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

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# 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


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Environment Agency

# 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)

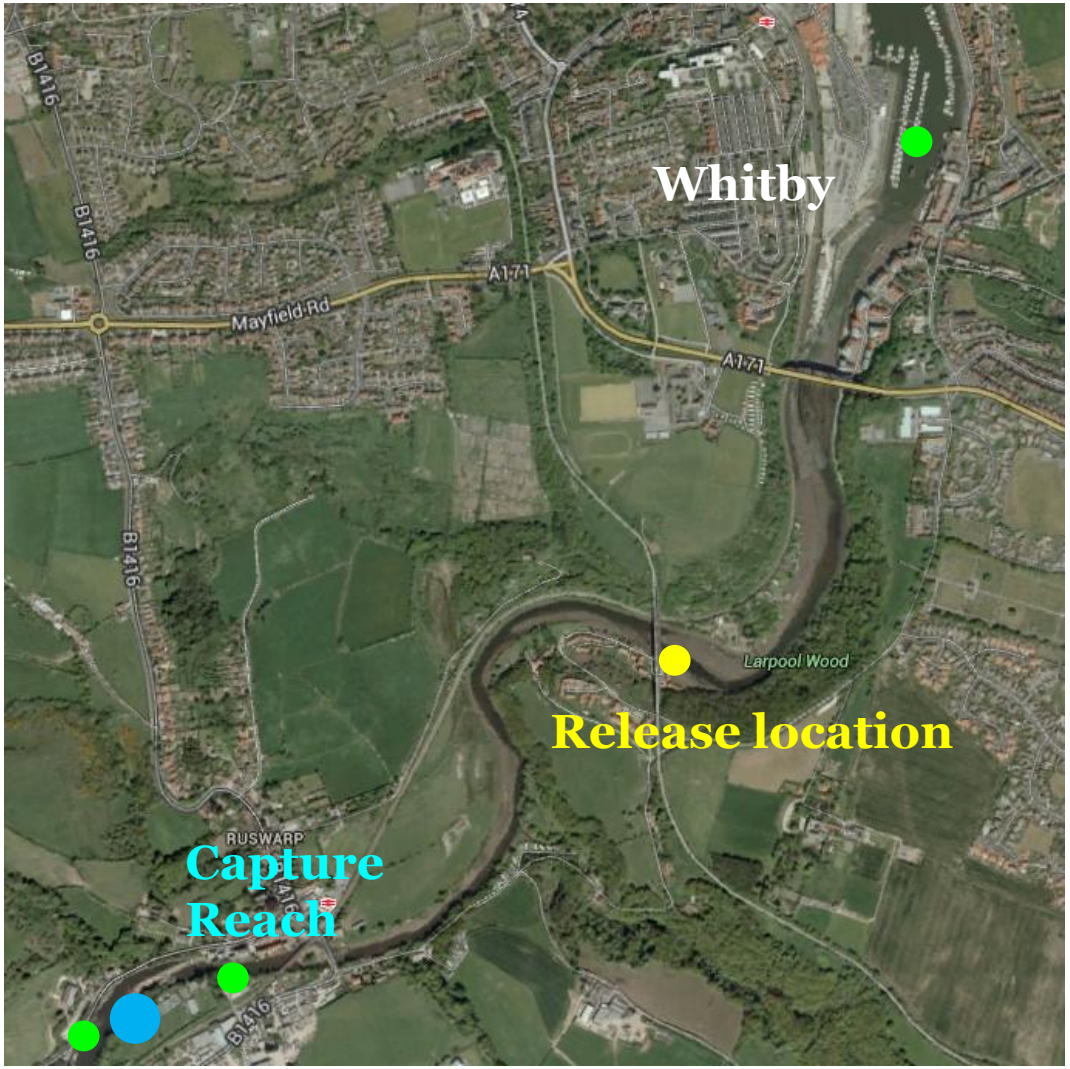
# Capture & Acoustic Tagging

| 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**

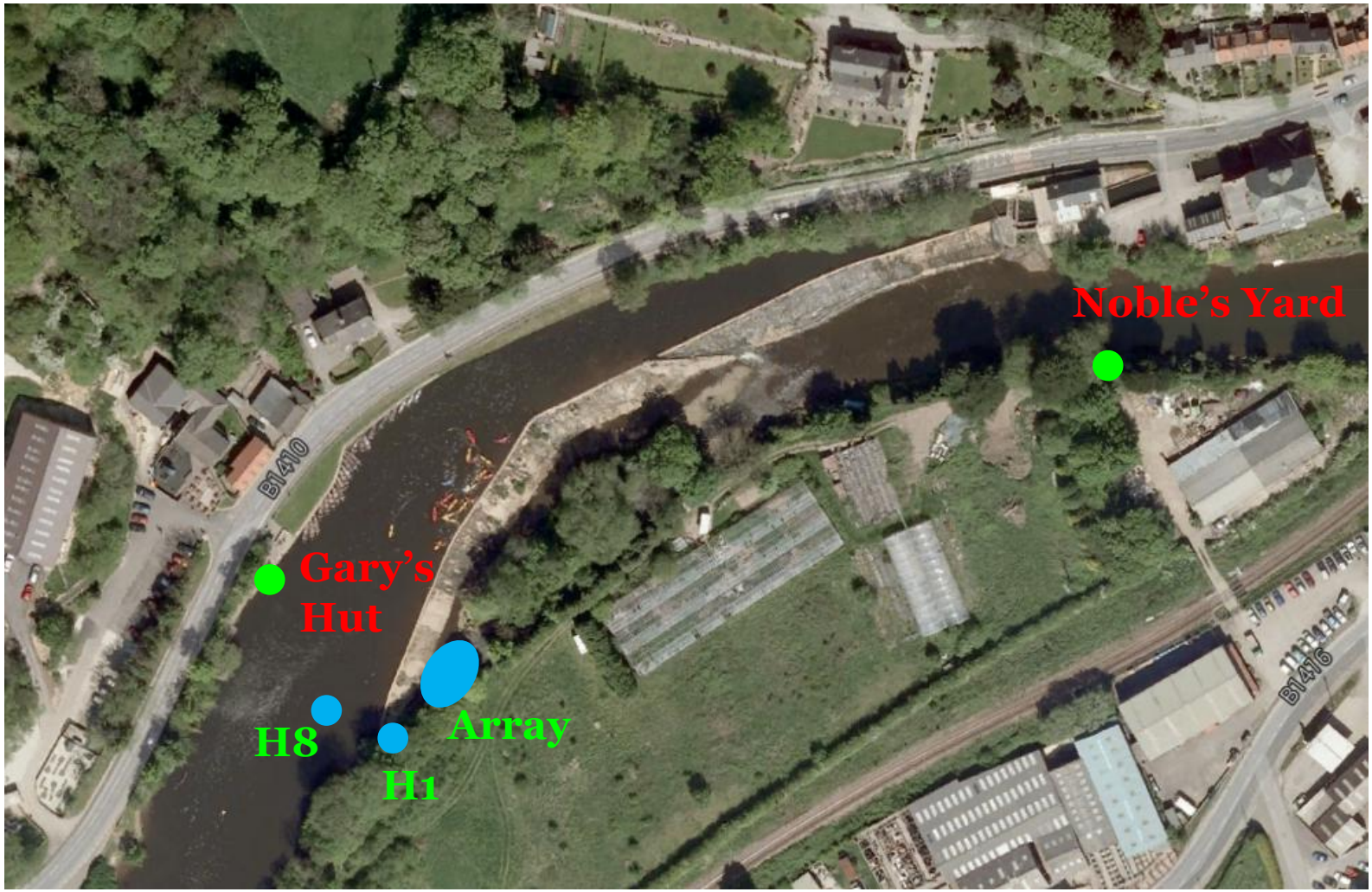
Model 290 acoustic tag receiver Acoustic Tracking System

- **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)

**Tagged Fish *n* = 62**
Sea trout (ST) *n* = 48
Atlantic salmon (AS) *n* = 14

**Baseline metrics – Sea Trout**

Attraction efficiency = 35% (17/48)

Passage efficiency = 35% (17/48)

Fish pass efficiency = 100% (17/17)

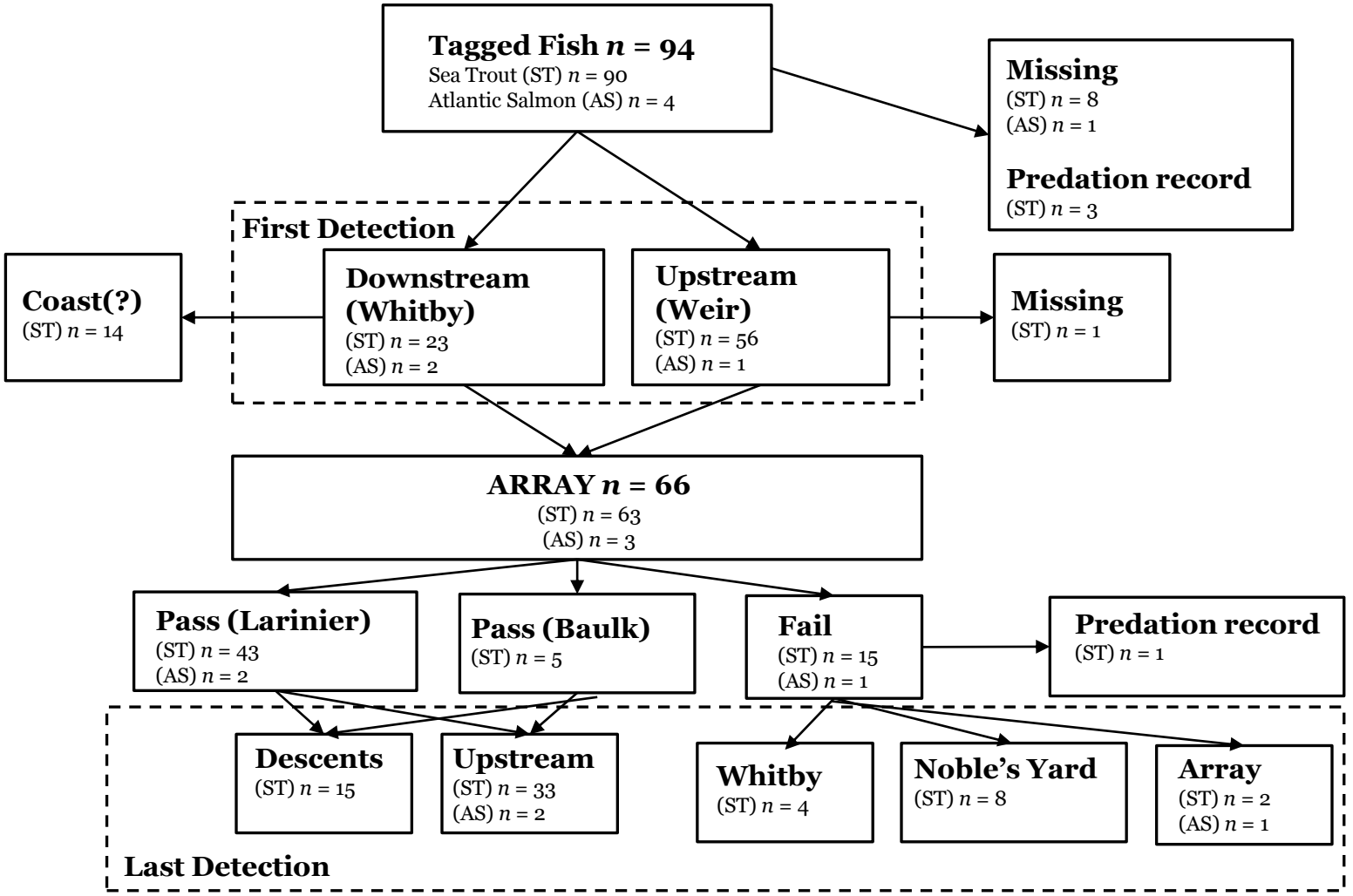
**ARRAY *n* = 23**
(ST) *n* = 17
(AS) *n* = 6

**Pass (Larinier)**
***n* = 23**
(ST) *n* = 17
(AS) *n* = 5

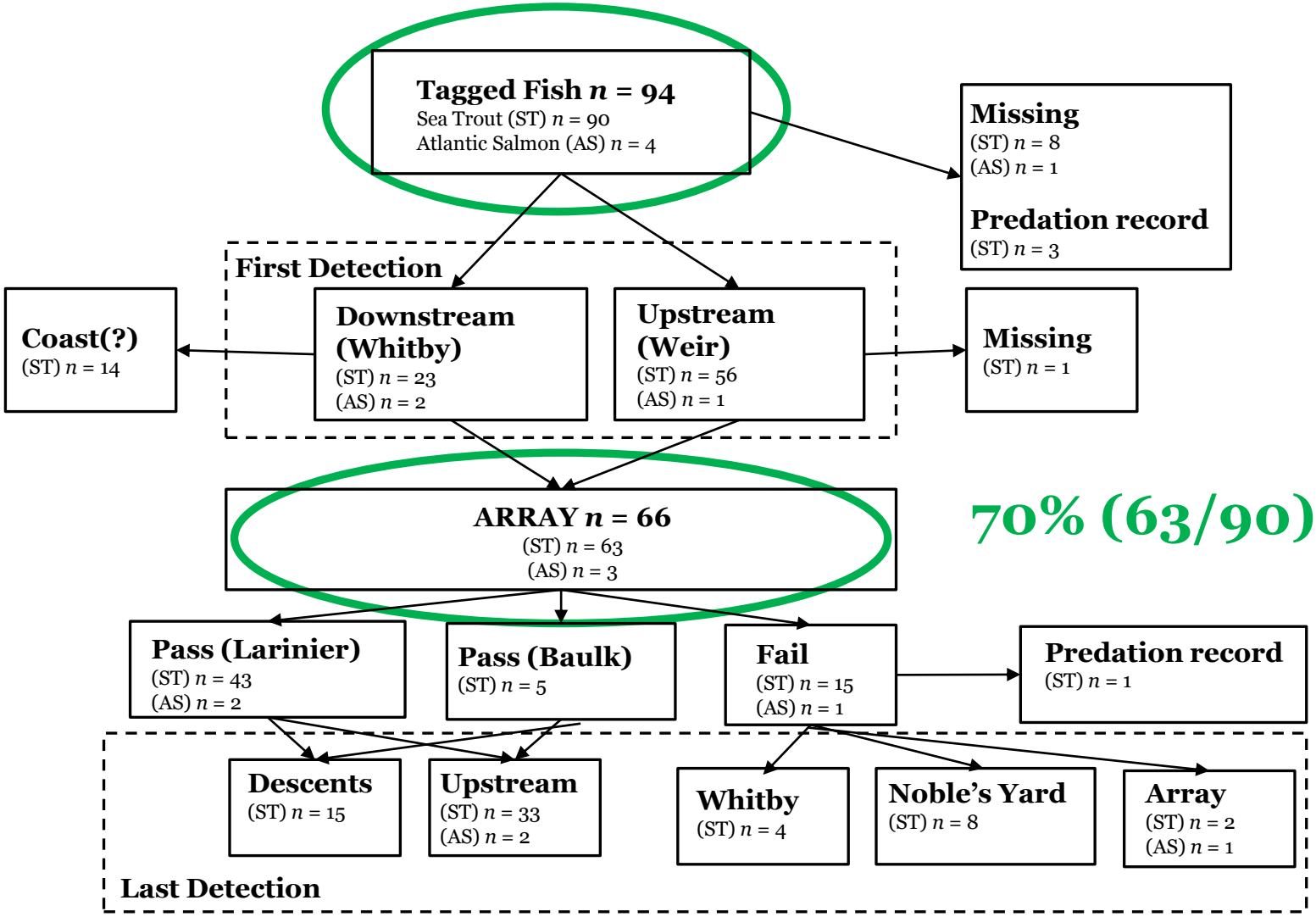
**Pass (Baulk)**
***n* = 0**

**Fail**
***n* = 1**
(AS) *n* = 1

# Post Commissioning (2013 & 2014)



# Sea Trout - Attraction efficiency



# Sea Trout - Attraction Efficiency

| | Detected in Array | Not detected in Array | *Totals* |
|---|---|---|---|
| Baseline | **17** | **31** | *48* |
| Post- | **63** | **27** | *90* |
| *Totals* | *80* | *58* | *138* |

**Baseline = 35%**

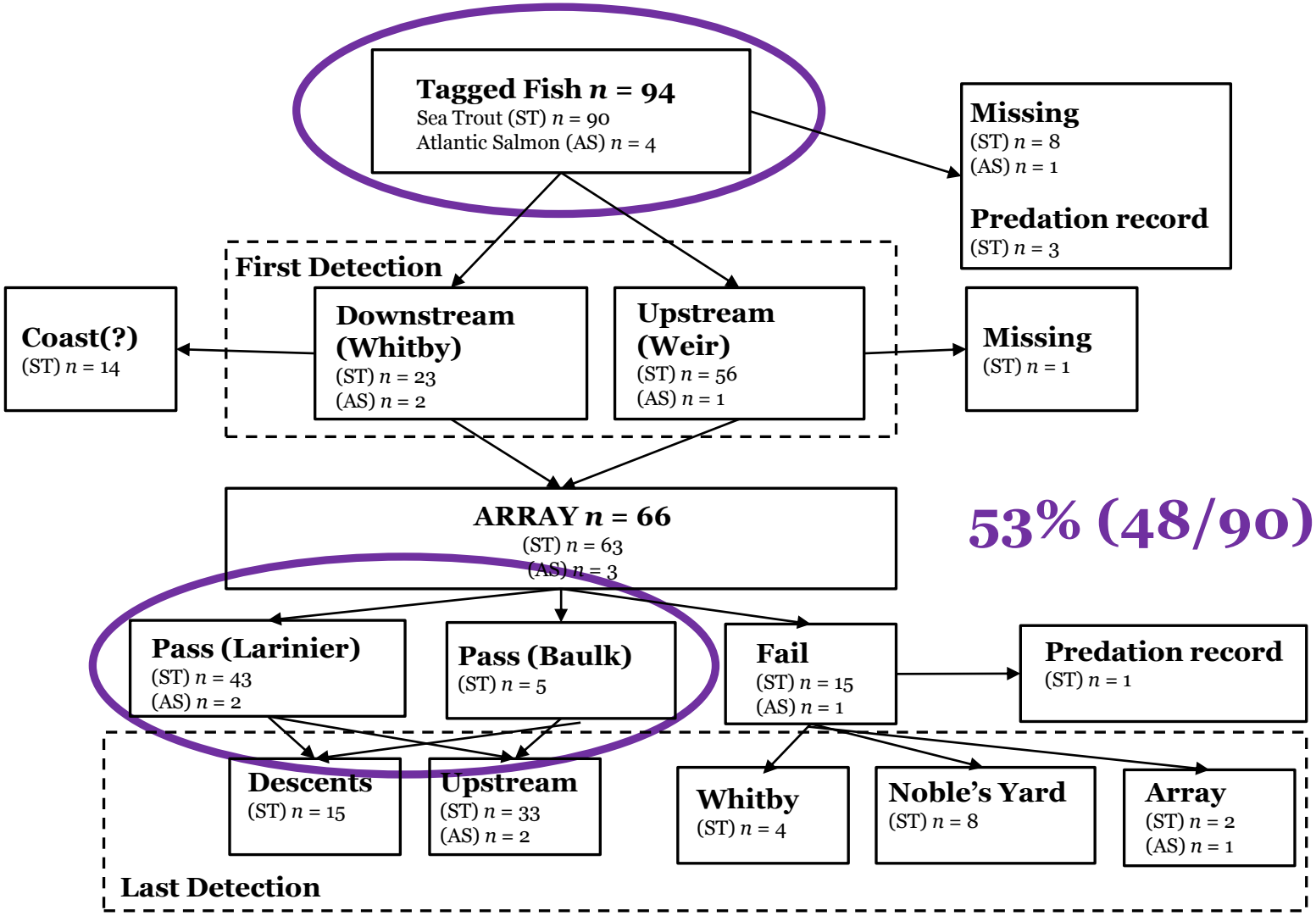
**Post- = 70%**

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 | *Totals* |
|---|---|---|---|
| Baseline | **17** | **31** | *48* |
| Post- | **48** | **42** | *90* |
| *Totals* | *65* | *73* | *138* |

**Baseline = 35%**

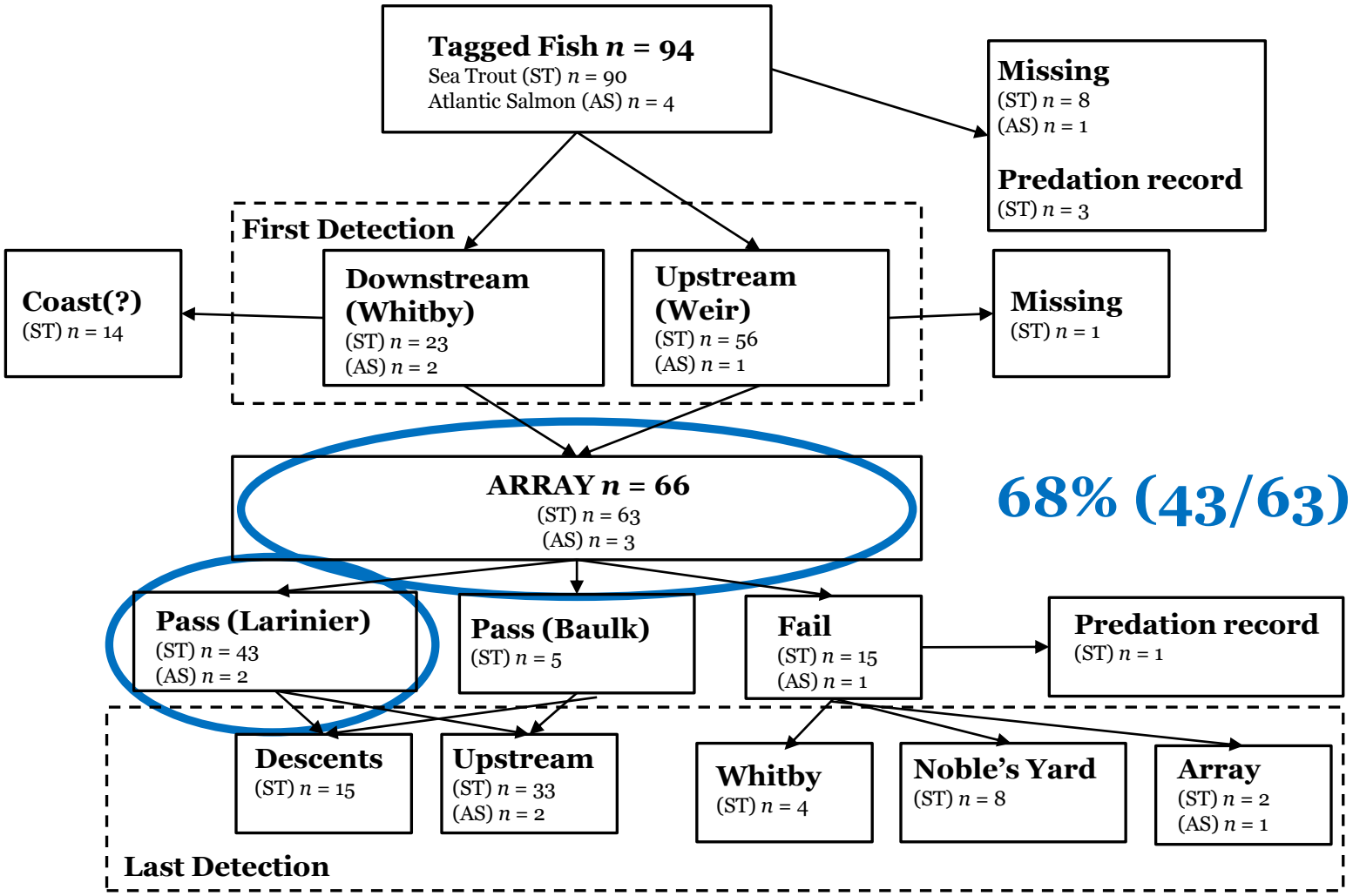
**Post- = 53%**

Chi-square Test for Independence (Frequency Distributions)

Chi-square = 4.03
*d.f.* = 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* |
| *Totals* | *60* | *20* | *80* |

**Baseline = 100%**

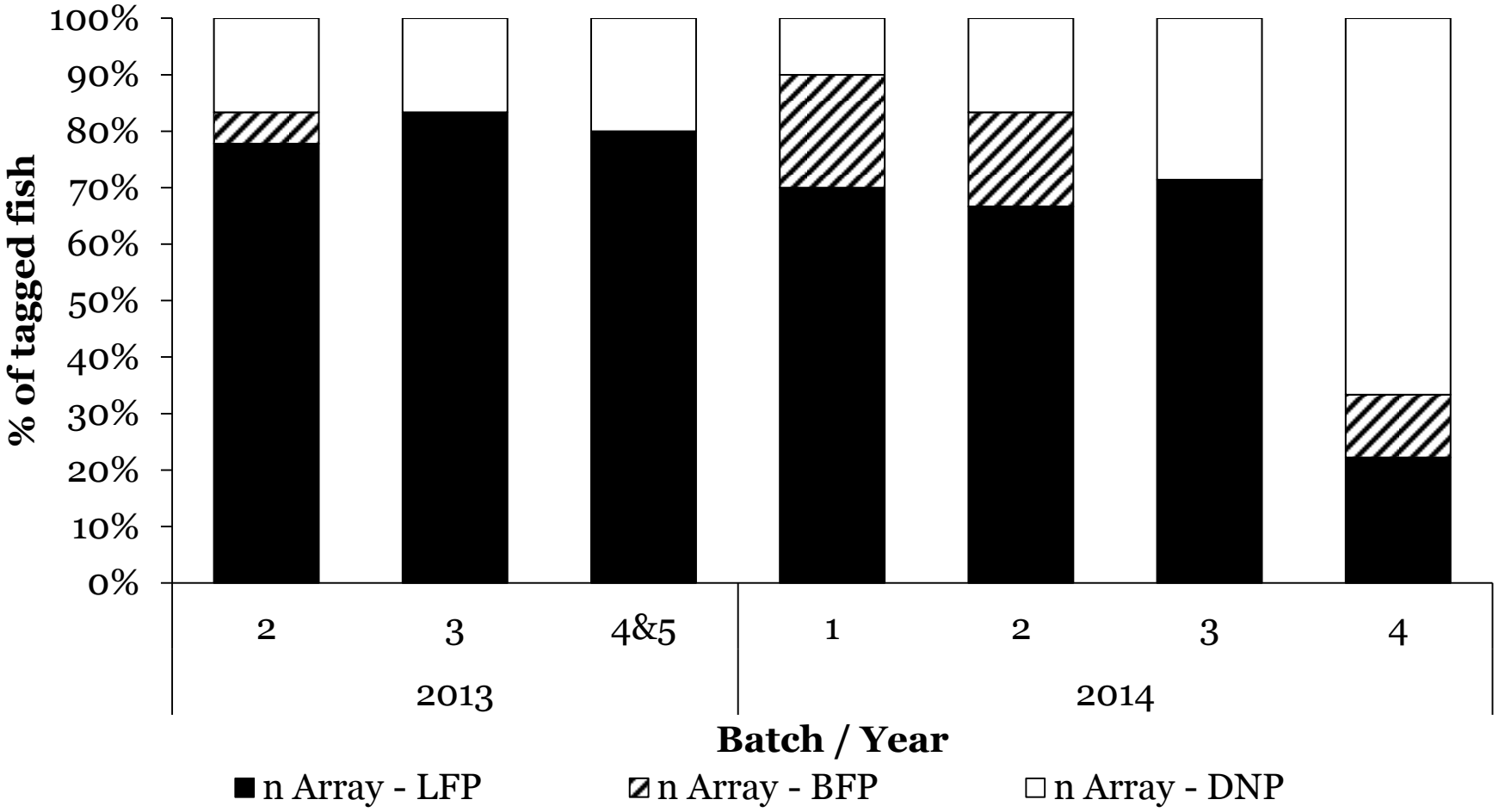
**Post- = 68%**

Chi-square Test for Independence (Frequency Distributions)

Chi-square (Yates') = 5.602
*d.f.* = 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