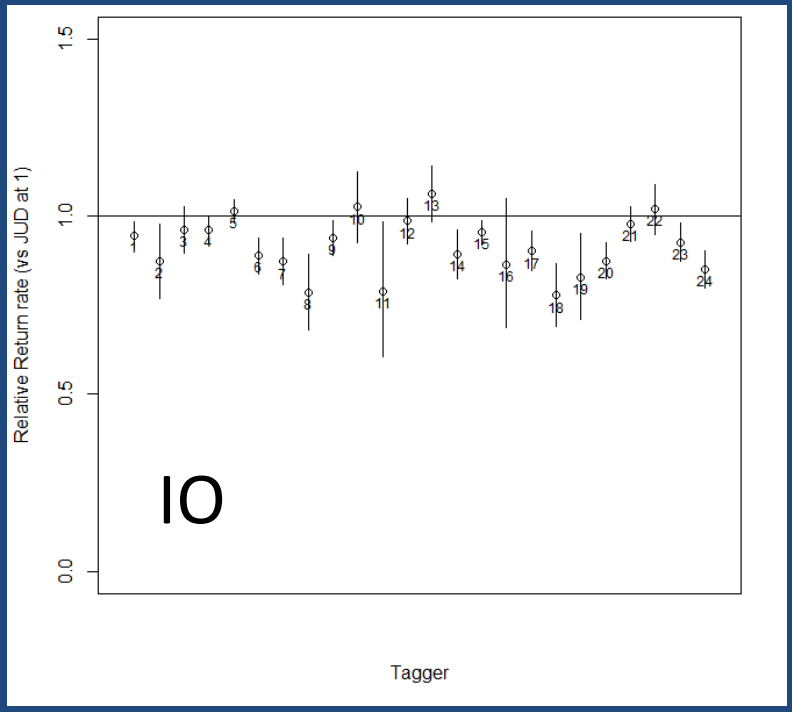


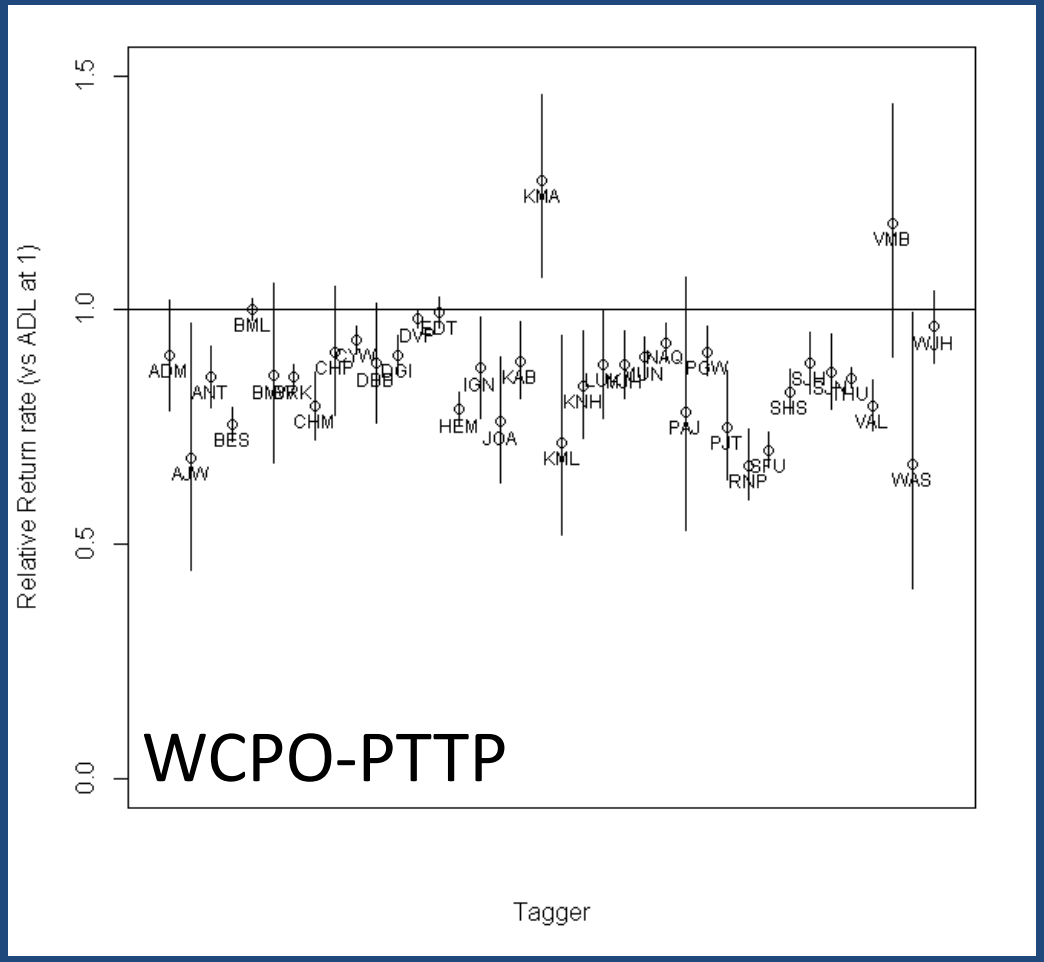
Tagger experience

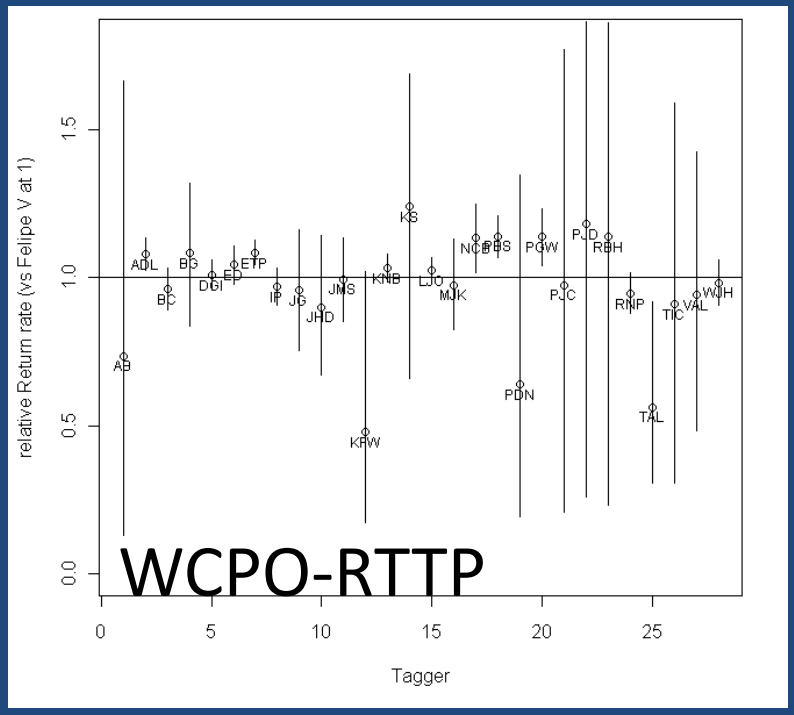
- WCPO
  - Increase with experience over first 500-1000 tags
- IO
  - Not statistically significant



Tagger greatness

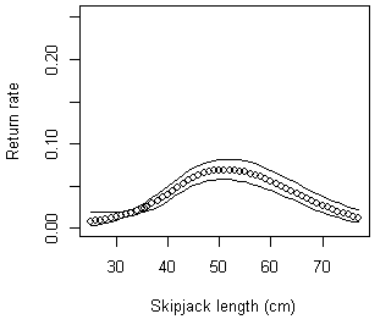


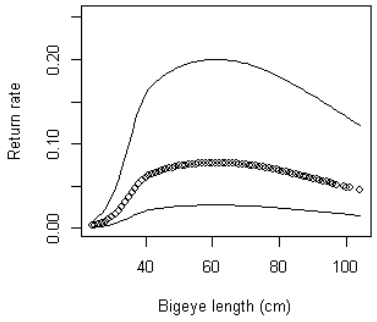


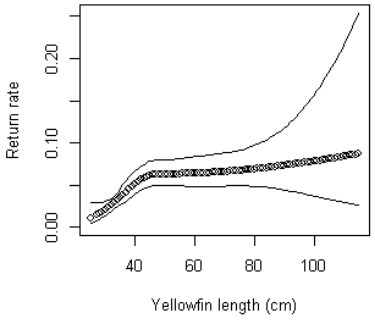


Species and size

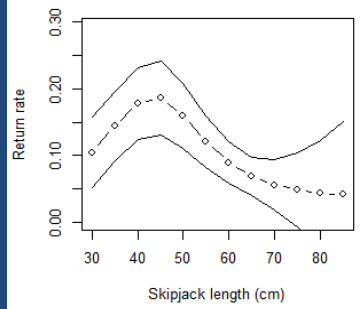
	PTTP	IOTC
SKJ	68%	47%
YFT	30%	32%
BET	2.7%	21%

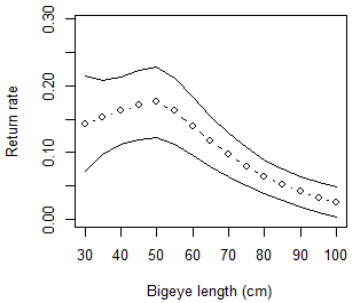


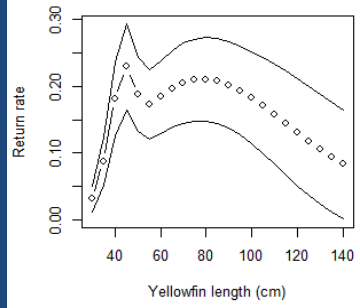




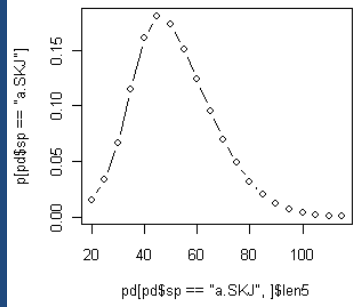
WCPO-PTTP

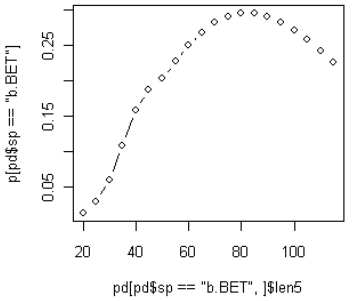


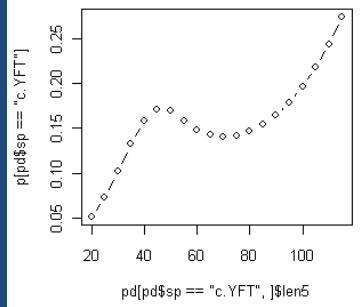




IO

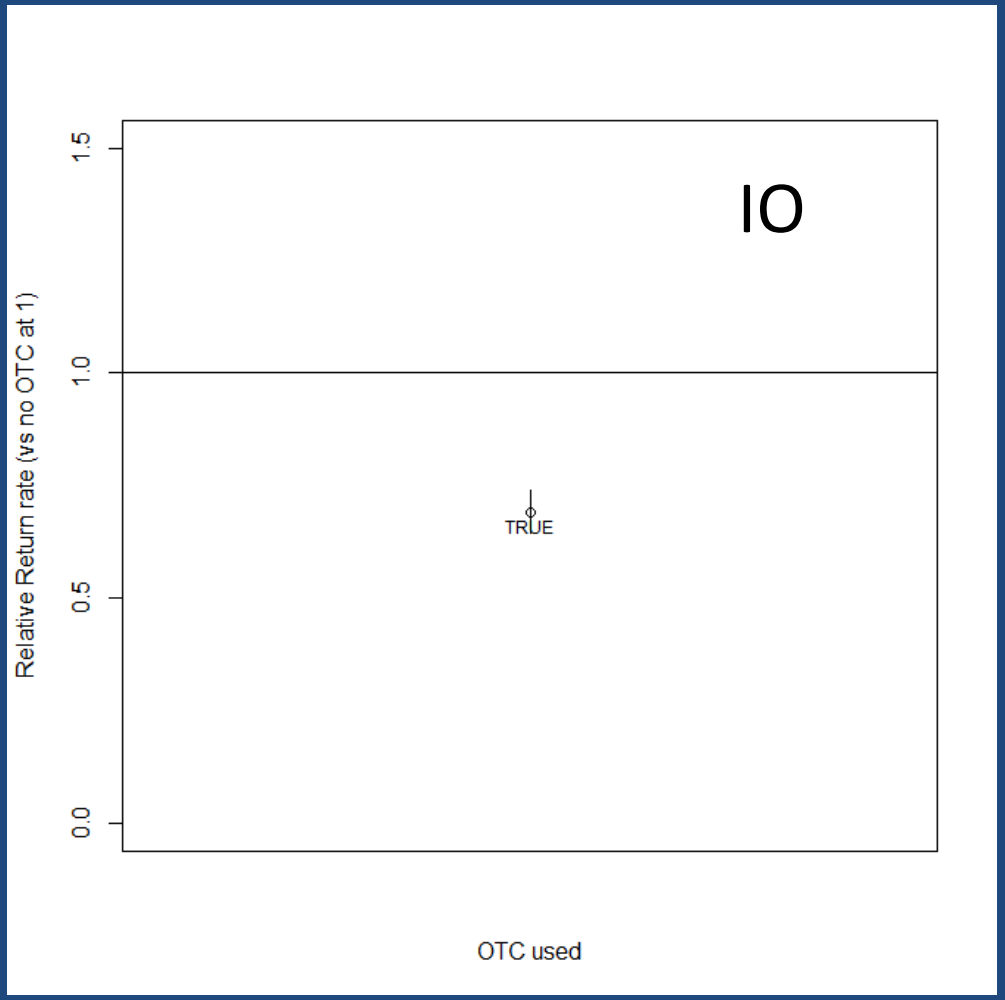






WCPO-RTTP

OTC



Using results in stock assessment

- The process
  - Tagger effects reduce tagged population, and return rates
  - More tagger effects mean fewer recaptures
  - Non-reporting has similar results: tagger effects are confounded with reporting rates
  - We integrated the tag loss estimates into our prior distributions for reporting rates
- The details
  - Assign a value to ‘base’ tagger effects
  - Estimate extra tagger effects across all releases
  - Reduce all reporting rate priors by the combined (base + extra) tagger effect rate

Tagger effects

- Base tag loss
  - 6% (as type 1) for expert taggers during WCPO-RTTP (Hampton 1997)
- Base tag mortality – unknown but probably significant
  - Tuna (especially SKJ) are reasonably sensitive to tagging
    - Mortality with damage and delay is high
    - Large variability among taggers probably mostly mortality
    - Chose arbitrary level: mean 7%, 95% CI 3-16%
- Extra effects, across tag events
  - PTTP: 12.7%
  - RTTP: 10.8%
  - IOTC: 12.6%
- Total = Base (tag loss + tag mortality) + extras
  - PTTP: mean RR = tag seeding RR * 0.76
  - RTTP: mean RR = tag seeding RR * 0.78
  - IOTC: mean RR = tag seeding RR * 0.81
  - WCPO prior CIs estimated with Monte Carlo approach

Conclusions

- Some tag loss and mortality effects can be estimated
  - Impacts and damage reduce return rates
  - OTC and internal tags reduce return rates
  - Individuals differ, and experience counts
- Mortality (unknown) probably the main issue
- Effects can be included in stock assessment via reporting rate priors – a moderate effect