Advances in the Science & Technology of Measuring Survival of Juvenile Fish at Sea

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Why Improve Technology?

- Early marine survival is thought to be critical for determining productivity
- Previously, tagging limited to large salmon smolts
- Acoustic tags are ~$350 each
- If we are testing hypotheses, how does reduced detection efficiency affect statistical power ("Scientific Efficiency")?
- *How can "efficiency" drive scientific advance?*

Acoustic Transmitter Specs

V4
3.6 x 5.7 mm
0.42 g

V9
9 x 24 mm
3.6 g

V7
7 x 20 mm
1.6 g

V4 Tag Considerations

Pros

- Small: Size & Weight of a Tic Tac (actually less- only 0.42 grams)
- Reduced tag burden
- Can be used in smaller smolts than previously possible
- More populations & species amenable to study

Cons

- Reduced range
- Reduced battery life
  - Solution: more receivers, clever tag programming, and clearly focused study goals
- Requires 180 kHz acoustic receivers
- Tracking arrays more expensive to build & maintain to achieve the same performance (but fewer tags then needed)

Tag Performance

V9

Frequency: 69 kHz

Power output: 151 dB

Range: 300-500 m

Weight in air: 3.6 g

V4

Frequency: 180 kHz

Power output: 134 dB

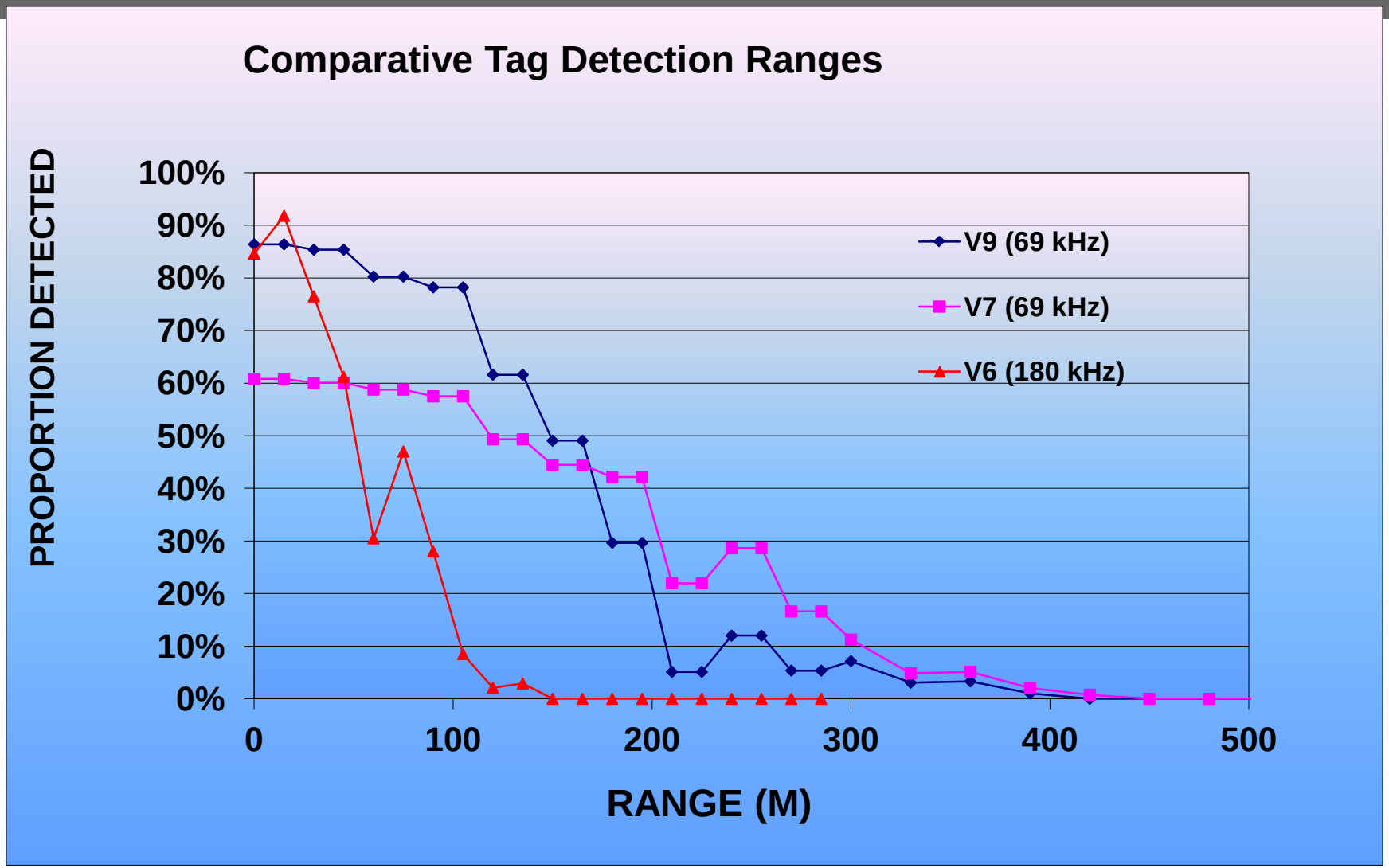
Range: ~80 m

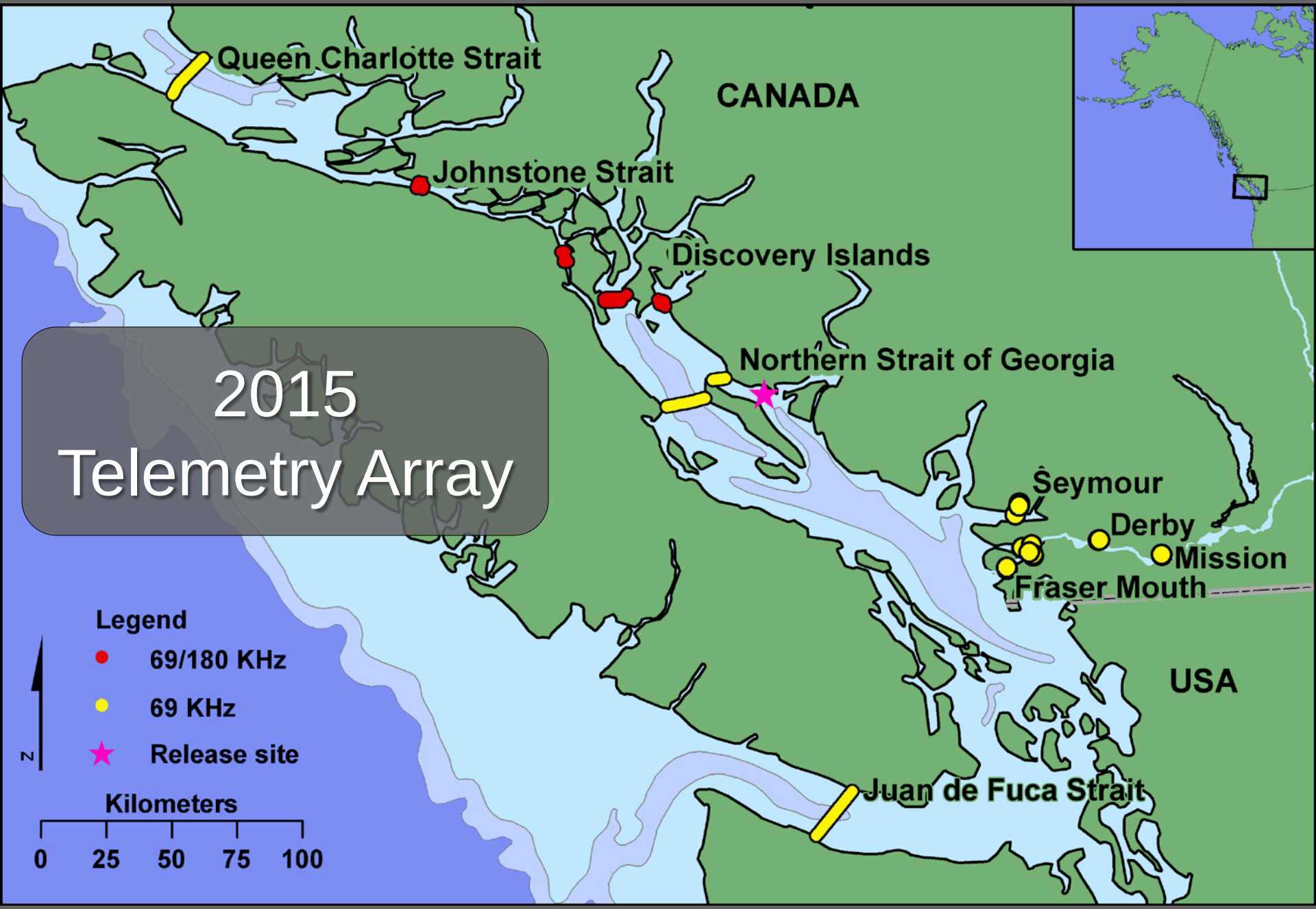
Weight in air: 0.42 g **(1/9th V9)**

Projected Battery Life (Days)		
Nominal Delay (seconds)	**V9-2L**	**V9-2H**
60	400	155
120	685	285
180	910	405

Estimated Battery Life (Days)		
Nominal Delay (secs)	**V4-1H**	**V5-1H**
20	34* (41)**	59* (70)**
40	46* (55)**	91* (107)**
60	53* (62)**	113* (131)**

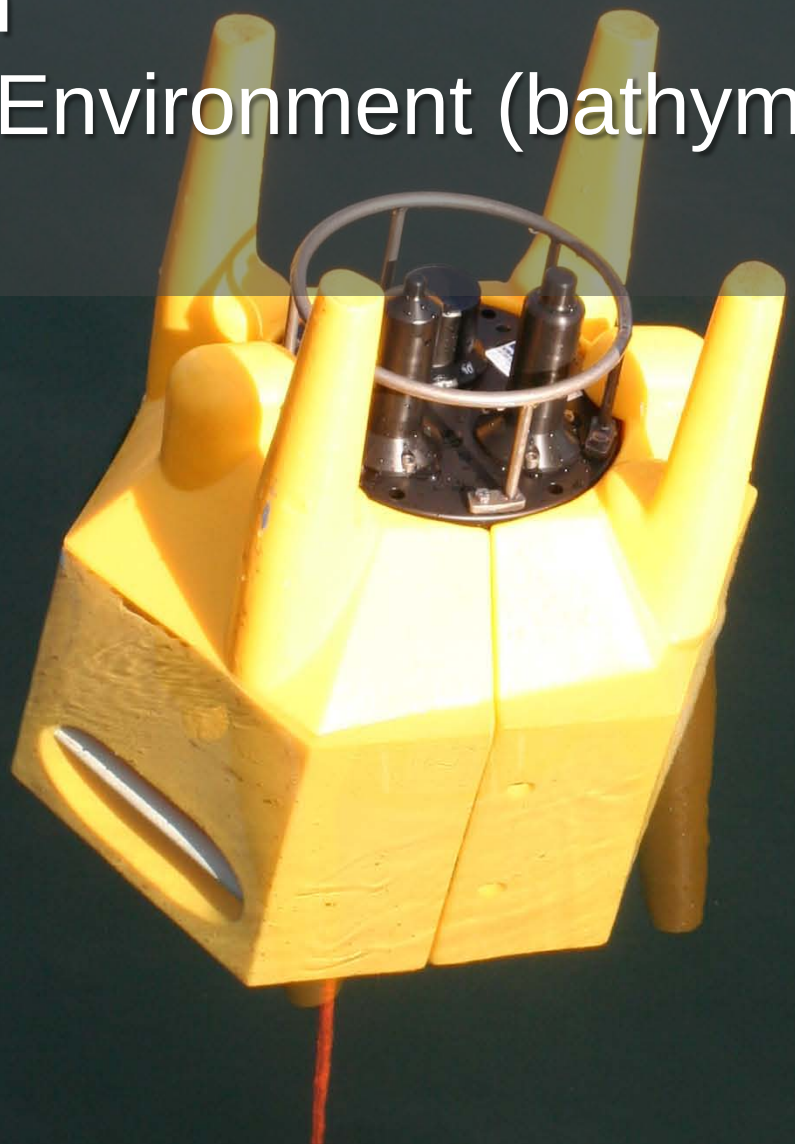
Different Acoustic Tags Have Different Performances




Queen Charlotte Strait
CANADA
Johnstone Strait
Discovery Islands
Northern Strait of Georgia
2015
Telemetry Array
Seymour
Derby
Mission
Fraser Mouth
USA
Juan de Fuca Strait
Legend
69/180 KHz
69 KHz
Release site
N
Kilometers
0
25
50
75
100

Array Design (and Recovery) Strategy

- Location
- Detection
- Physical Environment (bathymetry, currents, etc)



ual Frequency Sub-arrays: D

V4 Tag (180 kHz)
r = 100 m

V9 Tag (69 kHz)
r = 400 m

UGANDA_01

QUADRA

ISLAN

Seymour Narrows

Race Pt

PASSAGE

Orange P

MARINA

ISLAND

1:250,000

Raster

New

ual Frequency Sub-arrays: Johnstone Strait

BC MAINLAND

VANCOUVER ISLAND

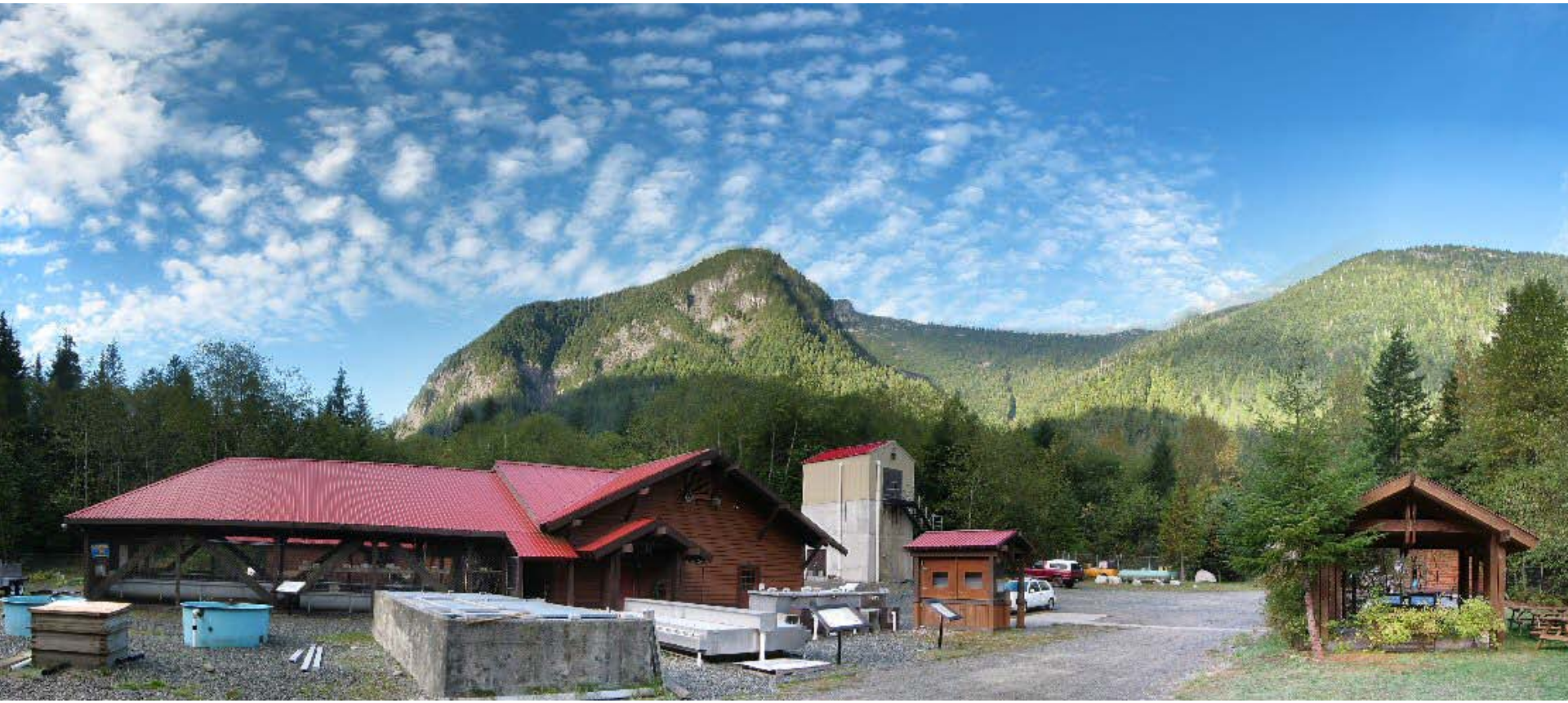
JS_W_01
JS_W_02
JS_W_03
JS_W_04
JS_E_01
JS_E_02
JS_E_03
JS_E_04

V9 Tag (69 kHz)
r = 400 m

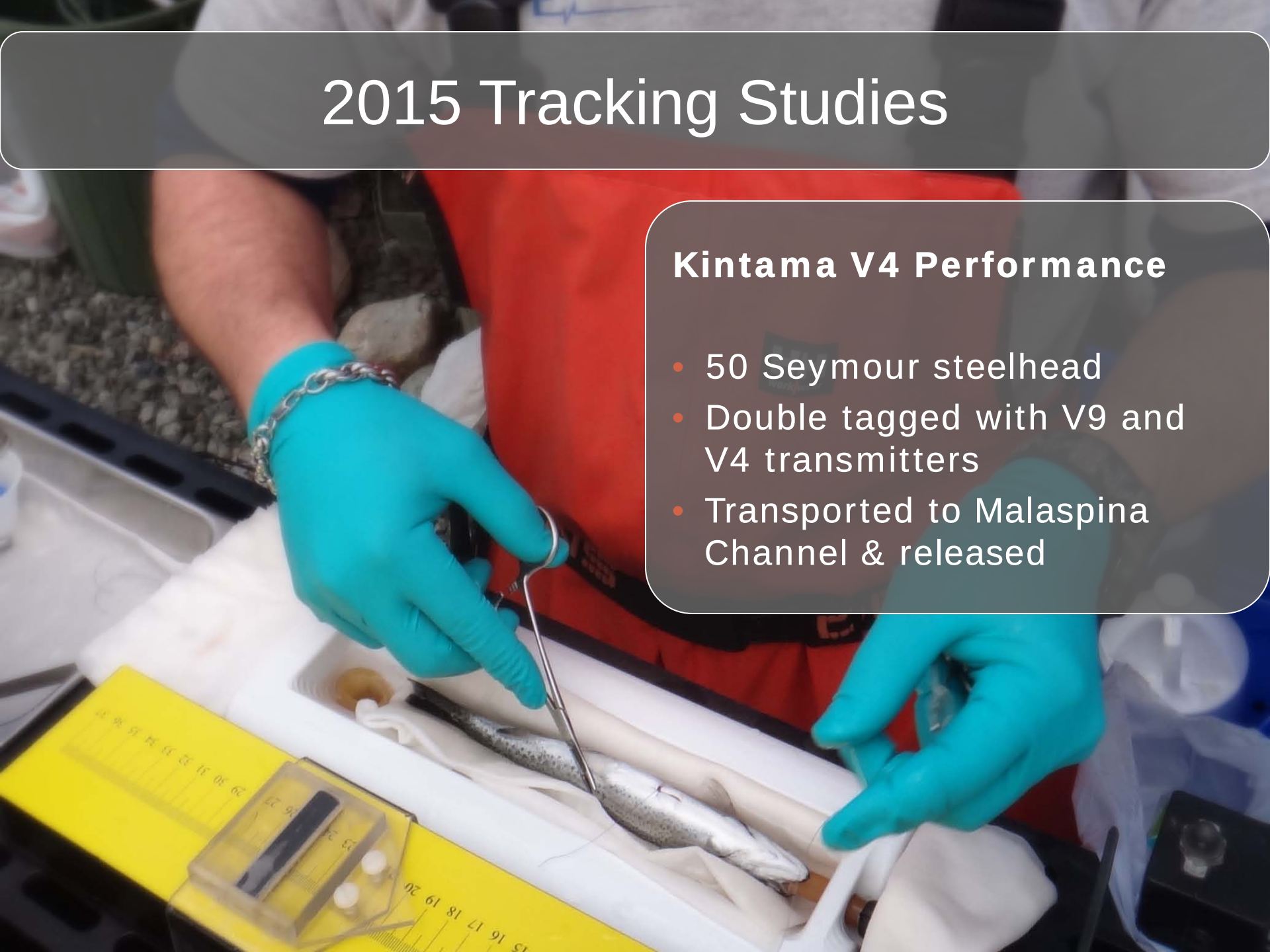
V4 Tag (180 kHz)
r = 100 m

PORT NEVILLE
Chart/Carte 3564
12.46 ft
Port Neville
NELSON RIDGE
Mt Nelson
Ransom Pt
Neville Pt
Windy Pt
St Vincent Bight
Hickey Pt

2015 Tracking Studies



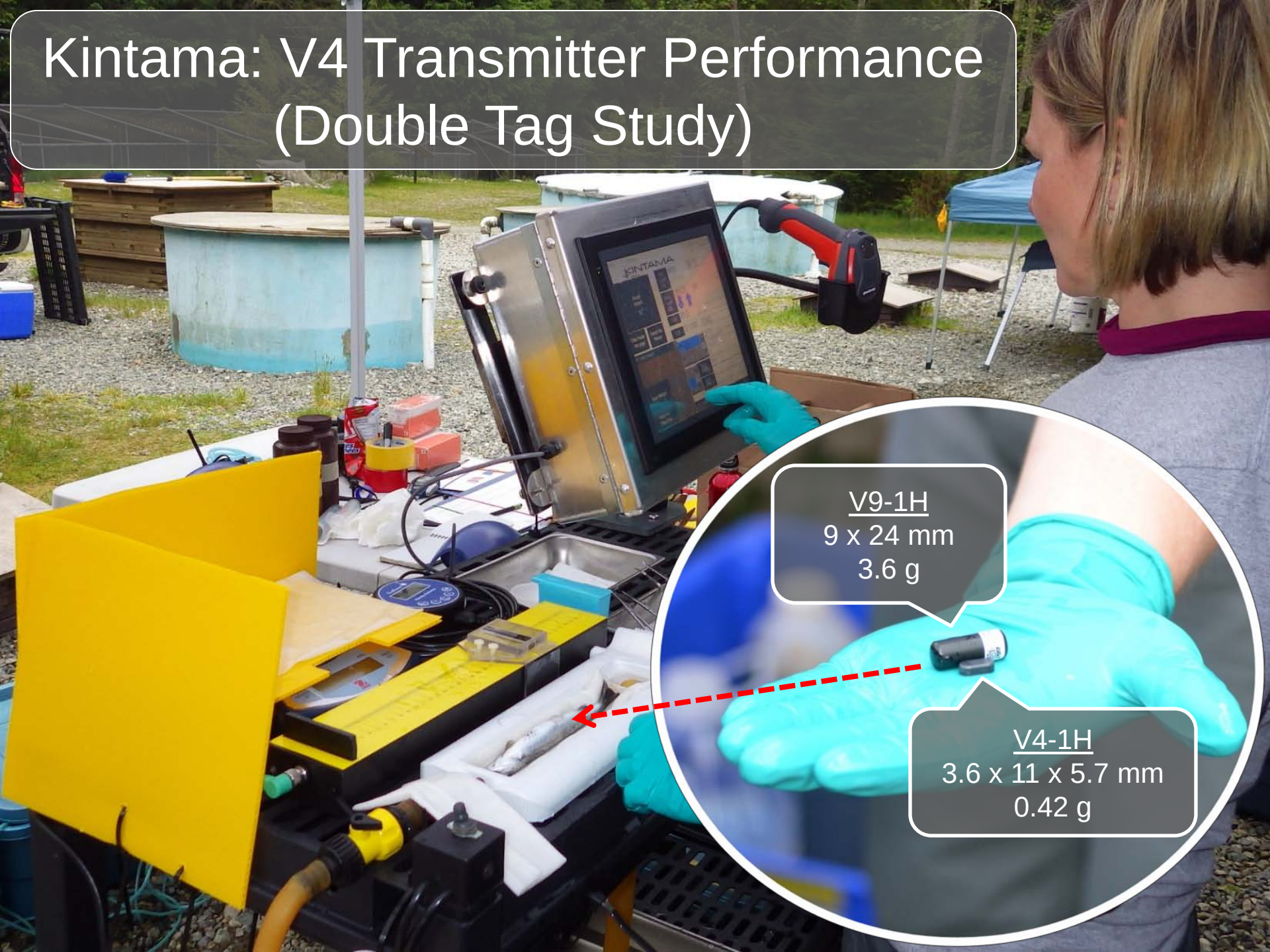
2015 Tracking Studies



Kintama V4 Performance

- 50 Seymour steelhead
- Double tagged with V9 and V4 transmitters
- Transported to Malaspina Channel & released

Kintama: V4 Transmitter Performance (Double Tag Study)



Transfer

Transport

Release

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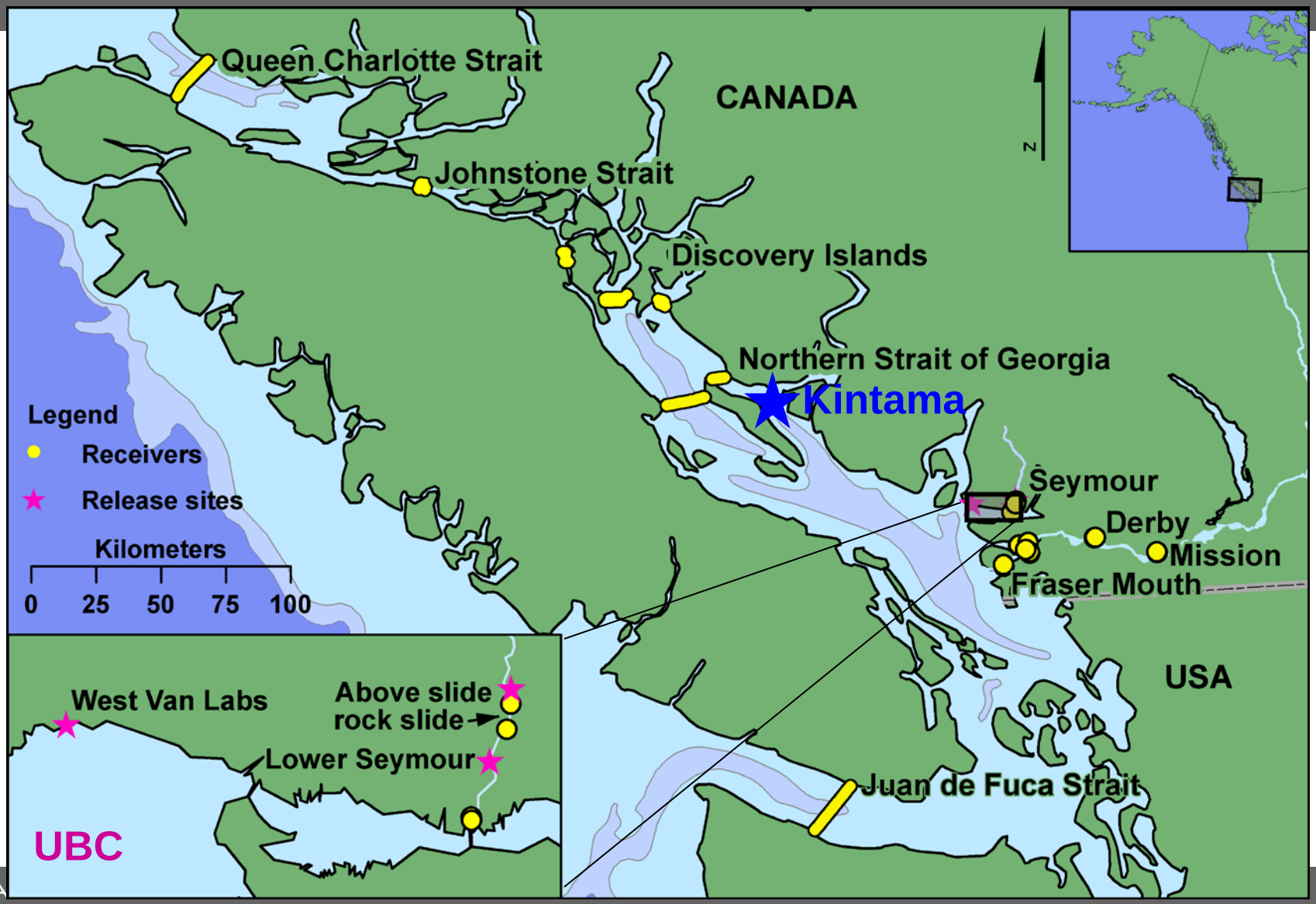
Release Locations



http://Kintama Animator/

www.kintama.com/visualizations

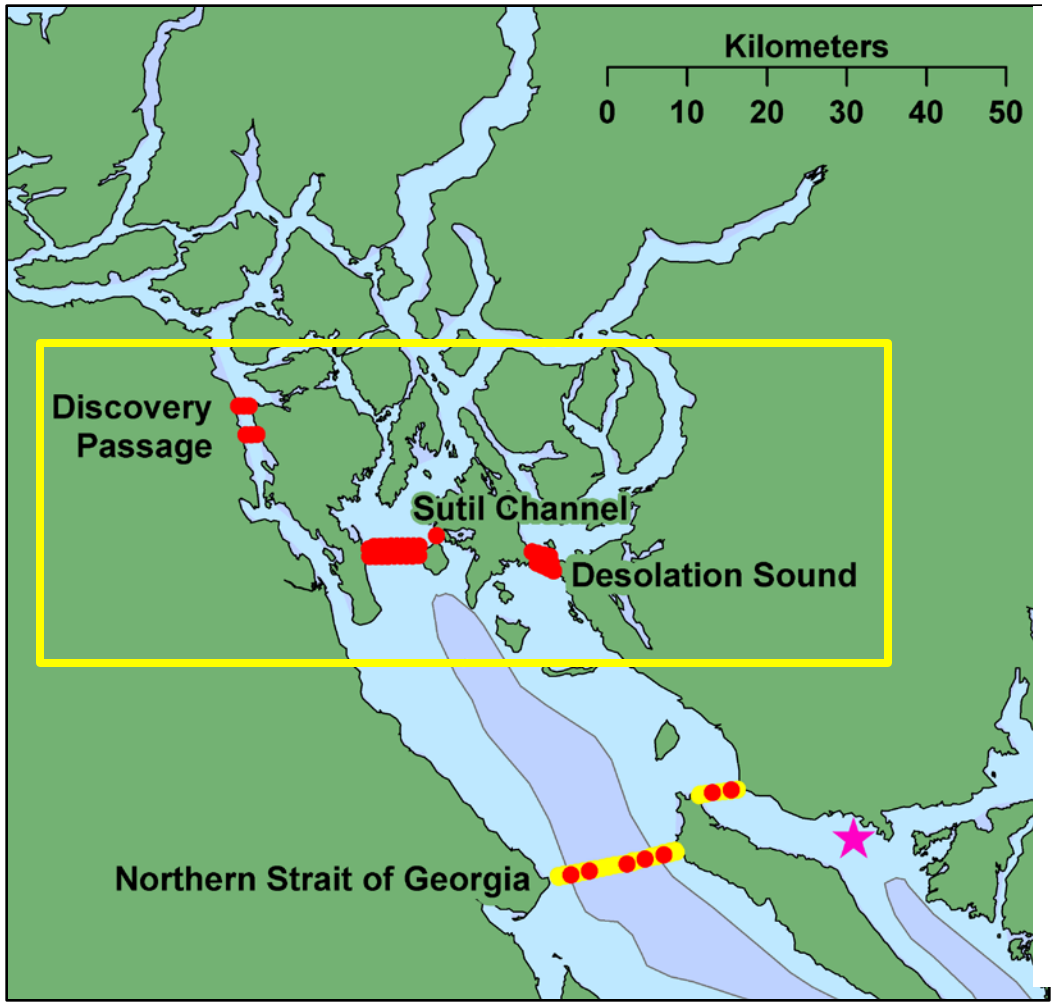
Dynamic Animations

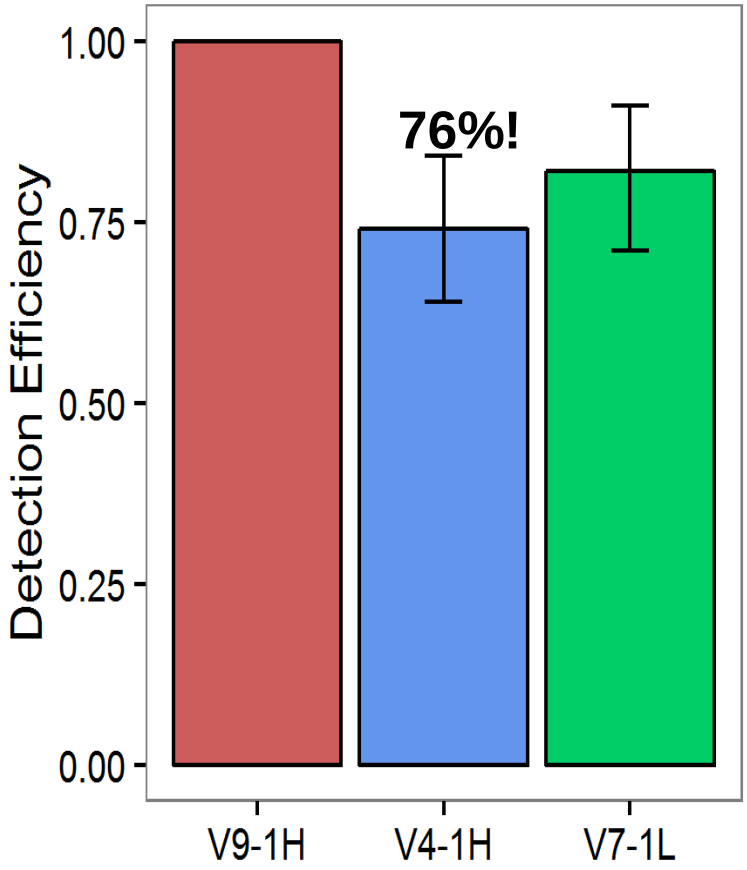
- Seymour River Steelhead (juvenile)
- Chilko Lake Sockeye (juvenile)
- Cook Inlet Chinook and Sockeye (adult)

Static Animations

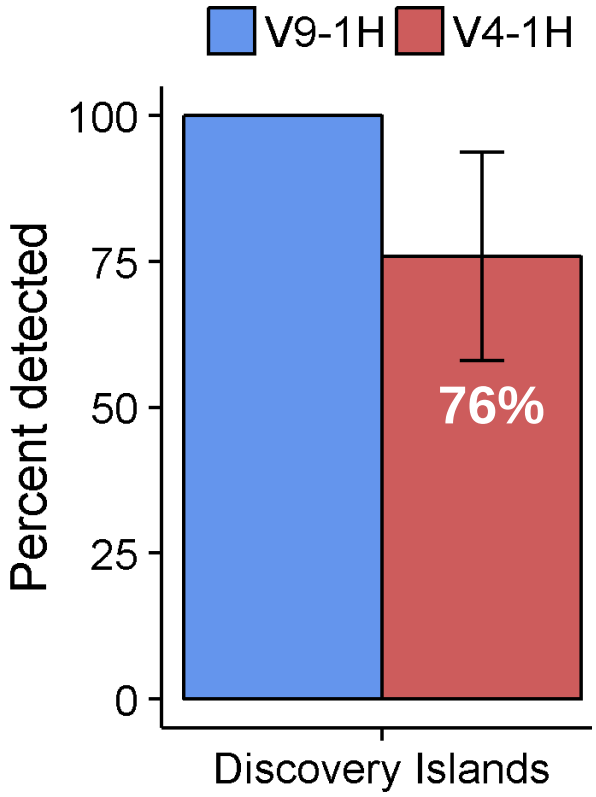
- Cultus Lake Sockeye (juvenile)
- Sakinaw Sockeye (juvenile)
- Columbia River Chinook (juvenile)

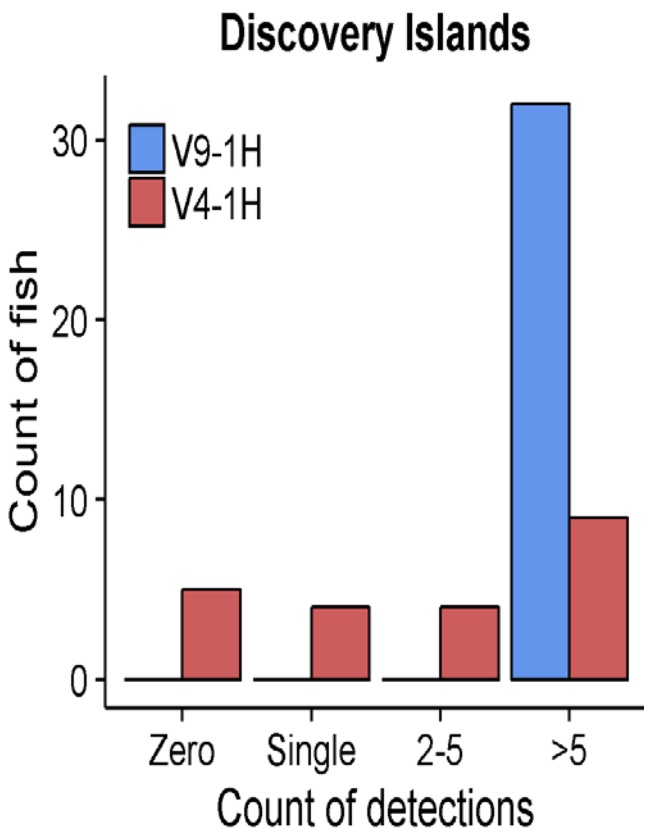
Tag Detection Rates: Discovery Islands Sub-array

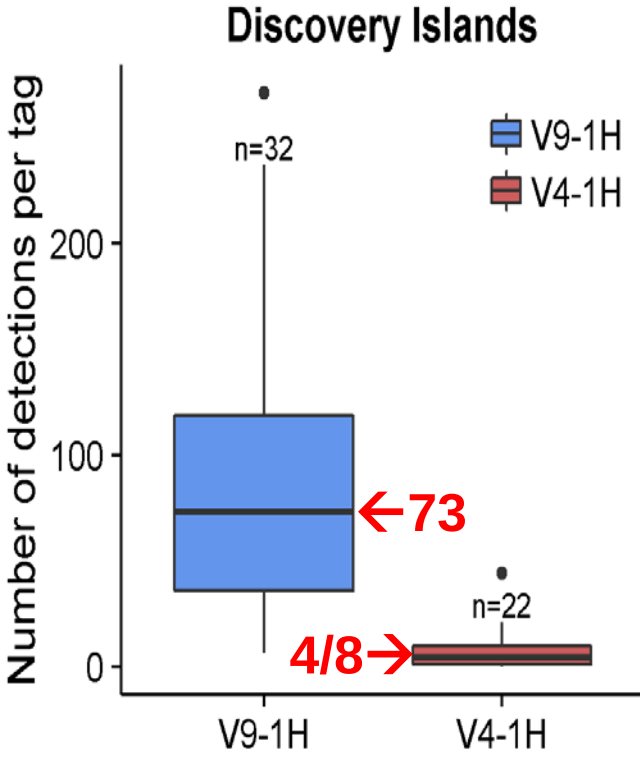




Tag Detection Rates- A Closer Look







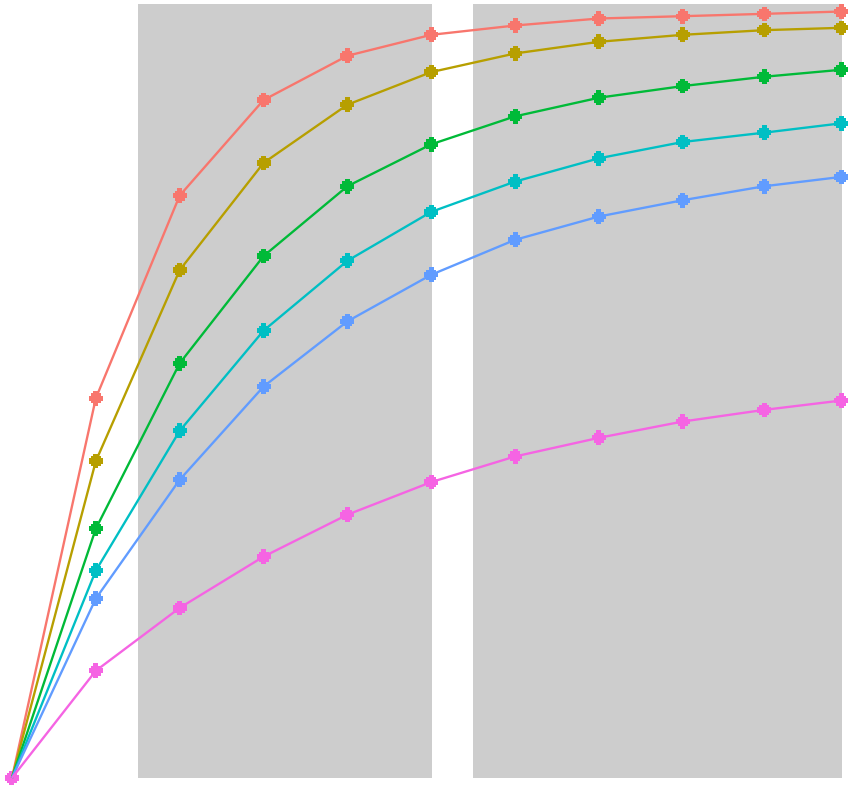
Summary: Array Performance

- *The new sub-array design is a major improvement in performance relative to the original design.*

- *It should now lead to several important performance advances for telemetry arrays*

- Such as...

Future Telemetry Studies: Good Engineering Means Reduced Sample Size & Reduced Cost



Future Telemetry Studies: Smaller Smolts and Reduced Tag Burden

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Summary

- POST array expanded in 2015
  - New sites in Discovery Islands and Johnstone Strait
  - Dual frequency capability
- Survival and migration routes for steelhead
- Excellent results with new, small tags
- New engineering designs allow reduced array costs & improved tracking performance *compared to original POST design*.


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psf.ca
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www.marinesurvivalproject.com

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- Seymour Salmonid Society Board
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Brian Riddell • Isobel Pearsall