

Jun 24th, 3:00 PM - 3:15 PM

## Session B8: Changes in Fish Passage Metrics Following the Co-Location of a Low-Head Hydropower Turbine with an Existing Fish Pass; Revealed by an Acoustic Tracking Study of Migratory Salmonids

Richard A.A. Noble

*University of Hull International Fisheries Institute*

Jon D. Bolland

*University of Hull International Fisheries Institute*

Jamie R. Dodd

*University of Hull International Fisheries Institute*

Sam E. Walton

*University of Hull International Fisheries Institute*

Terry Coddington

*University of Hull International Fisheries Institute*

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Noble, Richard A.A.; Bolland, Jon D.; Dodd, Jamie R.; Walton, Sam E.; Coddington, Terry; Cowx, Ian G.; Hateley, Jon; and Gregory, Jim, "Session B8: Changes in Fish Passage Metrics Following the Co-Location of a Low-Head Hydropower Turbine with an Existing Fish Pass; Revealed by an Acoustic Tracking Study of Migratory Salmonids" (2015). *International Conference on Engineering and Ecohydrology for Fish Passage*. 9.

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**Presenter Information**

Richard A.A. Noble, Jon D. Bolland, Jamie R. Dodd, Sam E. Walton, Terry Coddington, Ian G. Cowx, Jon Hateley, and Jim Gregory

# Changes in fish passage metrics following the co-location of a low-head hydropower turbine with an existing fish pass; revealed by an acoustic tracking study of migratory salmonids

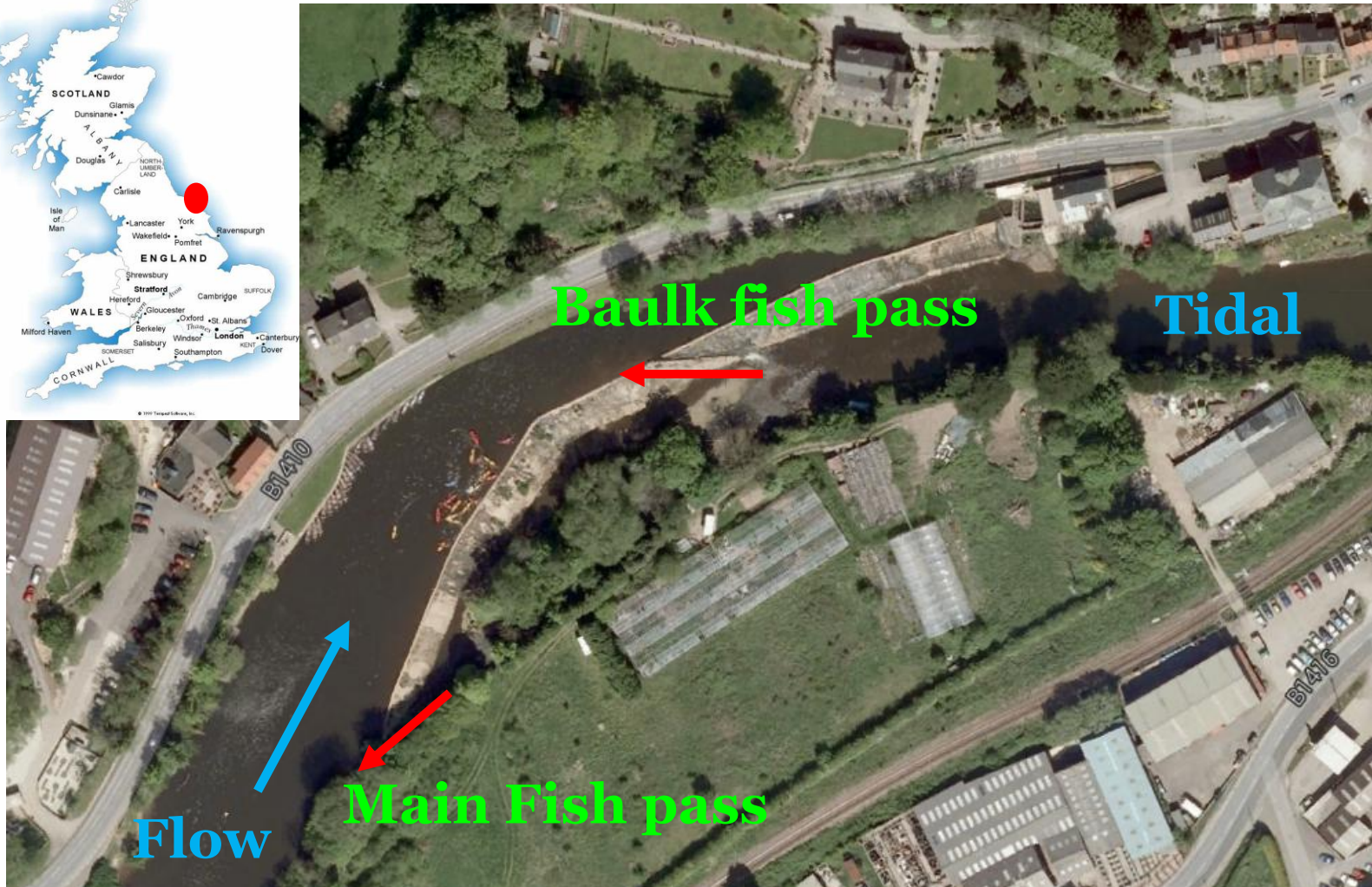
*R. A. A. Noble, J. D. Bolland, J. Dodd, S. E. Walton,  
T. Coddington, I. G. Cowx*



*J. Hateley & J. Gregory*



# Ruswarp Weir





# Ruswarp Weir – Co-located fish pass & Turbine



**Before:**

Pool-traverse pass

**After:**

Larinier pass  
Low-head 50 kW HP  
(max 4 cumec abstraction)





# Capture & Acoustic Tagging



Year	Dataset	Sea Trout	Salmon
2011	Baseline	38	1
2012	Baseline	10	13
2013	Post	46	1
2014	Post	44	3

Model 795LG acoustic tags

11-mm x 25 mm

4.6-g weight in air

expected life of 220 days

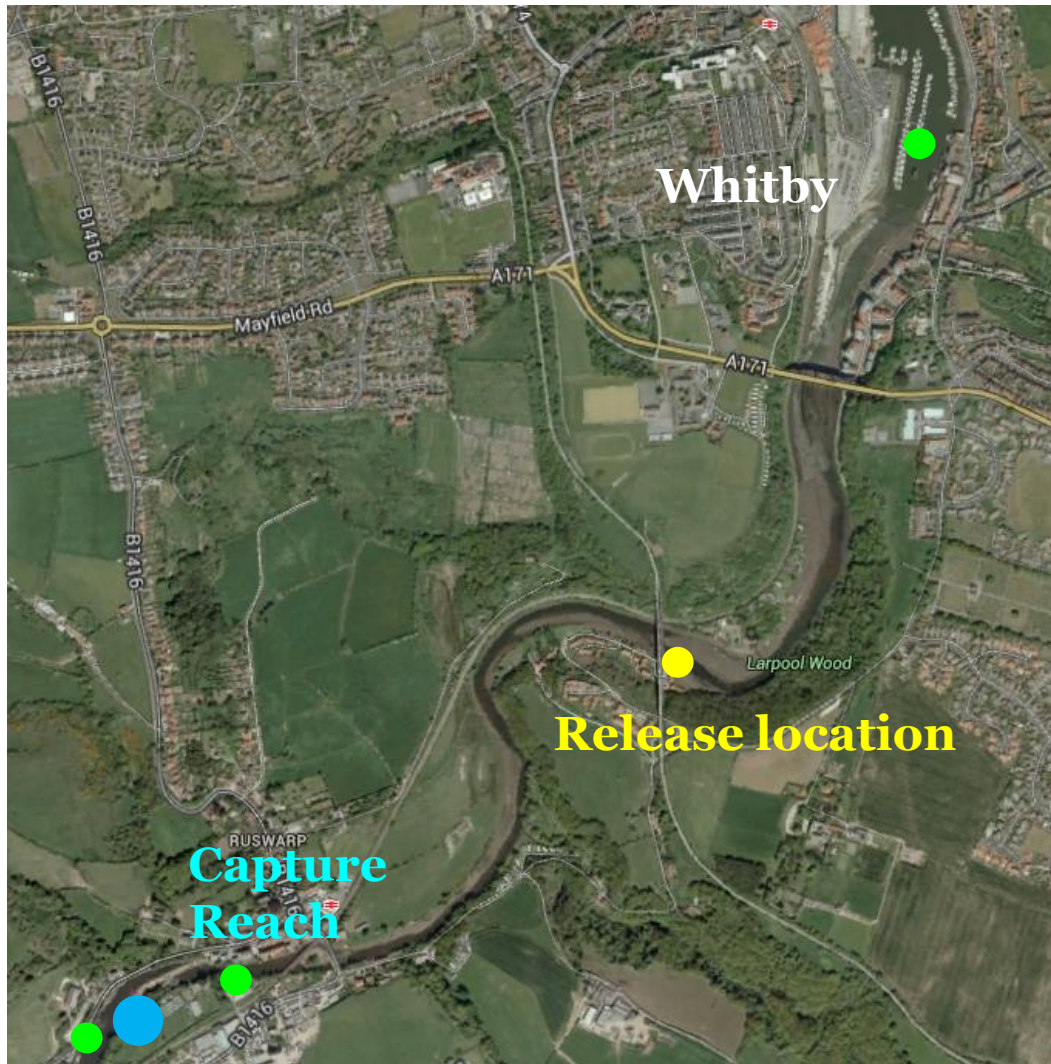
307 kHz

Hydroacoustic Technology Inc., Seattle, USA

All tagging done under Home Office Licence



# Tracking design



- **HTi ATS Array**

Model 290 acoustic tag receiver Acoustic Tracking System

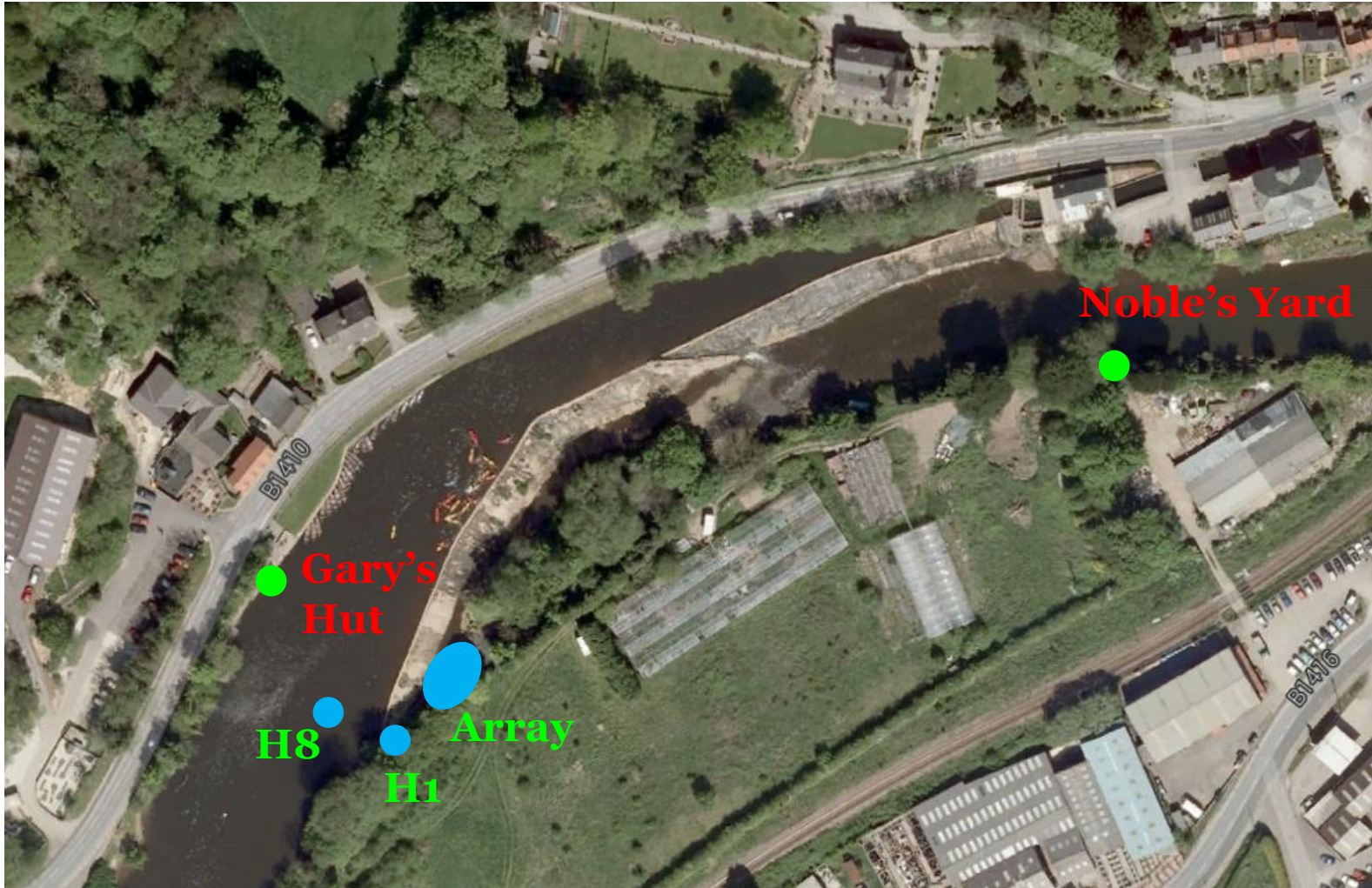
- **HTi Remote hydrophones**  
**Post Commissioning**  
**Monitoring Only**

Model 300 mobile hydrophones

Hydroacoustic Technology Inc., Seattle, USA



# Determination of passage route and timing



# Fate of tagged fish & Fish passage metrics

# Metrics of Fish Passage

## 1) The overall **passage efficiency**

- proportion of tagged fish ascending the weir via any route (main fish pass, side of main fish pass, baulk fish pass or weir face at high tide/flows)

## 2) The **attraction efficiency**

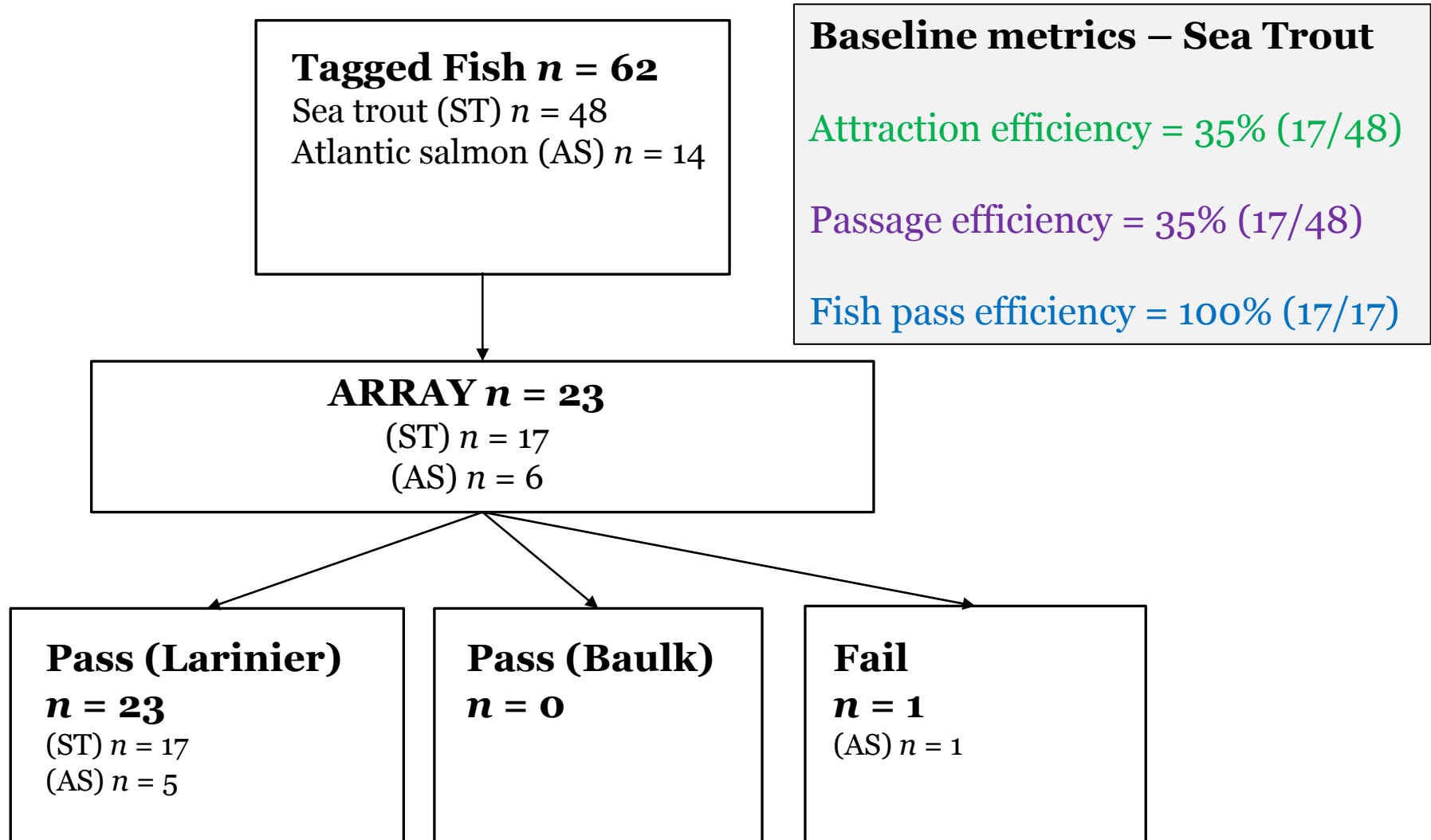
- proportion of tagged fish detected in the ATS array downstream of the main fish pass

## 3) The efficiency of the main fish pass (**fish pass efficiency**)

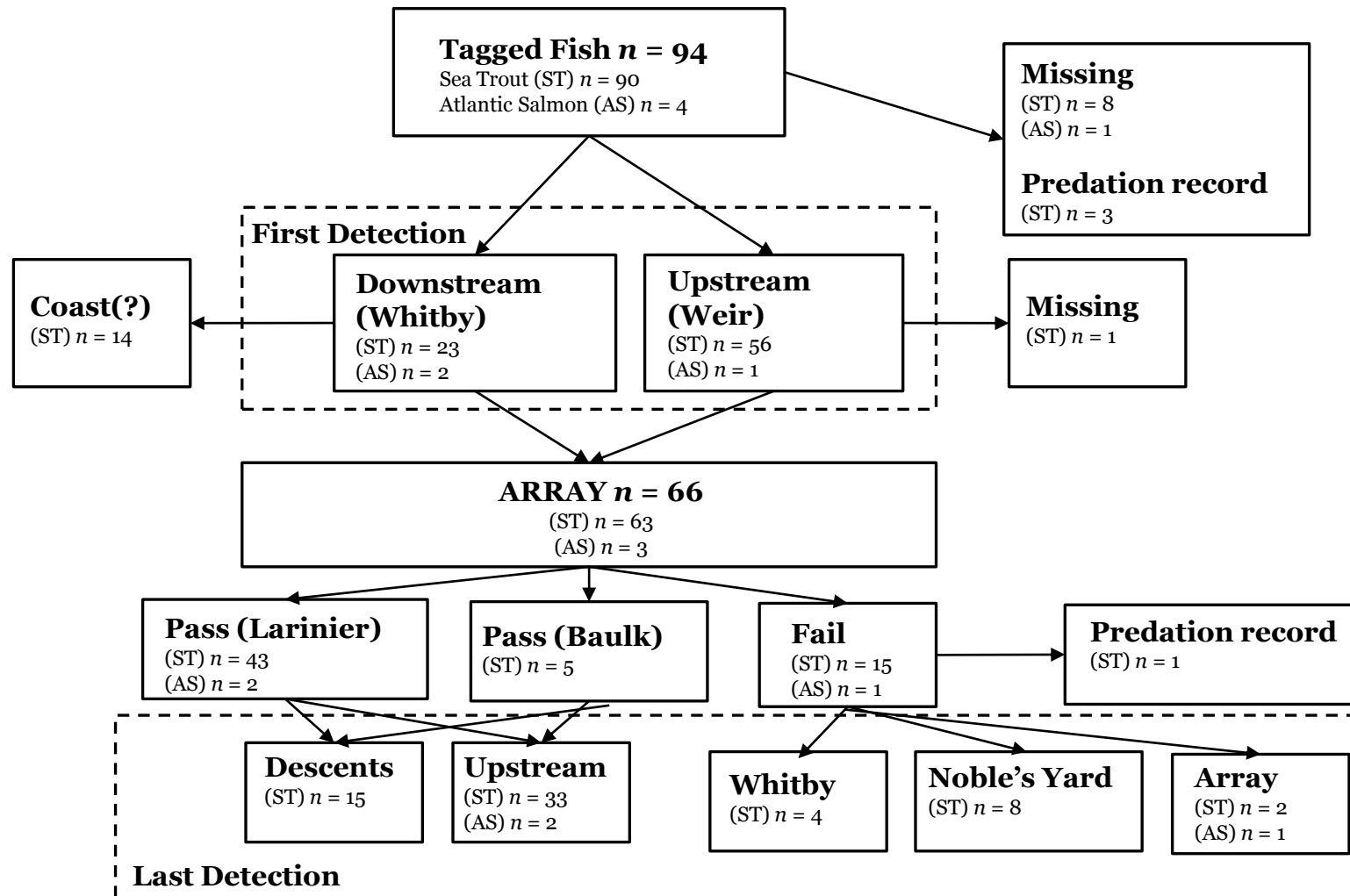
- proportion of tagged fish detected in the array that ascended the weir via either the main fish pass (Larinier since 2012 or pool-traverse in 2011) or the side-of-fish pass route (i.e. ascended the weir heading upstream from the array pool)



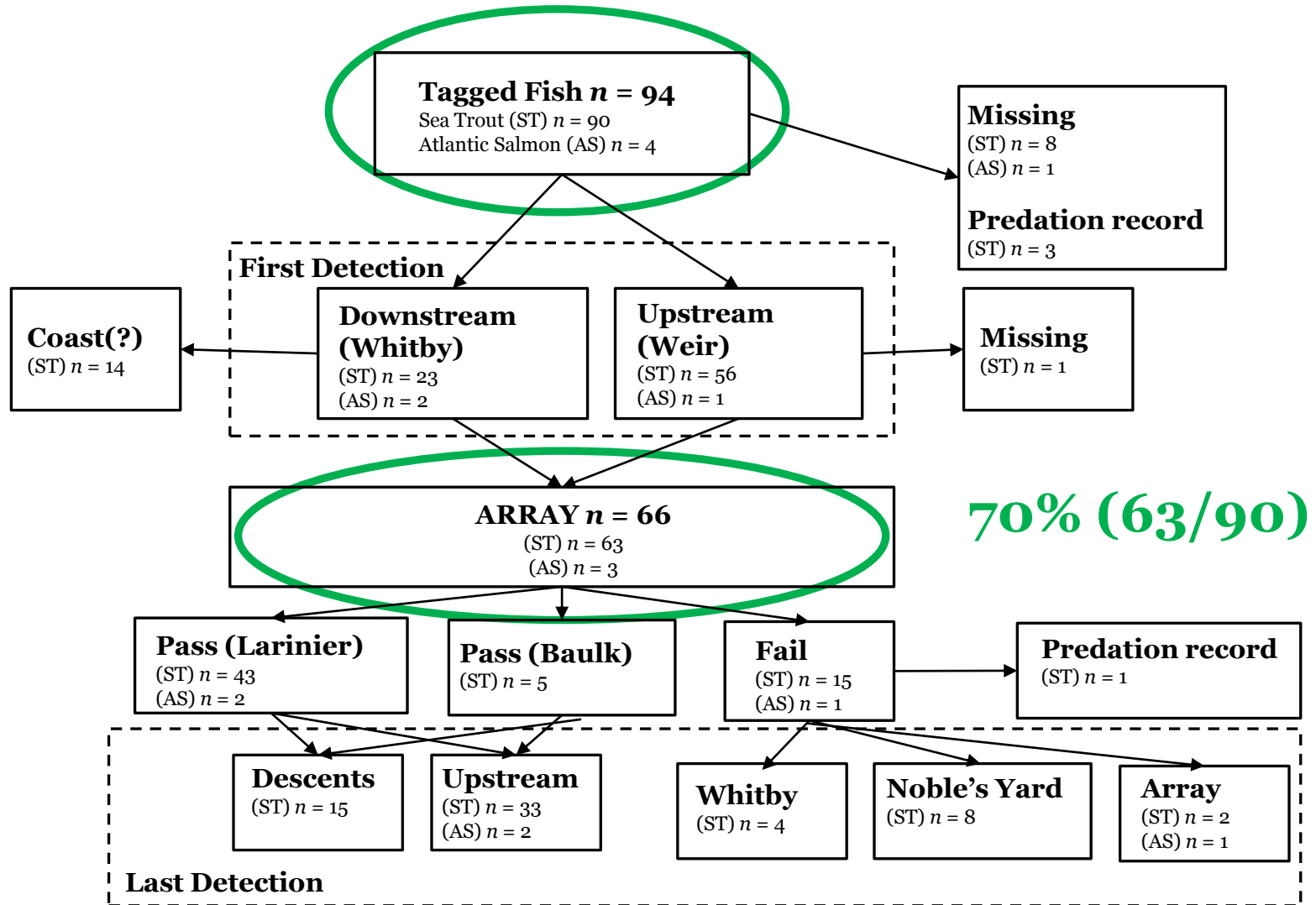
## Baseline (2011 & 2012)



# Post Commissioning (2013 & 2014)



# Sea Trout - Attraction efficiency





# Sea Trout - Attraction Efficiency

	Detected in Array	Not detected in Array	<i>Totals</i>
Baseline	17	31	48
Post-	63	27	90
<i>Totals</i>	80	58	138

**Baseline = 35%**

**Post- = 70%**

Chi-square Test for Independence (Frequency Distributions)

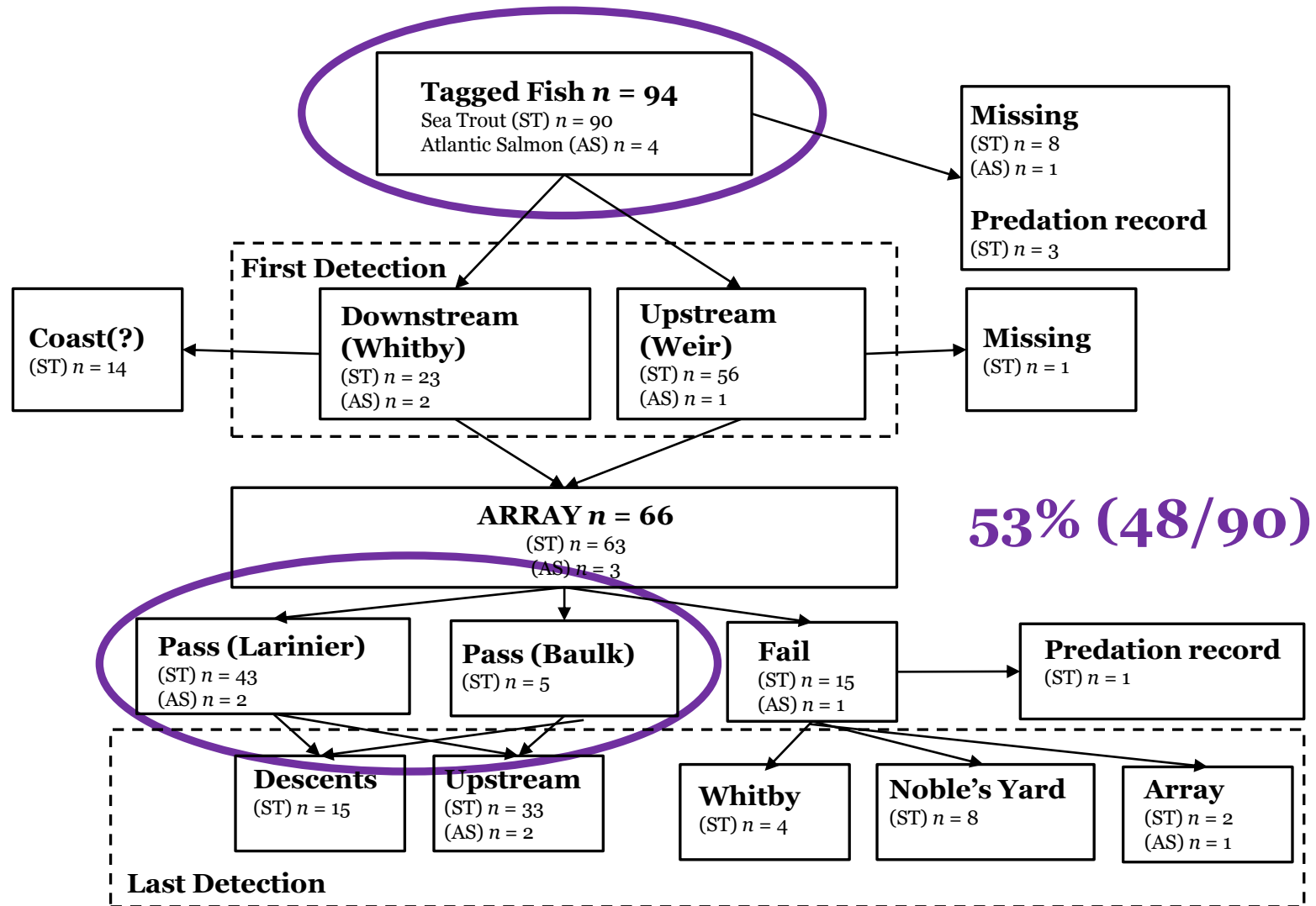
Chi-square = 15.367

*d.f.* = 1

*p* < 0.01

***Highly significantly different***

# Sea Trout - Overall Passage rate



# Sea Trout - Overall Passage Efficiency

	Passed Weir (LFP+ BFP)	Did not pass Weir	<i>Totals</i>
Baseline	17	31	48
Post-	48	42	90
<i>Totals</i>	65	73	138

**Baseline = 35%**

**Post- = 53%**

Chi-square Test for Independence (Frequency Distributions)

Chi-square = 4.03

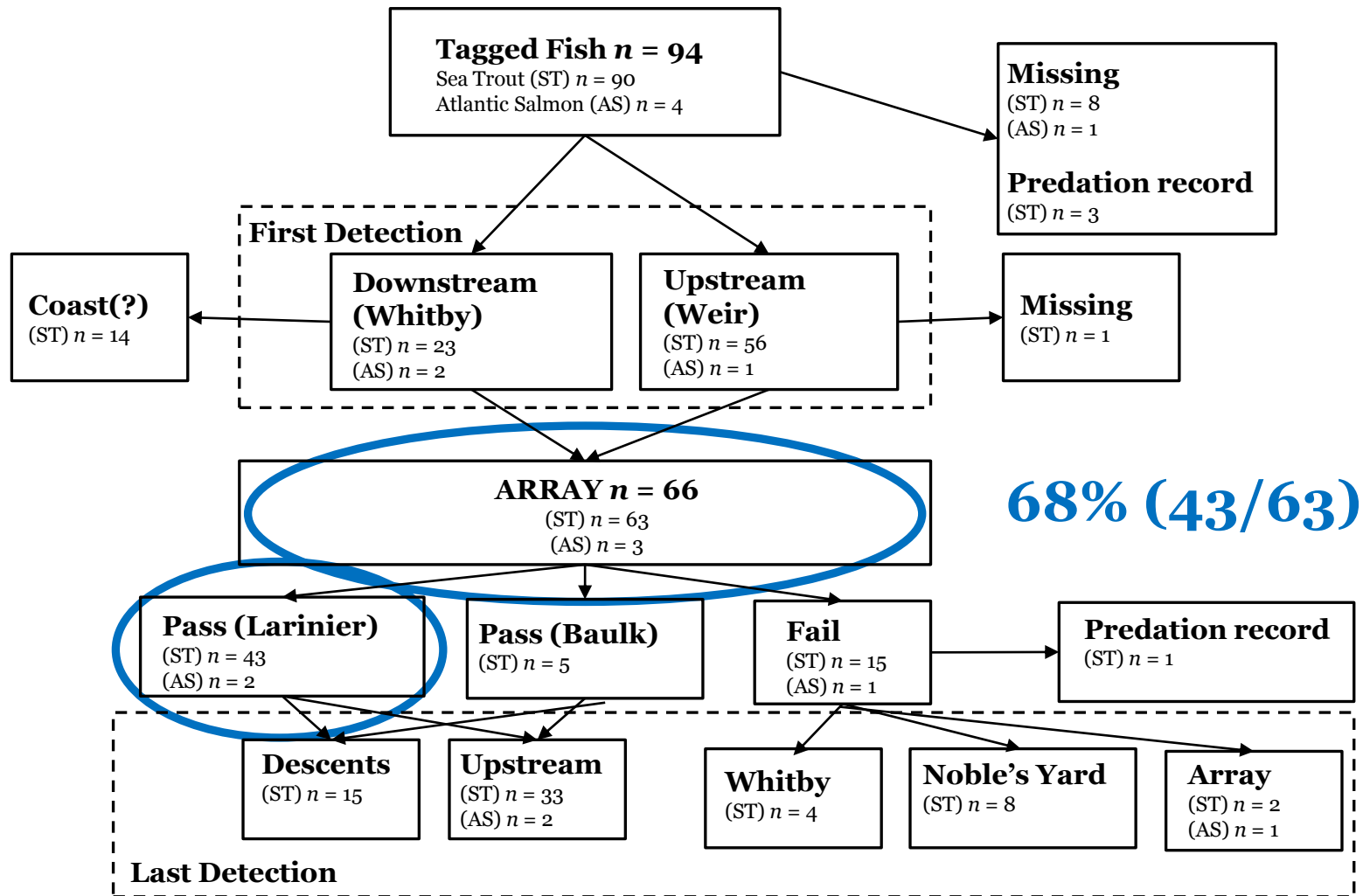
*df.* = 1

*p* < 0.05

***Significant difference***



# Sea Trout - Fish Pass efficiency



# Sea Trout - Fish Pass Efficiency

	Array - LFP	Array (BFP or DNP)	Totals
Baseline	17	0	17
Post-	43	20	63
<i>Totals</i>	60	20	80

**Baseline = 100%**

**Post- = 68%**

Chi-square Test for Independence (Frequency Distributions)

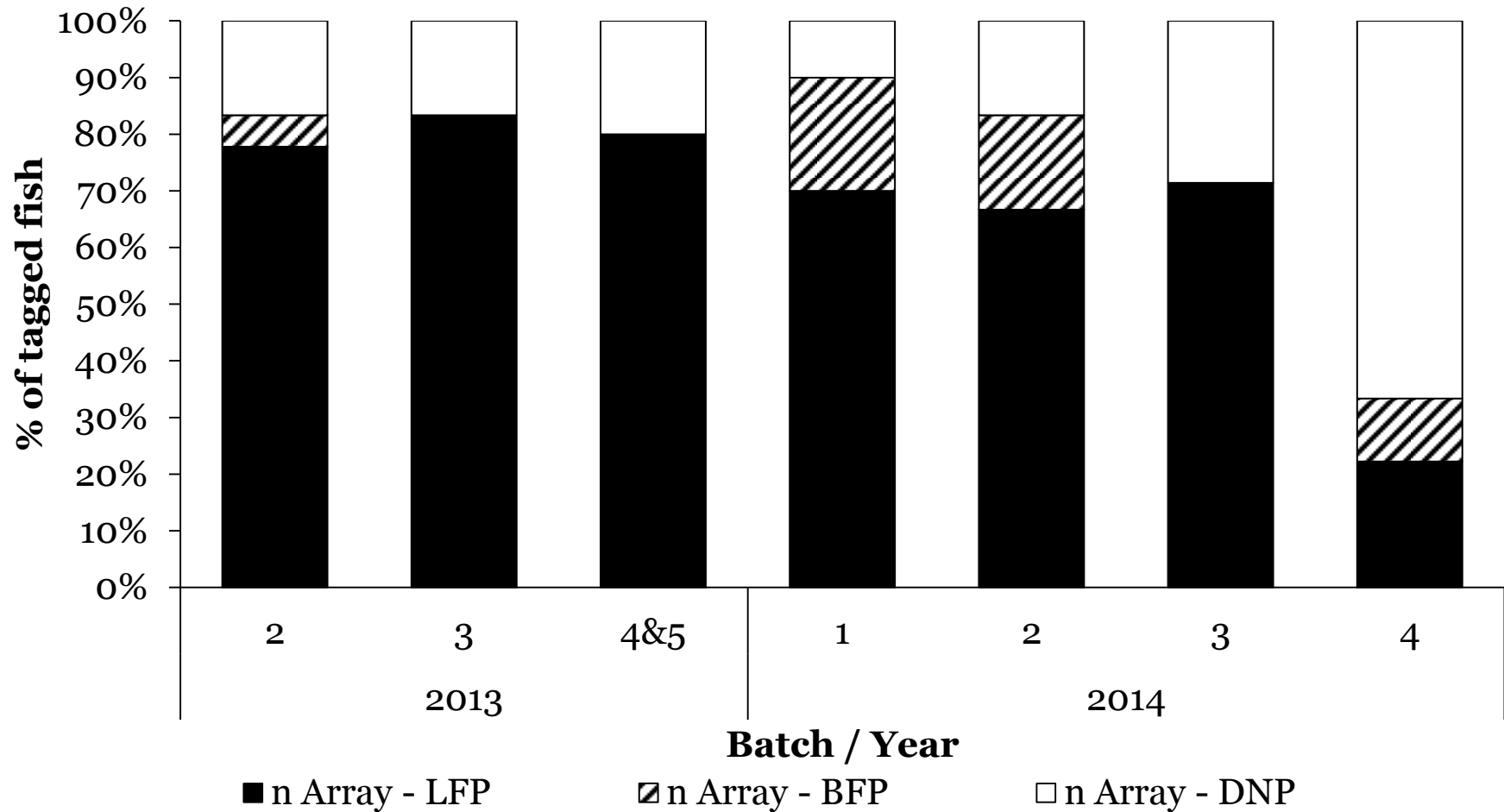
Chi-square (Yates') = 5.602

*df.* = 1

*p* < 0.05

***Significant difference***

# Passage success per batch



# Conclusions

- (1) The *Attraction Efficiency* (proportion of tagged sea trout entering the array) **significantly higher** in post-commissioning dataset
  - supports concept of co-location and improved attraction flows
  
- (2) The overall *Passage Efficiency* (proportion of tagged sea trout successfully ascending the weir) **significantly higher** in the post-commissioning dataset
  - related to improved attraction?
  - why was the baseline so low though?
  
- (3) The *Fish Pass Efficiency* (proportion of tagged sea trout detected in the array that ascended the weir via the main fish pass structure) **significantly lower** in the post-commissioning dataset



Thank you