Identifying barriers to the use and detection of passive integrated transponder (PIT) tags in Southern Brook Lamprey ammocoetes (*Ichthyomyzon gagei*, Hubbs & Trautman, 1937)

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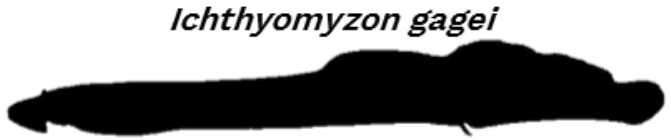
Department Wildlife, Fisheries & Aquaculture

Mississippi State University



SOUTHERN BROOK LAMPREY RESEARCH GROUP

Southeastern Fishes Council 44th Annual Meeting

Hickory Knob State Park Resort, McCormick, SC

2018-11-08 08:45

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DEPARTMENT OF WILDLIFE, FISHERIES AND AQUACULTURE

Measurement problem

Classical issue
(e.g., Schrödinger’s cat).

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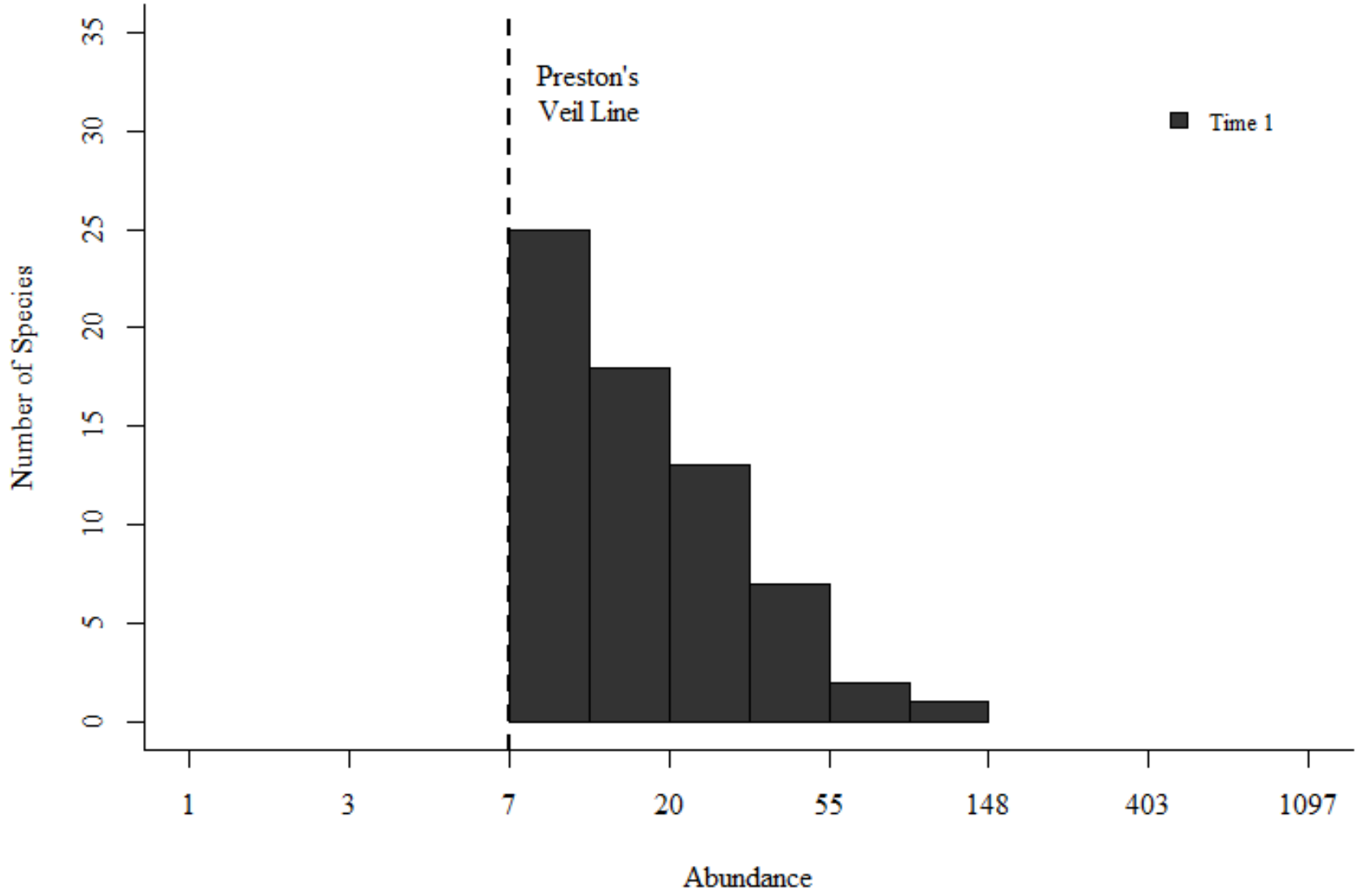
Practical issue
(e.g., Preston's veil line).



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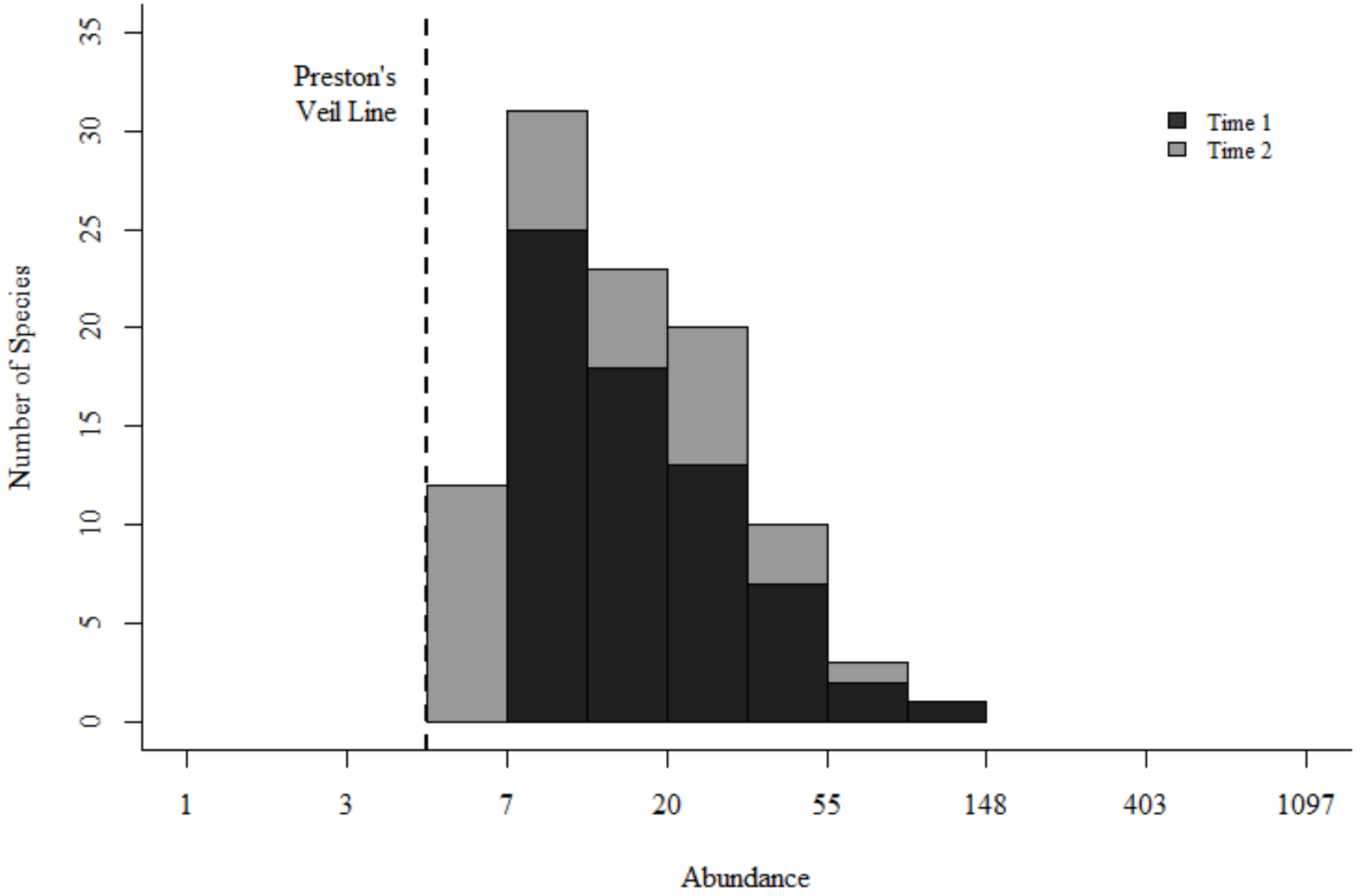

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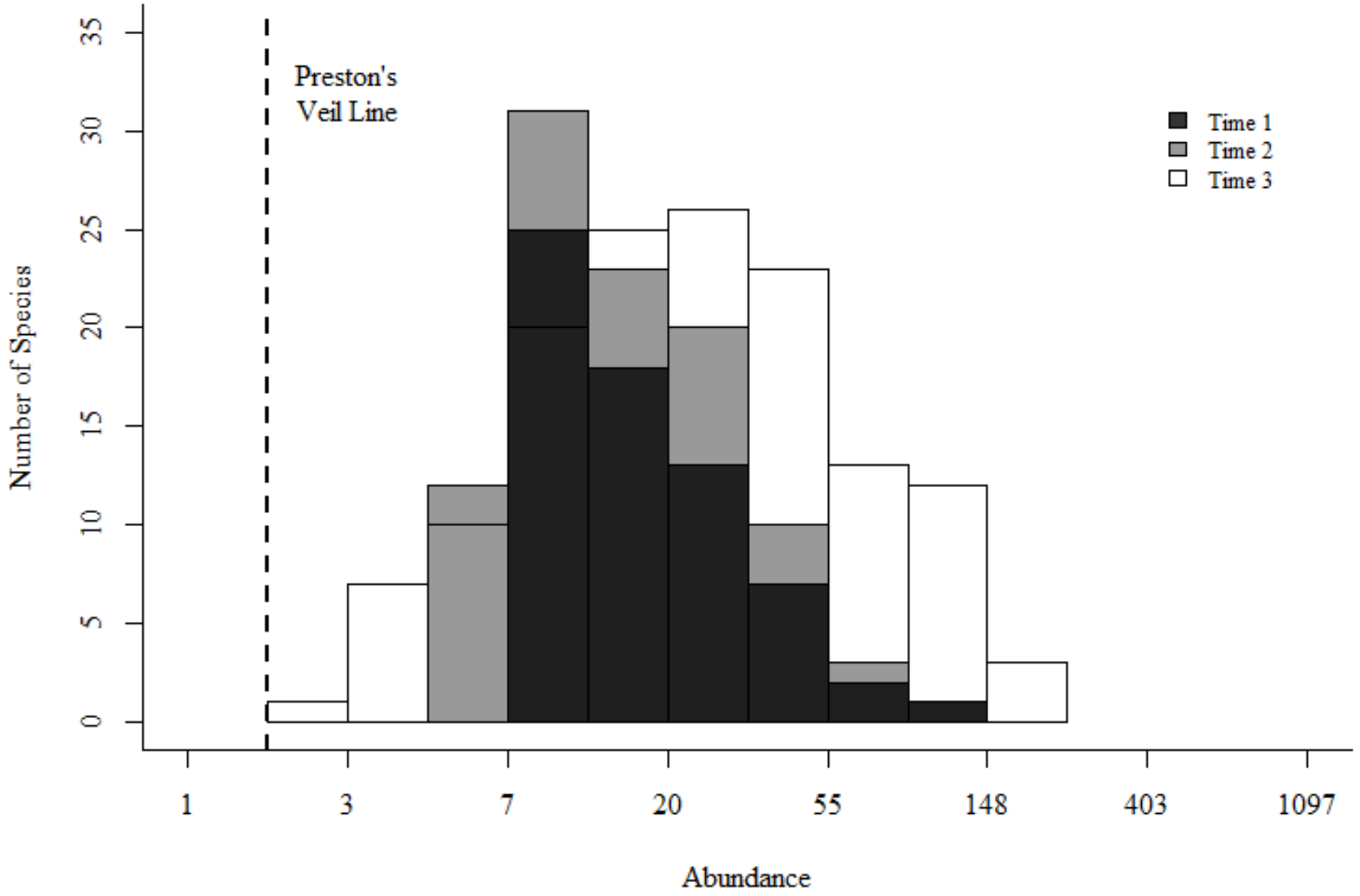
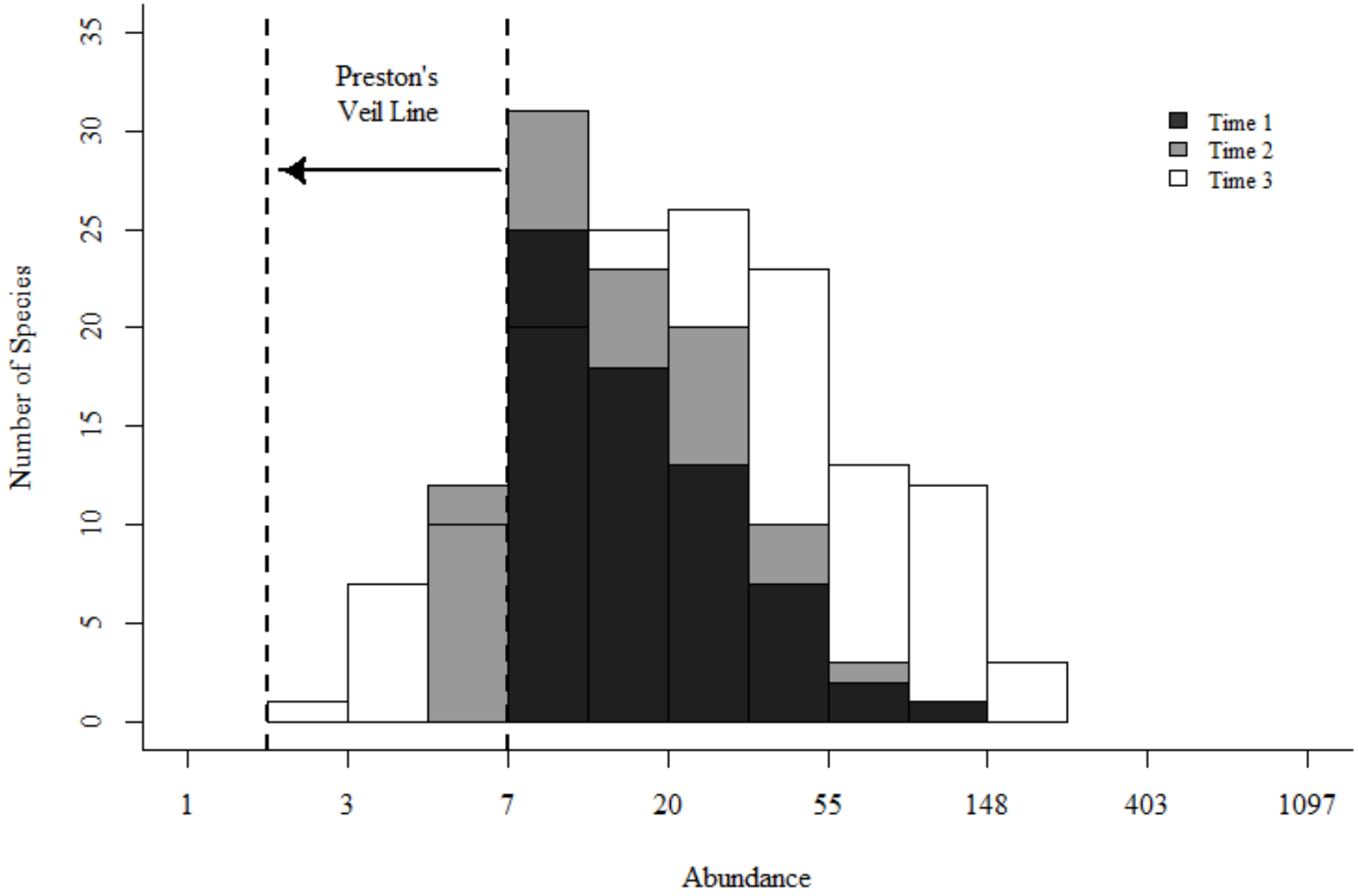


Measurement problem

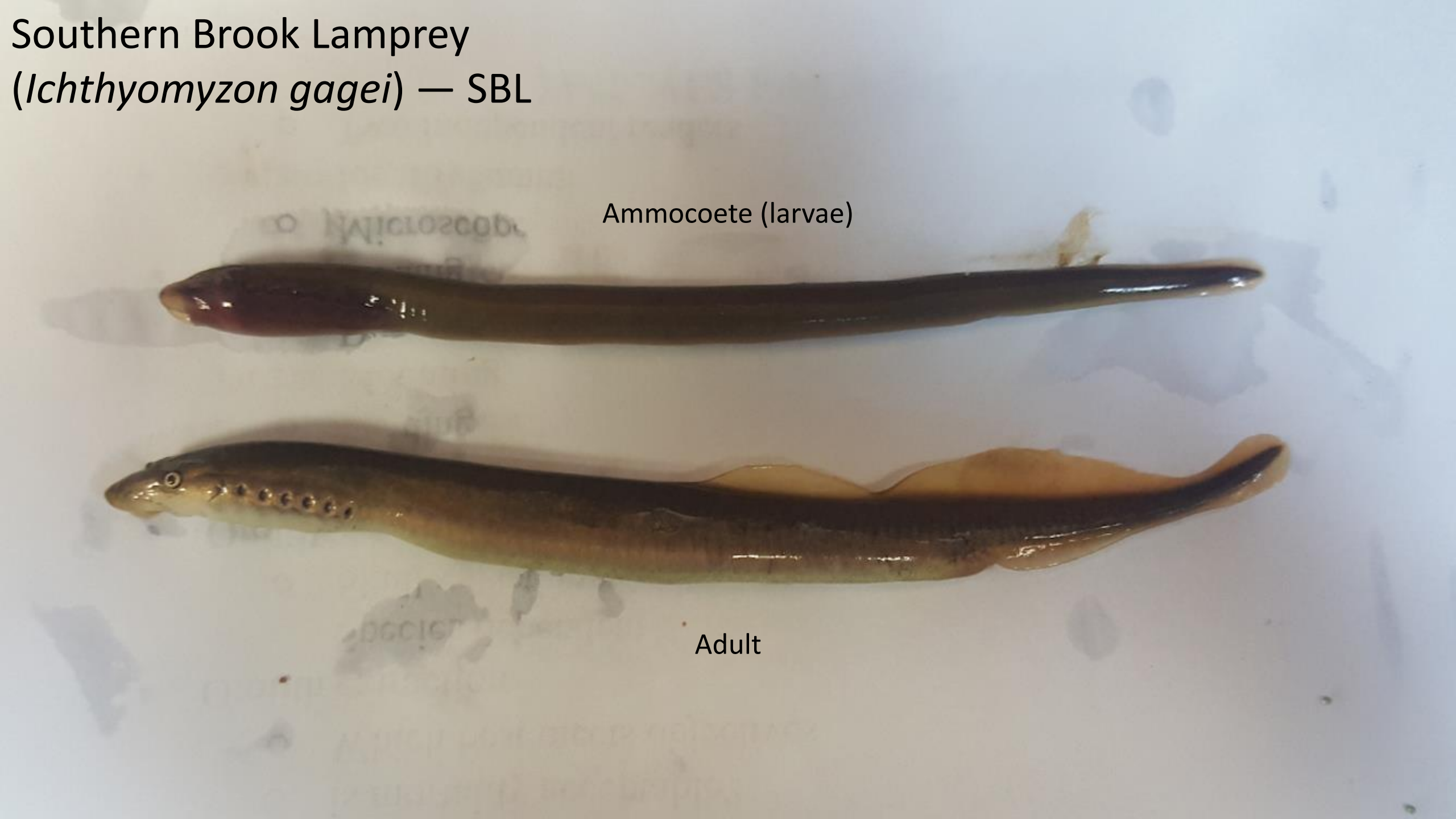
Classical issue
(e.g., Schrödinger's cat).

Practical issue
(e.g., Preston's veil line).

Technical issue
(e.g., Southern Brook Lamprey).



Southern Brook Lamprey (*Ichthyomyzon gagei*) — SBL



Gernal questions

What habitat types are SBL are associated with? Which types do they select?

How far do SBL move within the stream? Are these movements seasonal?

At what age-year do SBL metamorphose? Are there environmental ques that induce metamorphosis?

What are their burrow characteristics, burrowing behavior, and interactions with predators?

Study questions and objectives

1. What percentage of SBL survive post-tagging and retain tags?

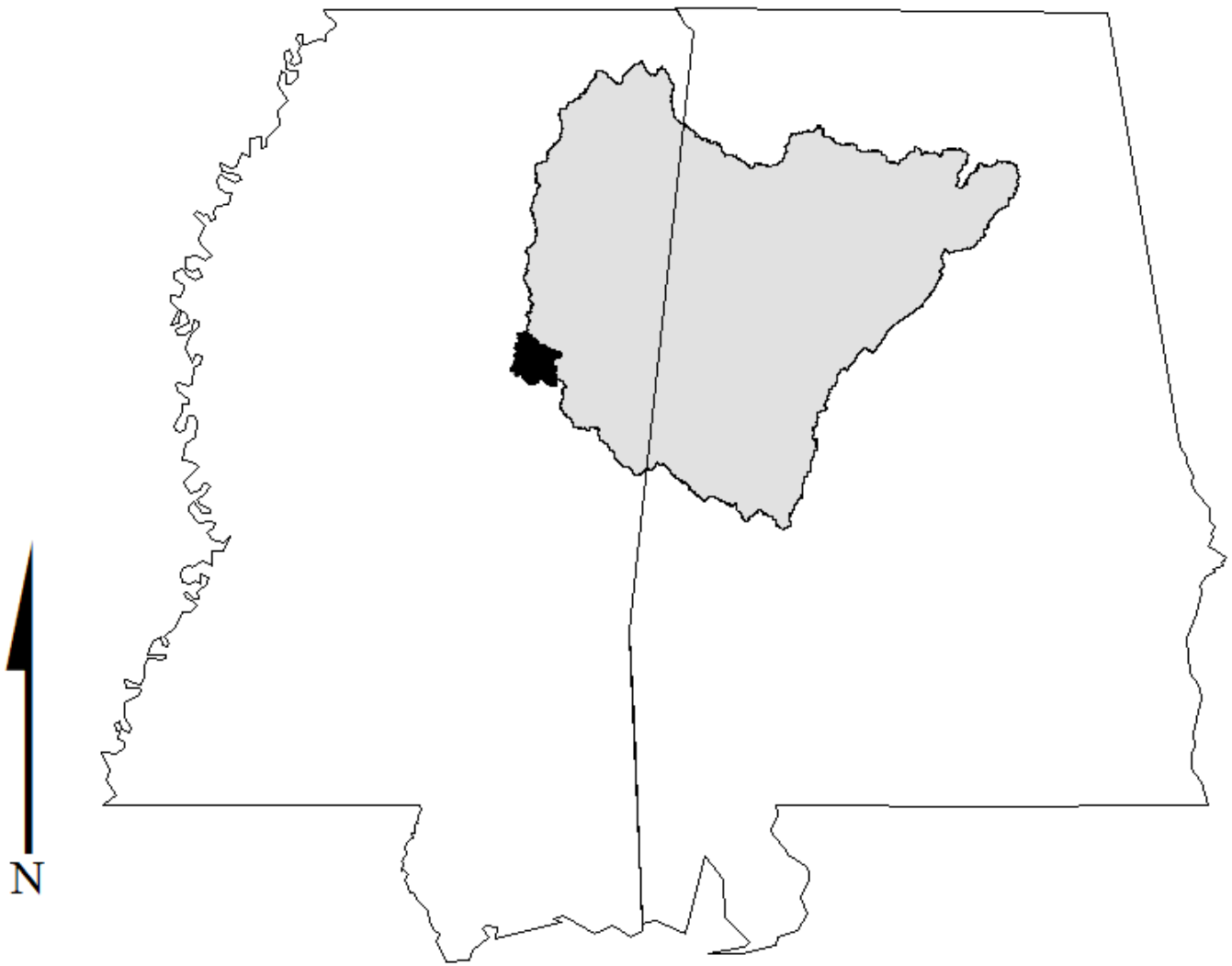
    1. Estimate survival and PIT tag retention of individuals *in situ*.

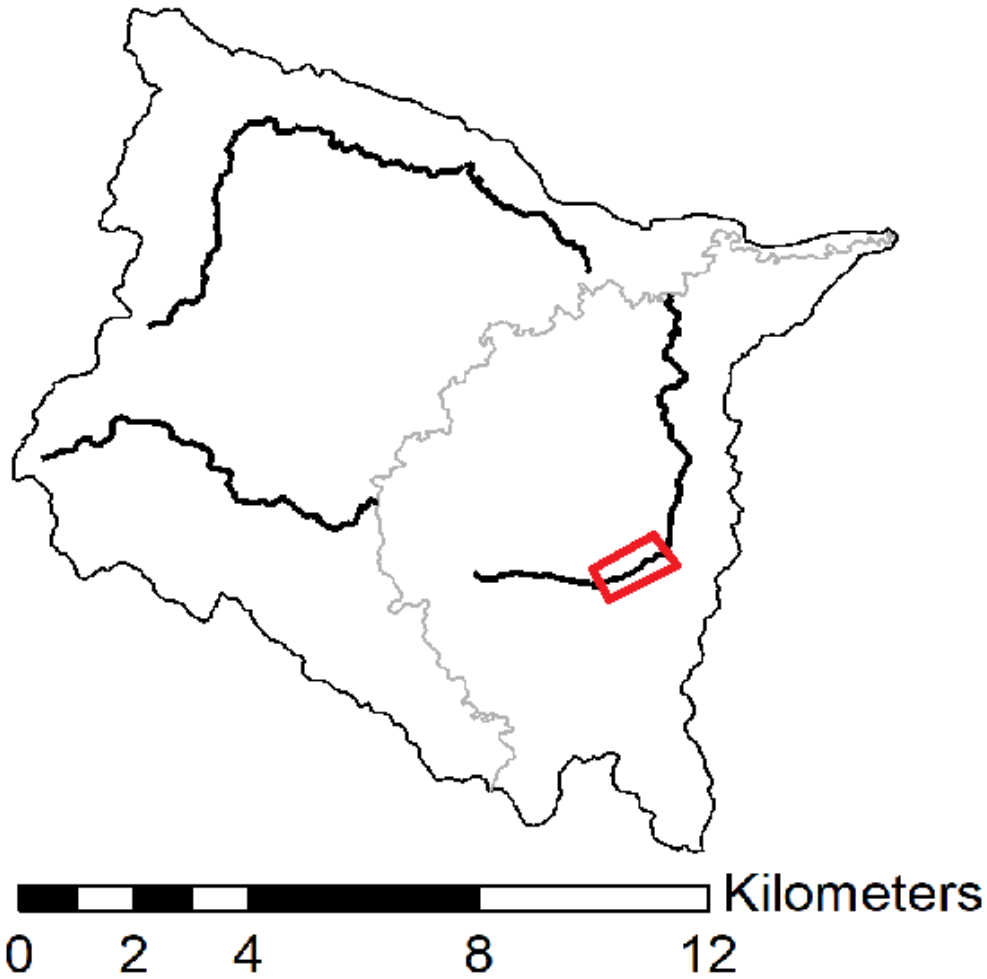
    2. Estimate survival and PIT tag retention of individuals *in laboratorium.*

2. Does the burrowing behavior of SBL pose a challenge to detecting tagged individuals?

    1. Test for effects of sediment type (medium) and depth of PIT tag in sediment on the probability of detecting PIT tags.

Study site

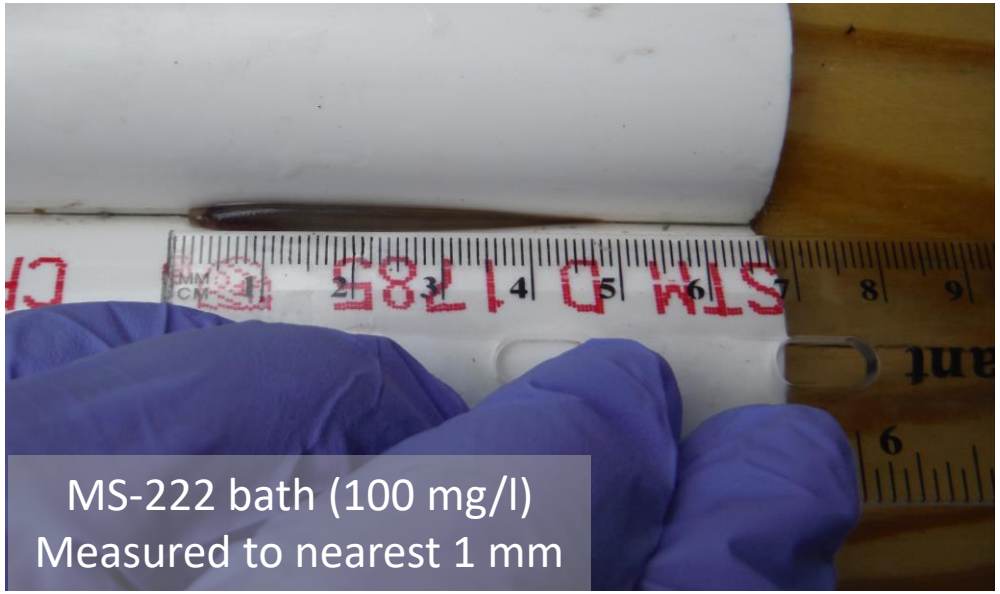


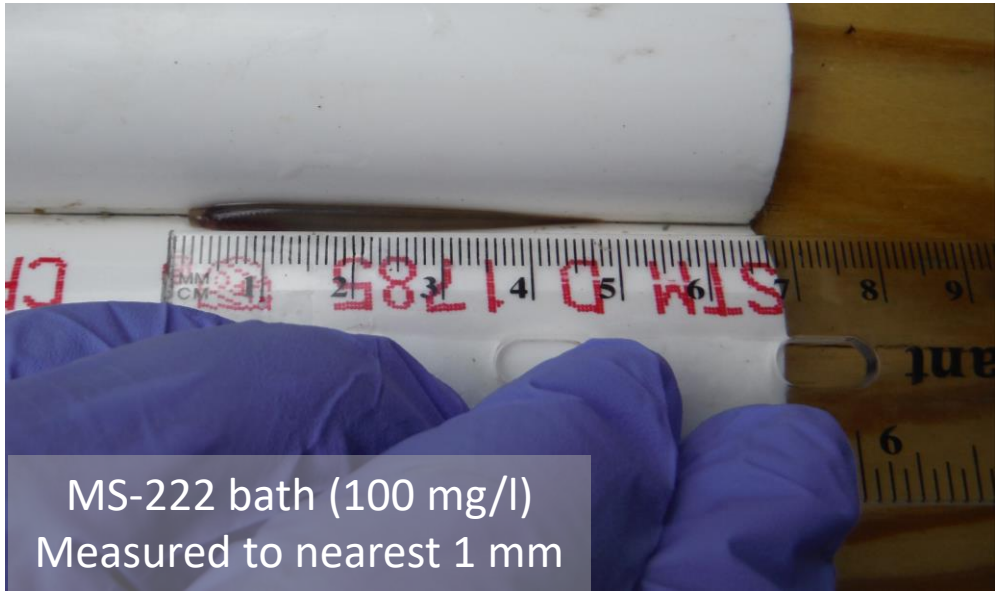



Study site

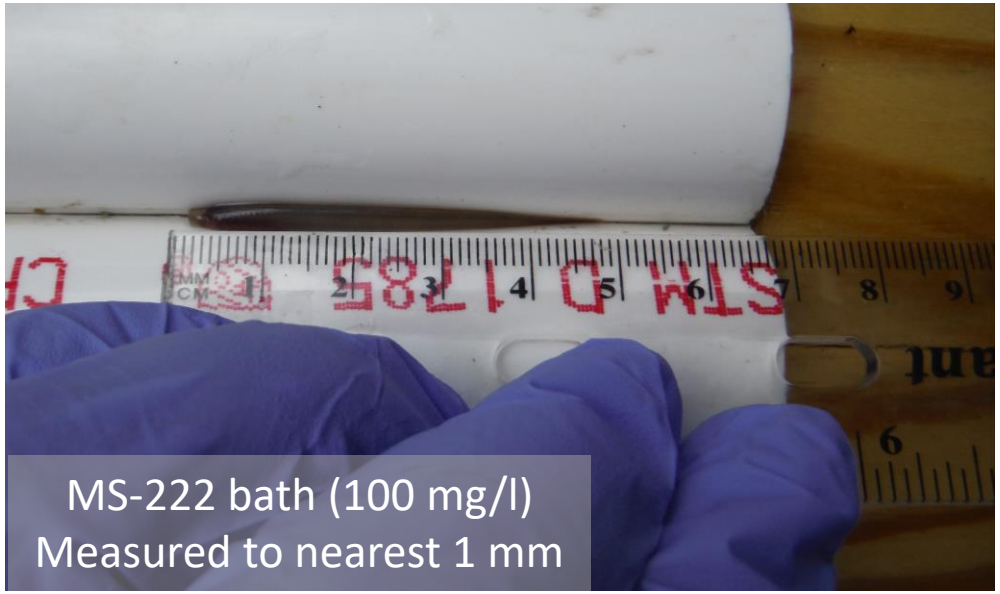

Study site

Collection


MS-222 bath (100 mg/l)
Measured to nearest 1 mm


MS-222 bath (100 mg/l)
Measured to nearest 1 mm

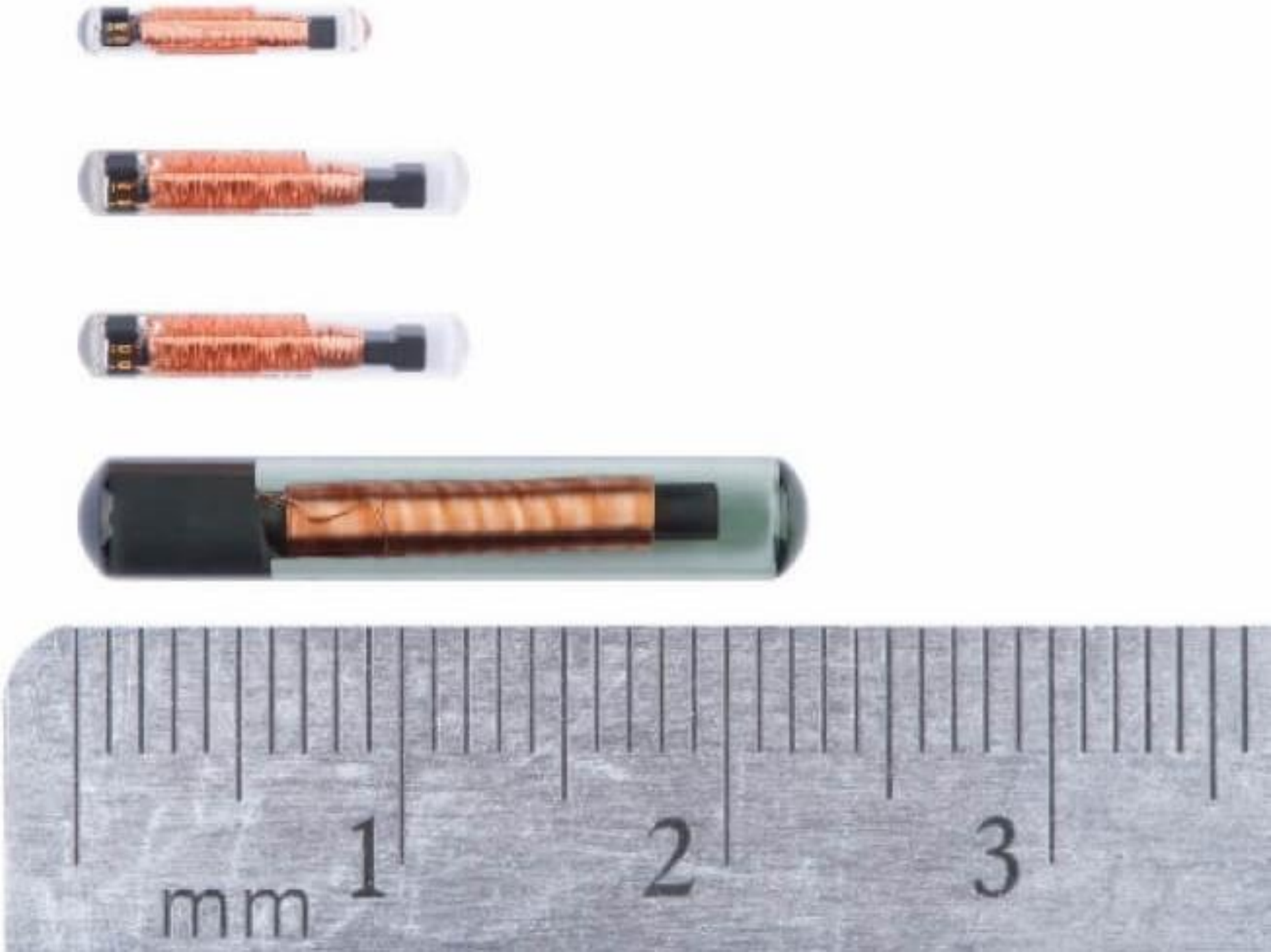

Mid-ventral incision


MS-222 bath (100 mg/l)
Measured to nearest 1 mm


Mid-ventral incision


Tag insertion

PIT tags



Pit tags. Digital image. Biomark, n.d. Web 02-11-2018 https://www.biomarkaqua.com

Reading tags

Survival and tag retention *in situ*

Question 1: What percentage of SBL survive post-tagging and retain tags?

Objective 1: Estimate survival and PIT tag retention of individuals *in situ*.

Survival and tag retention *in situ*

- Methods
  - Collected and tagged (*n* = 27)
  - Placed in plastic exclosures, *in situ*, for 7 days

Survival and tag retention *in situ*

- Methods
  - Collected and tagged (*n* = 27)
  - Placed in plastic exclosures, *in situ*, for 7 days

- Results

Exclosure No.	No. Stocked	No. Survived	Percent Survival
1	8	3	38%
2	7	2	29%
3	12	3	25%
Tag retention: 100%			

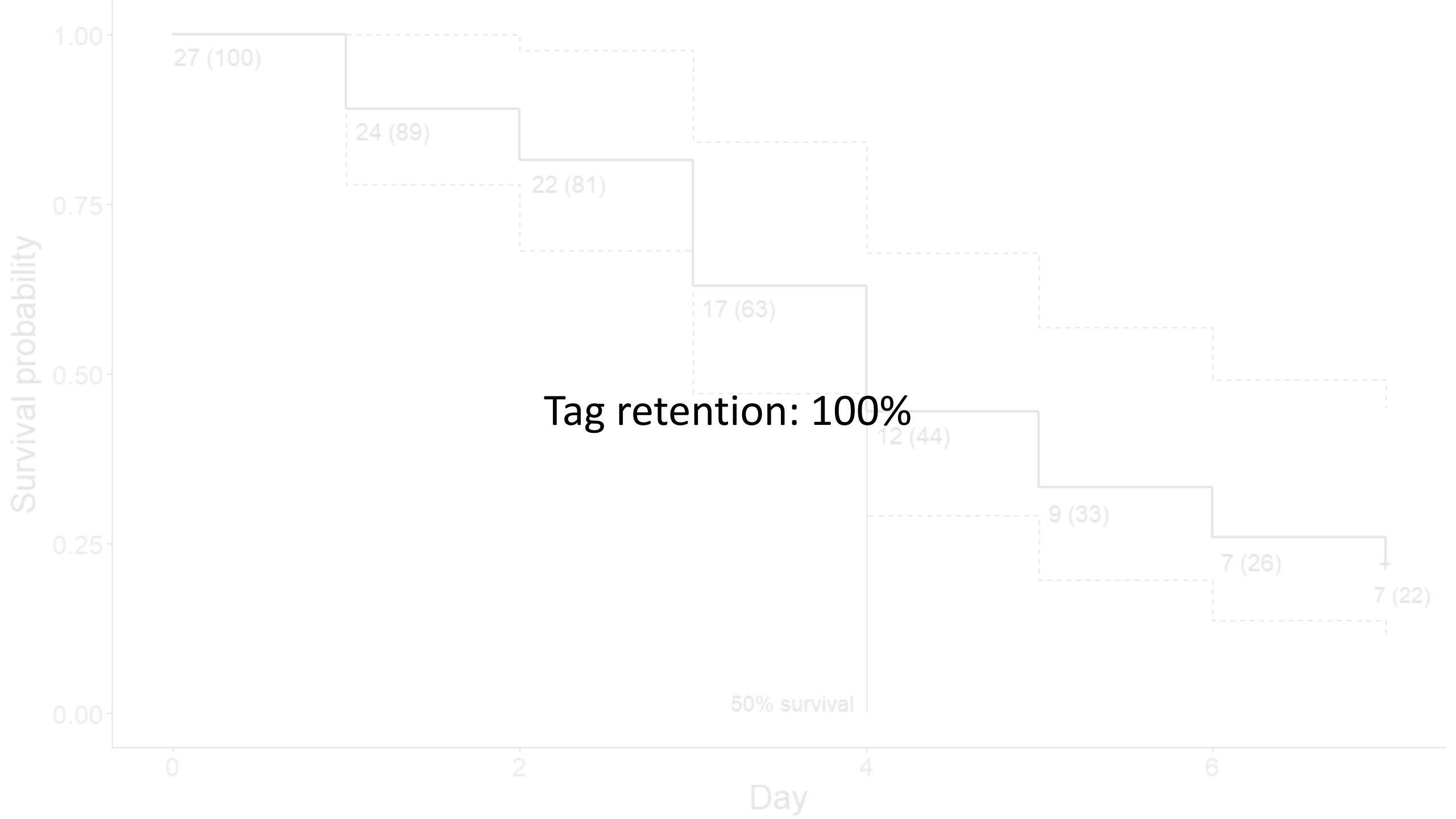
Survival and tag retention *in laboratorium*

Question 1: What percentage of SBL survive post-tagging and retain tags?

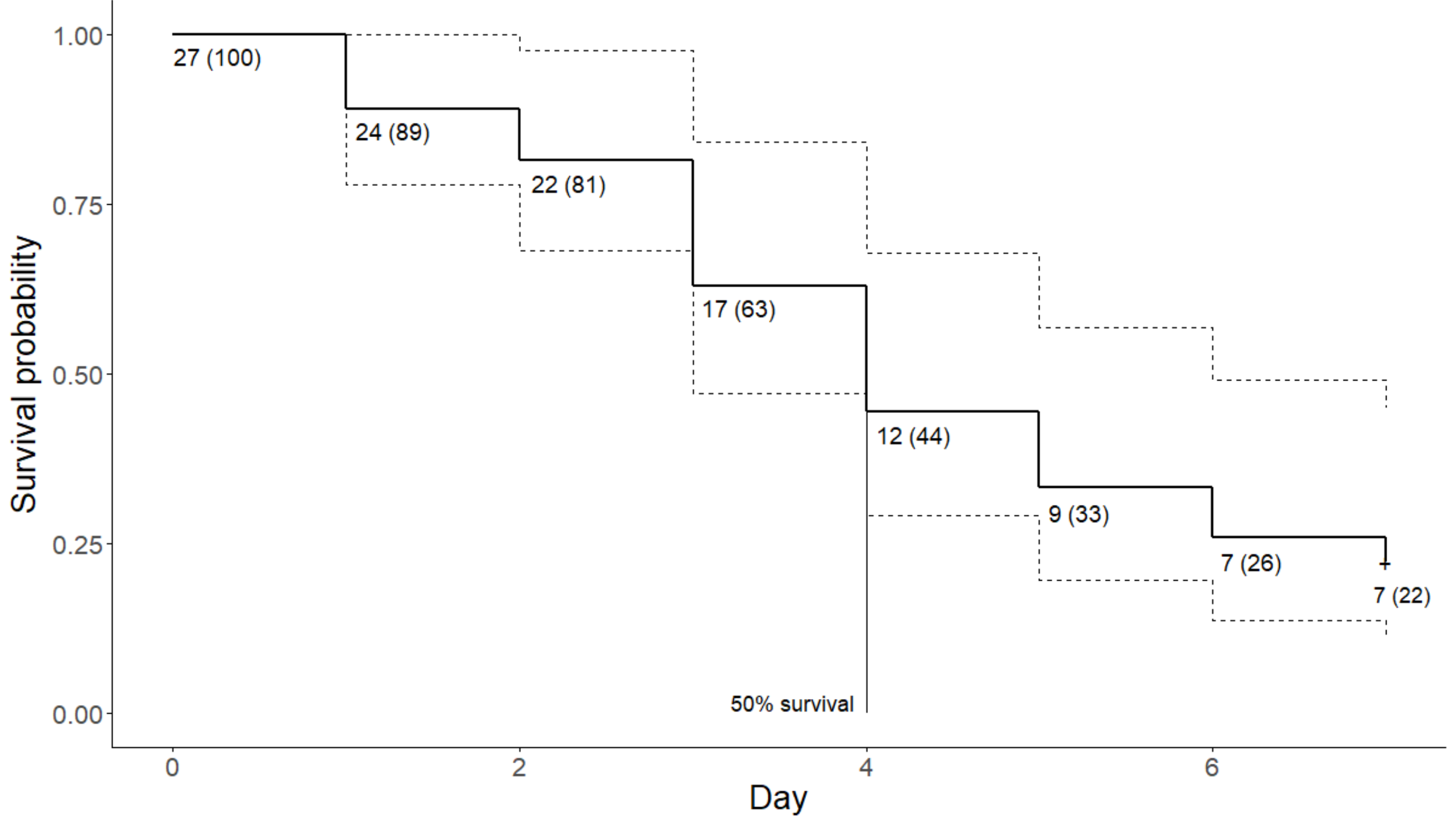
Objective 2: Estimate survival and PIT tag retention of individuals *in laboratorium*.

Survival and tag retention *in laboratorium*

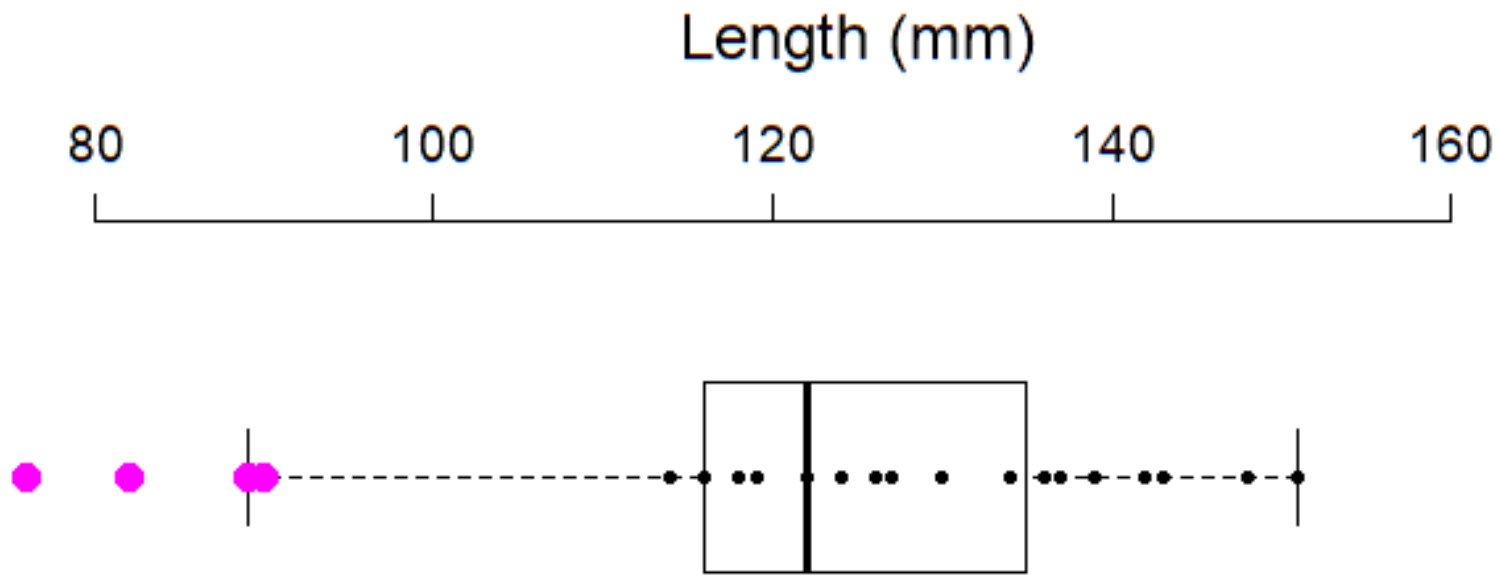
- Methods
  - Collected and tagged (*n* = 27)
  - Placed in aerated livewell for 7 days
  - Survivorship recorded daily, noting tag-ID and removing ‘dead’ individuals

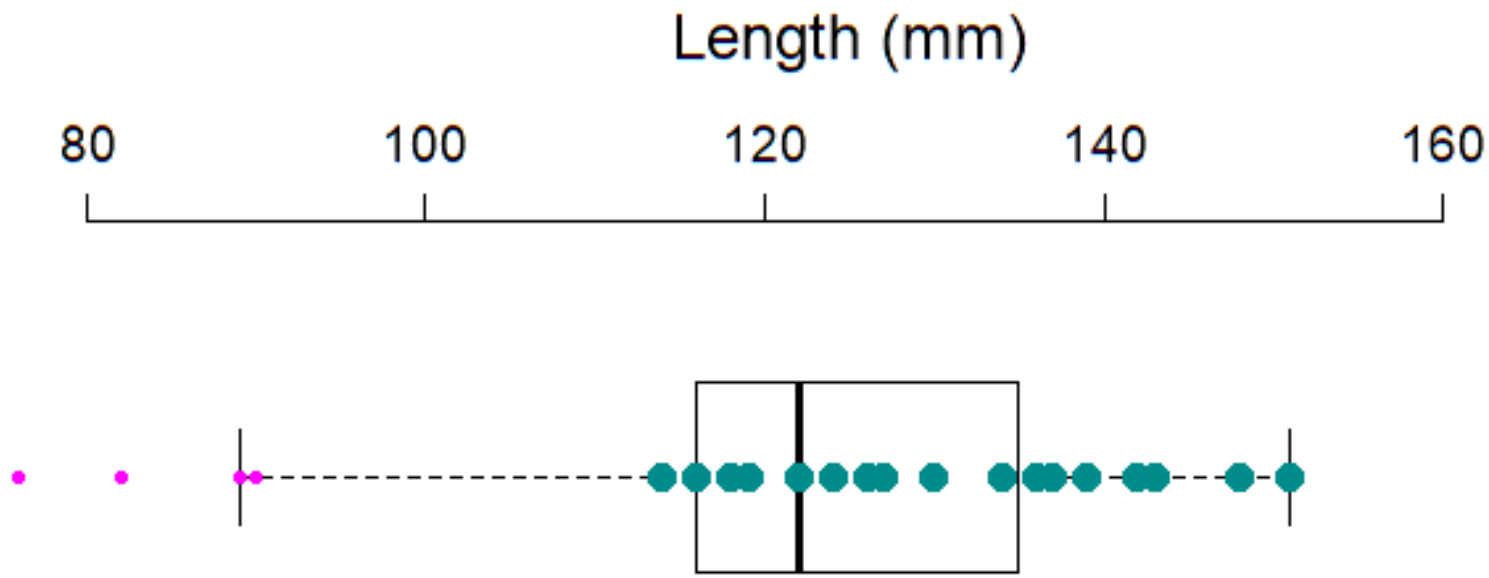


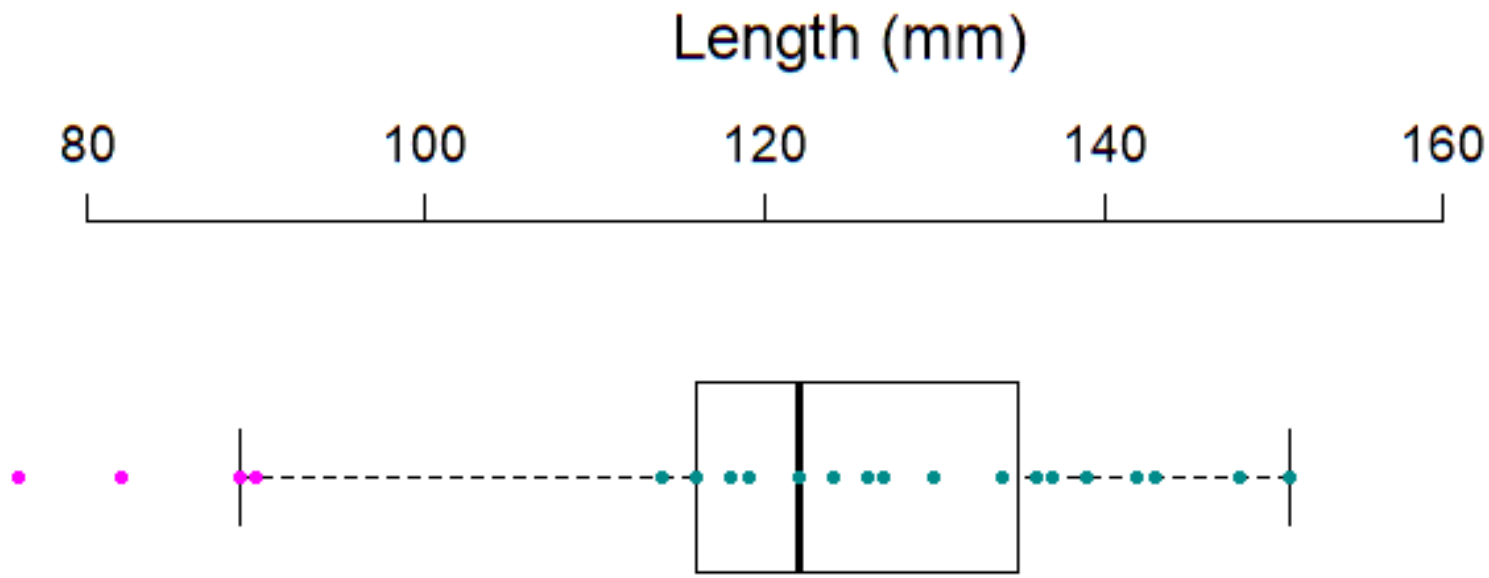
Tag retention: 100%

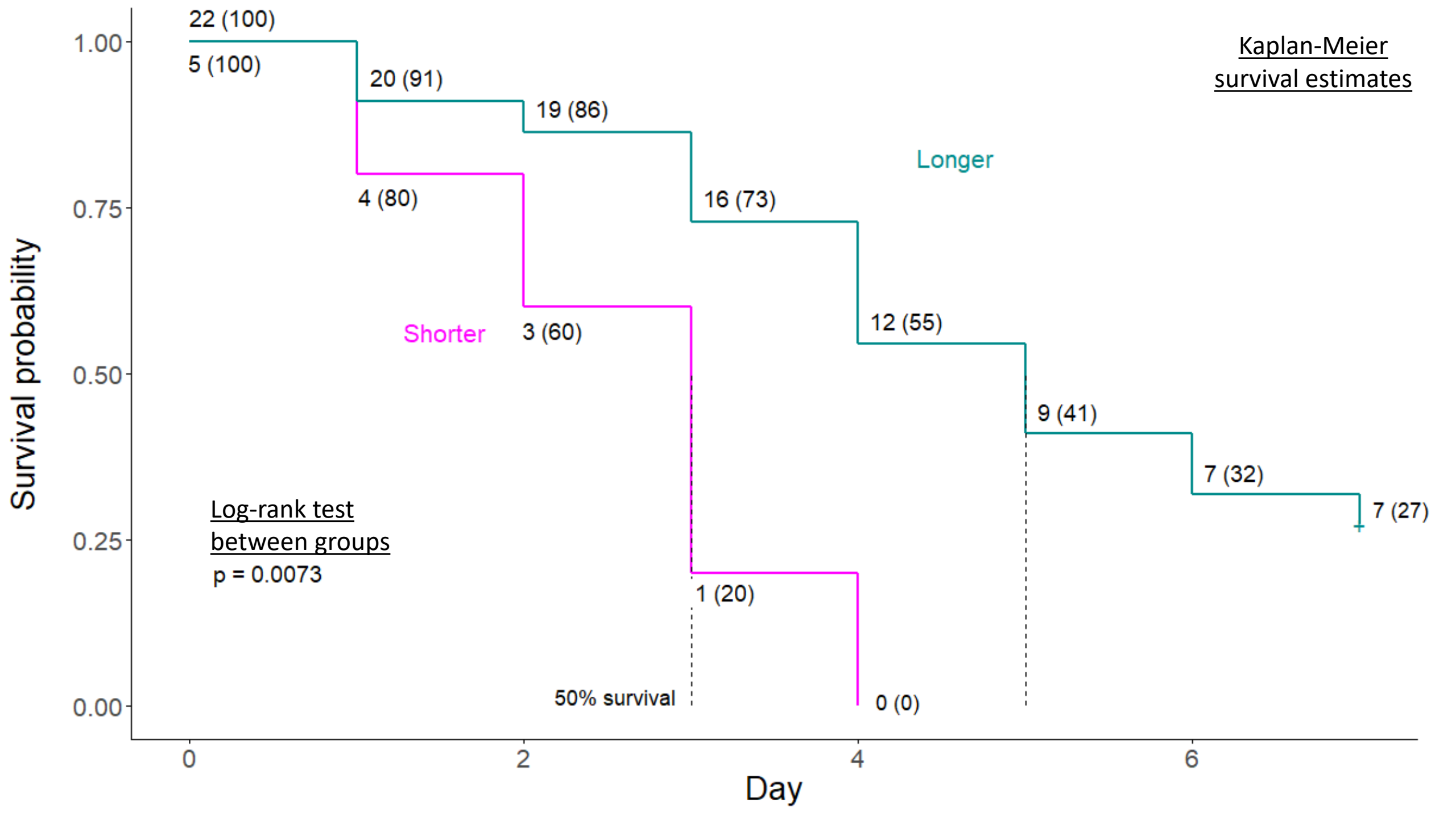

1.00
0.75
0.50
0.25
0.00
Survival probability
27 (100)
24 (89)
22 (81)
17 (63)
12 (44)
9 (33)
7 (26)
7 (22)
50% survival
0
2
4
6
Day


Suspected infection and hemorrhaging
Location of incision


Length (mm)
80
100
120
140
160


Length (mm)
80
100
120
140
160


Length (mm)
80
100
120
140
160


Kaplan-Meier
survival estimates
Survival probability
1.00
0.75
0.50
0.25
0.00
0
2
4
6
Day
22 (100)
5 (100)
20 (91)
19 (86)
16 (73)
12 (55)
9 (41)
7 (32)
7 (27)
Longer
4 (80)
3 (60)
1 (20)
0 (0)
Shorter
50% survival
Log-rank test
between groups
p = 0.0073

Detection of tags in sediment at depth

Question 2: Does the burrowing behavior of SBL pose a challenge to detecting tagged individuals?

Objective 3: Test for effects of sediment type (medium) and depth of PIT tag in sediment on the probability of detecting PIT tags.

Detection of tags in sediment at depth

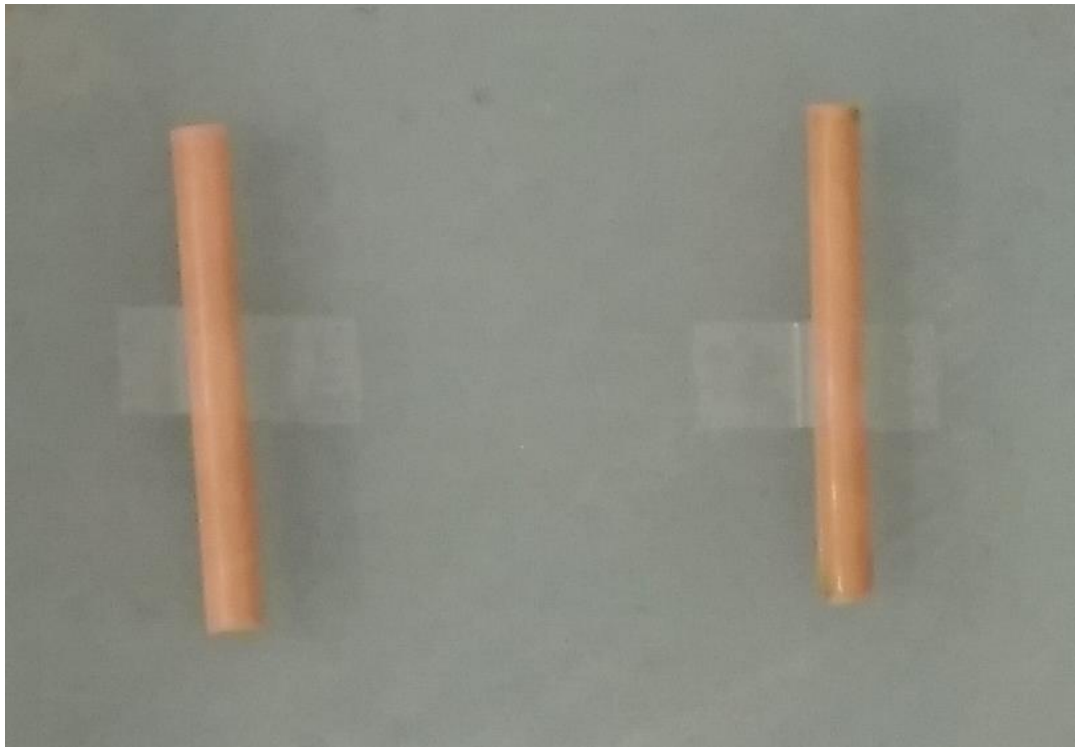
Exclosure No.	No. Stocked	No. Survived	Percent Survival
1	8	3	38%
2	7	2	29%
3	12	3	25%
		8	

- Methods
  - Release survivors
  - Reach monitored weekly
    - 4 weeks
    - 8 passes per week (4 upstream, 4 downstream)

Detection of tags in sediment at depth

Exclosure No.	No. Stocked	No. Survived	Percent Survival
1	8	3	38%
2	7	2	29%
3	12	3	25%
		8	

- Methods
  - Release survivors
  - Reach monitored weekly
    - 4 weeks
    - 8 passes per week (4 upstream, 4 downstream)
  - Scans for analog tags
    - 8 analog tags buried (stratified along reach; random depth, approx. 5-20 cm)
    - 4 weeks
    - 8 passes per week (4 upstream, 4 downstream)

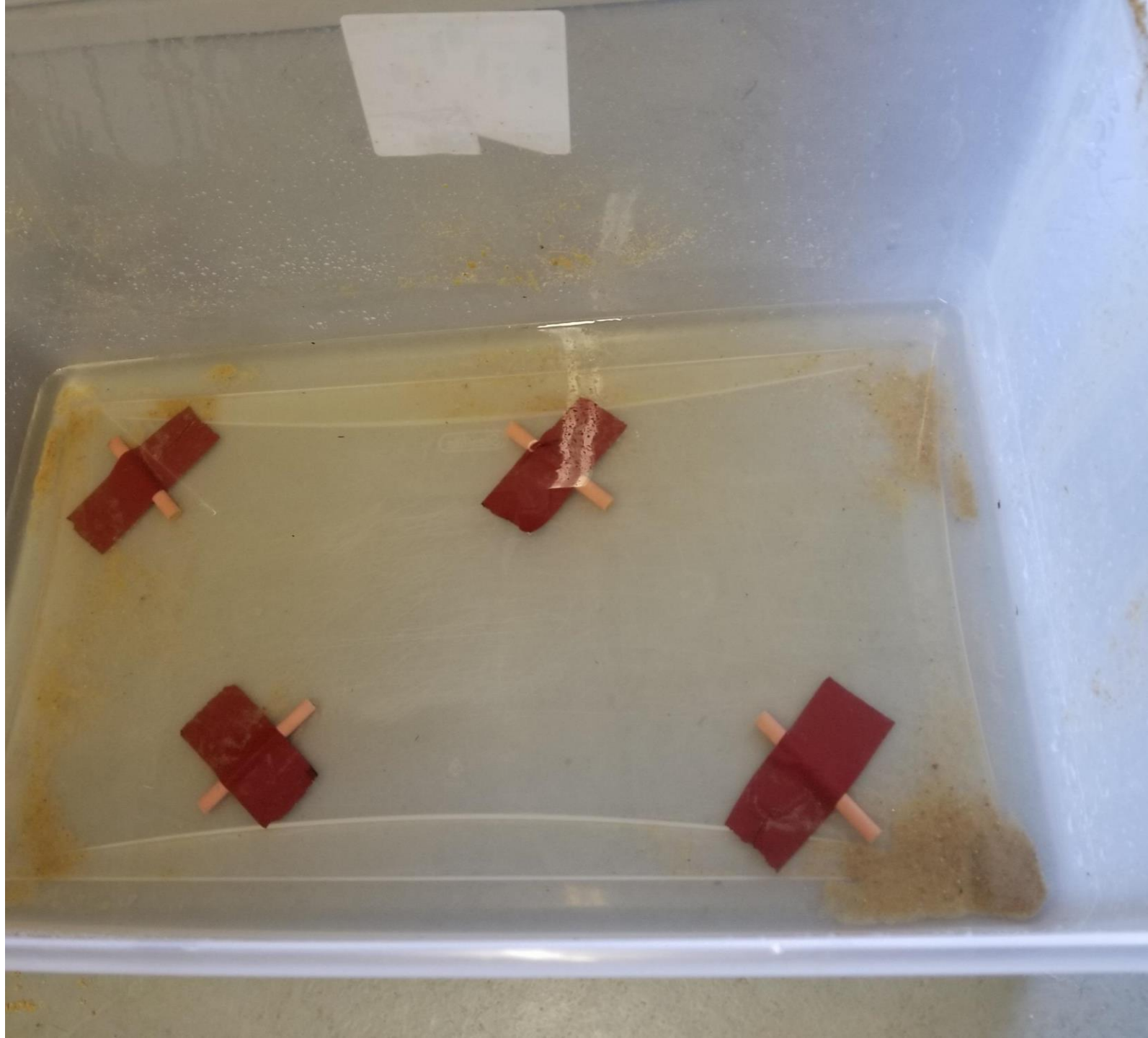


Tagged SBL: 5%

Analog tags: 66%

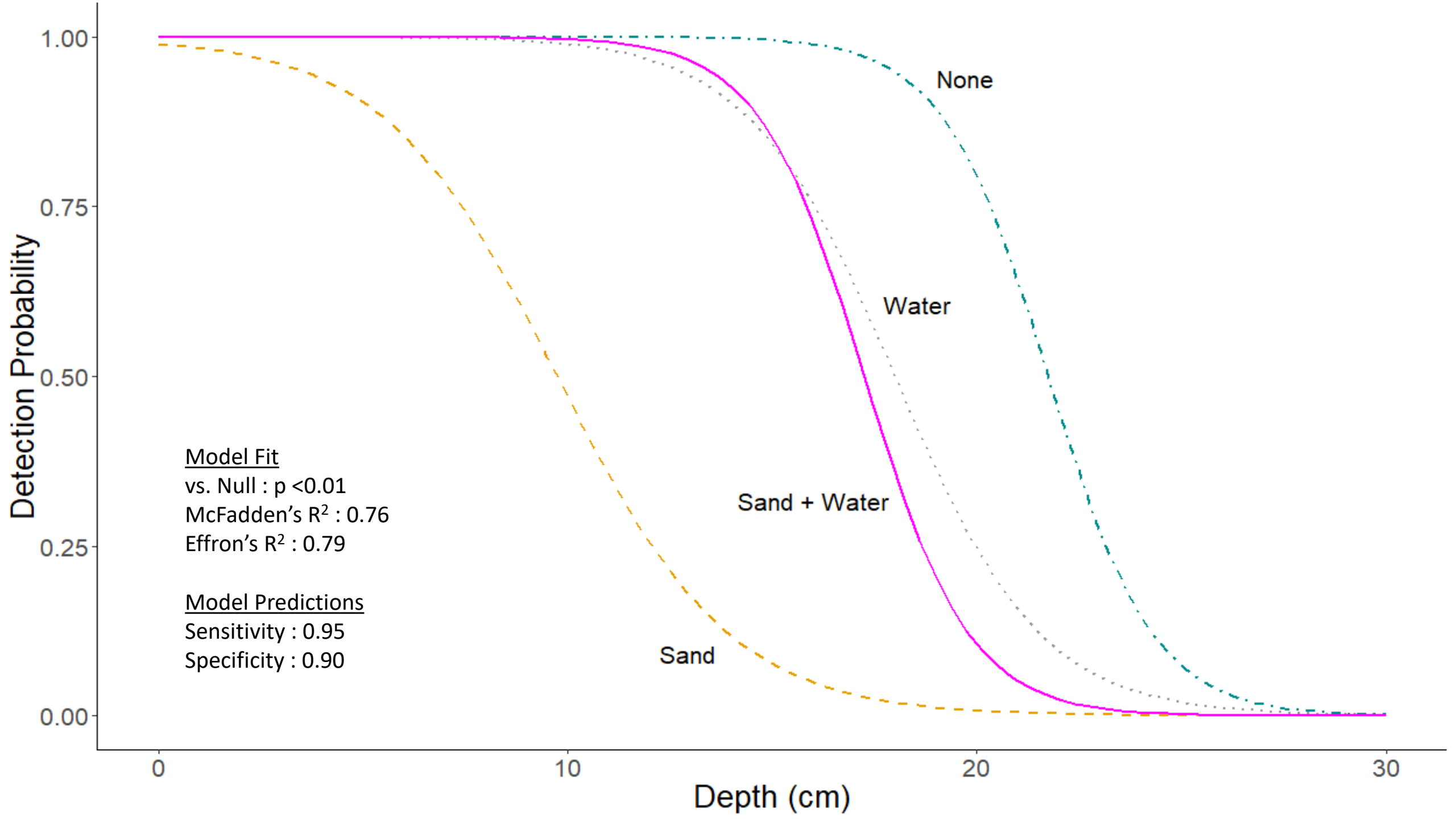
Detection of tags in sediment at depth

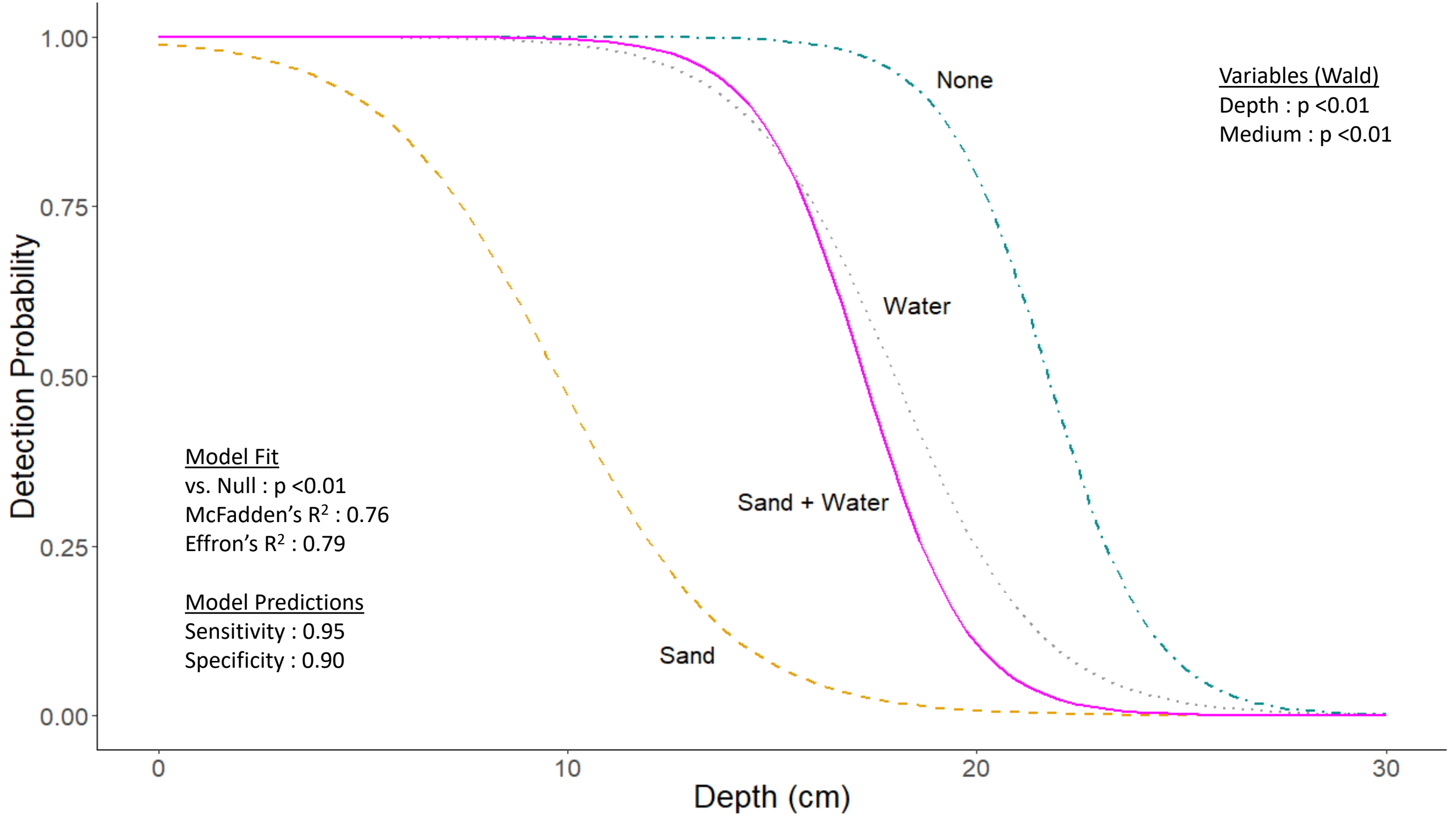
- Methods
  - 4 analogs placed in bottom of a plastic container



Detection of tags in sediment at depth

- Methods
  - 4 analogs placed in bottom of a plastic container
  - Scanned at ‘depths’ from bottom at 3 cm intervals
  - 4 sediment types (mediums)
    - None
    - Sand
    - Water
    - Sand + water


1.00
0.75
0.50
0.25
0.00
Detection Probability
0
10
20
30
Depth (cm)
None
Water
Sand + Water
Sand
Model Fit
vs. Null : p <0.01
McFadden's R2 : 0.76
Effron's R2 : 0.79
Model Predictions
Sensitivity : 0.95
Specificity : 0.90


1.00
0.75
0.50
0.25
0.00
Detection Probability
0
10
20
30
Depth (cm)
None
Water
Sand + Water
Sand
Variables (Wald)
Depth : p <0.01
Medium : p <0.01
Model Fit
vs. Null : p <0.01
McFadden's R2 : 0.76
Effron's R2 : 0.79
Model Predictions
Sensitivity : 0.95
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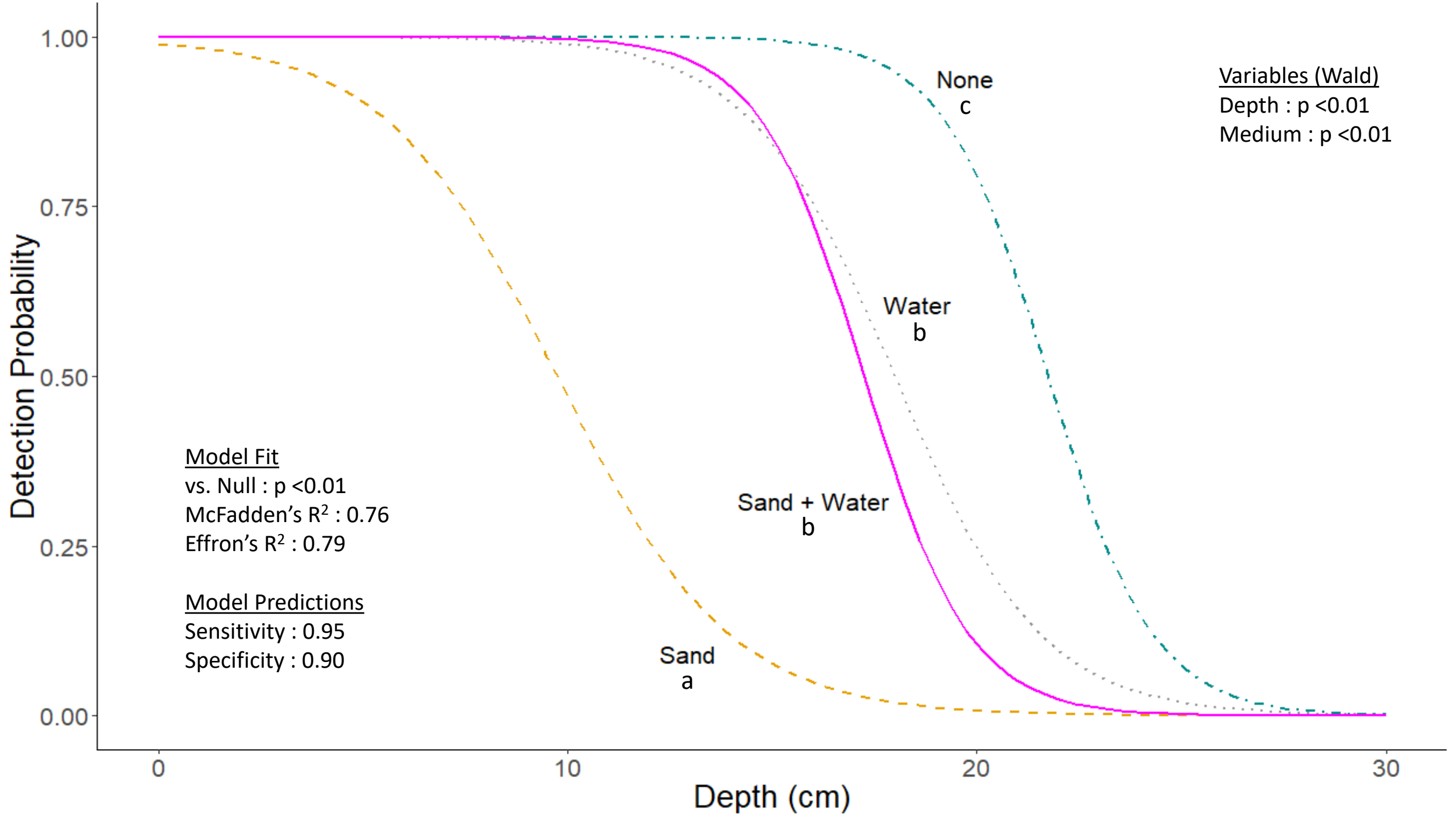
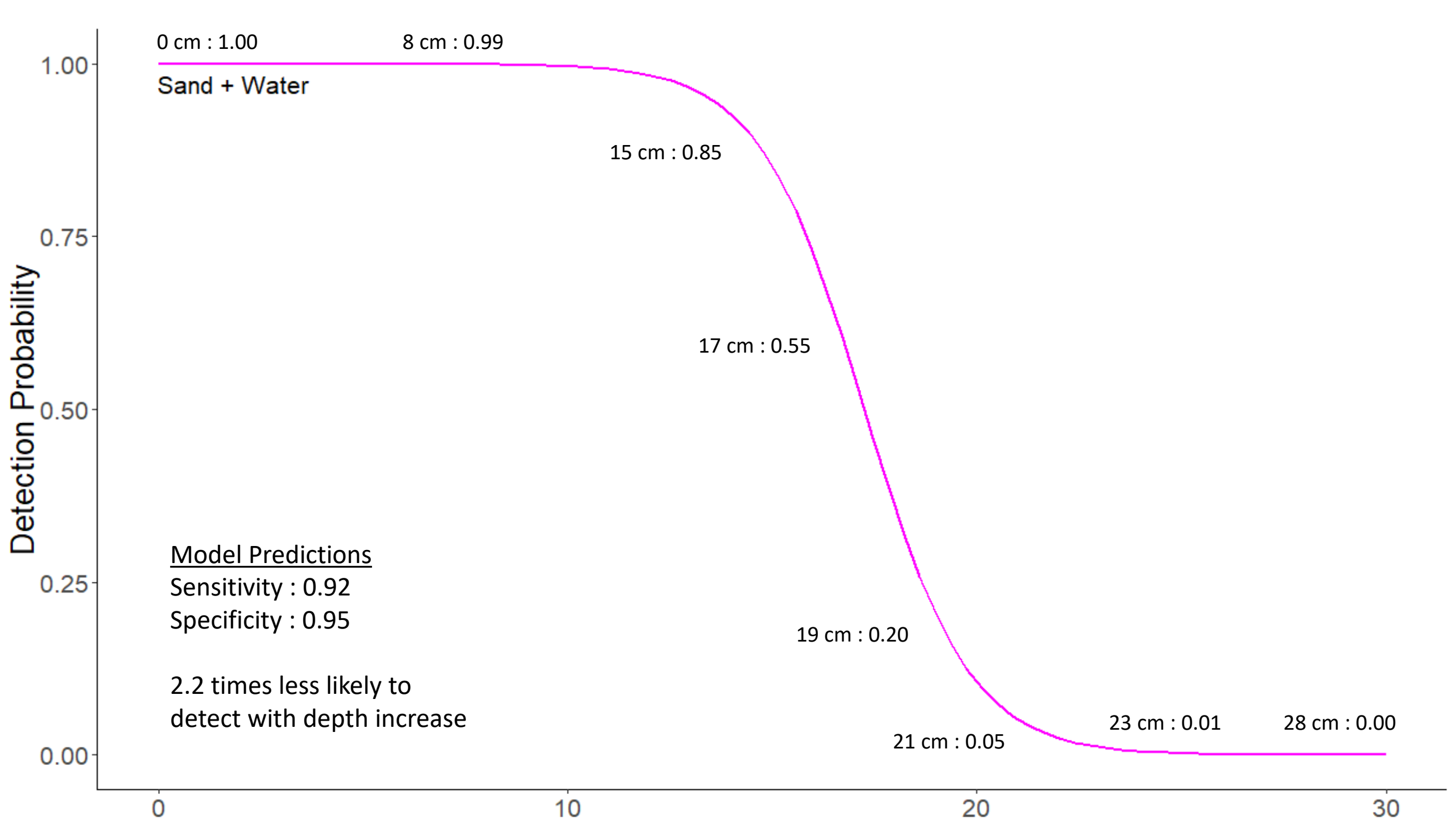
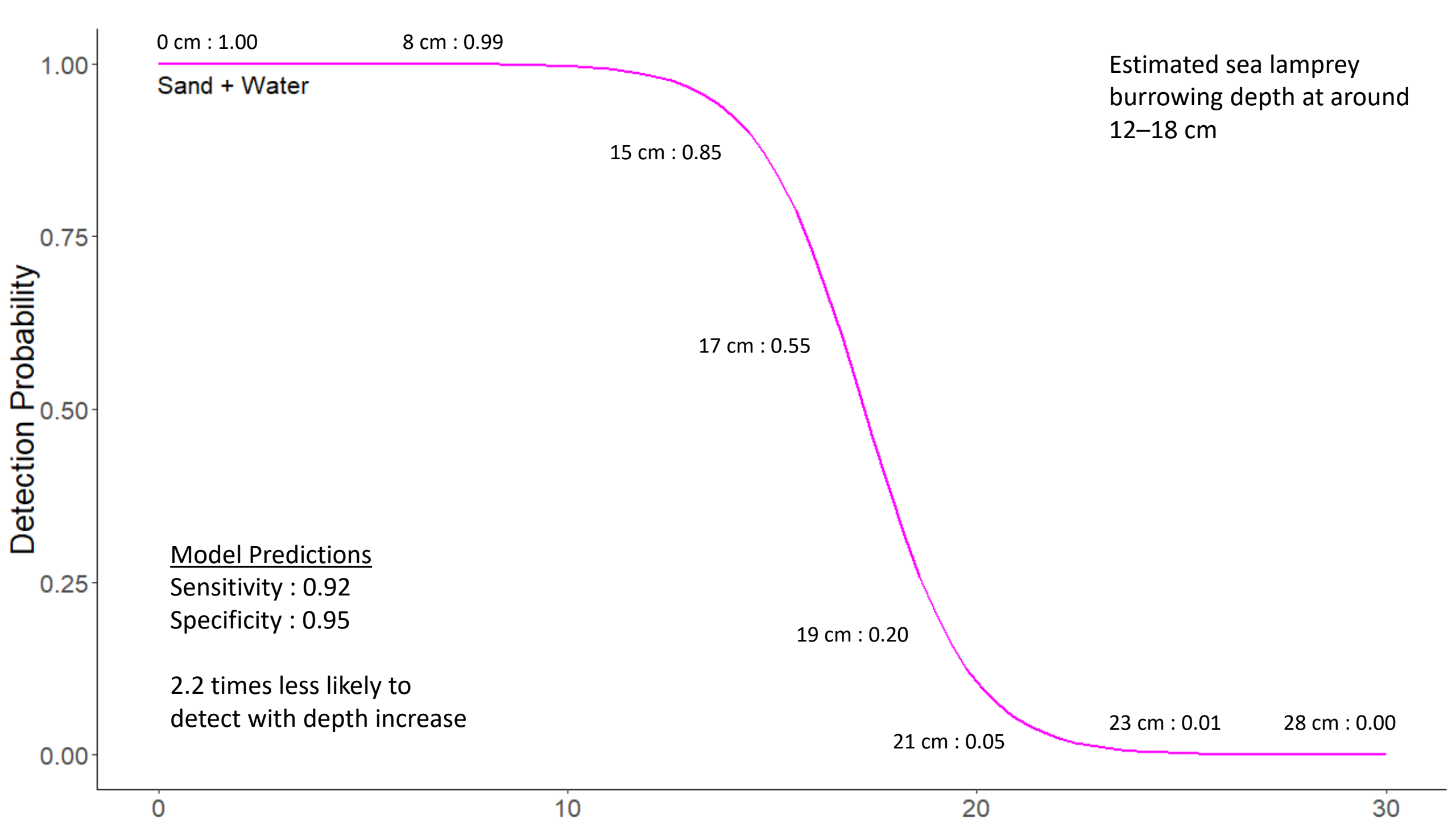

1.00
0.75
0.50
0.25
0.00
Detection Probability
0
10
20
30
Depth (cm)
None
c
Water
b
Sand + Water
b
Sand
a
Variables (Wald)
Depth : p <0.01
Medium : p <0.01
Model Fit
vs. Null : p <0.01
McFadden's R^2 : 0.76
Effron's R^2 : 0.79
Model Predictions
Sensitivity : 0.95
Specificity : 0.90


0 cm : 1.00
8 cm : 0.99
Sand + Water
15 cm : 0.85
17 cm : 0.55
19 cm : 0.20
21 cm : 0.05
23 cm : 0.01
28 cm : 0.00
Model Predictions
Sensitivity : 0.92
Specificity : 0.95
2.2 times less likely to
detect with depth increase
Detection Probability
1.00
0.75
0.50
0.25
0.00
0
10
20
30


0 cm : 1.00
8 cm : 0.99
Sand + Water
15 cm : 0.85
17 cm : 0.55
19 cm : 0.20
21 cm : 0.05
23 cm : 0.01
28 cm : 0.00
Estimated sea lamprey burrowing depth at around 12–18 cm
Model Predictions
Sensitivity : 0.92
Specificity : 0.95
2.2 times less likely to detect with depth increase
Detection Probability
1.00
0.75
0.50
0.25
0.00
0
10
20
30

Future directions

- Better control in survival trials (PVT. J. Allen Natl. Fish Hatchery)
- Optimize anesthetic concentration
- Burrowing behavior (e.g., depth and body orientation)
- Habitat selection and movement
- Basic biology (e.g., growth and metamorphosis)

Acknowledgements

- Dr. Scott Rush, Miss. State for allowing us to use his Biomark PIT tag reader

- Numerous undergraduate students for assistance in the field, especially Bayley Wilmoth (Undergraduate Research Assistant)

- Funding assistance through MSU Department of Wildlife, Fisheries & Aquaculture

Connect with us

Project log on ResearchGate

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Southeastern Fishes Council
While I breathe, I hope: Recovery and Resilience
McCormick, South Carolina 8-9 November 2018

Ichthyomyzon gagei
SOUTHERN BROOK LAMPREY
RESEARCH GROUP

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FISHERIES AND AQUACULTURE

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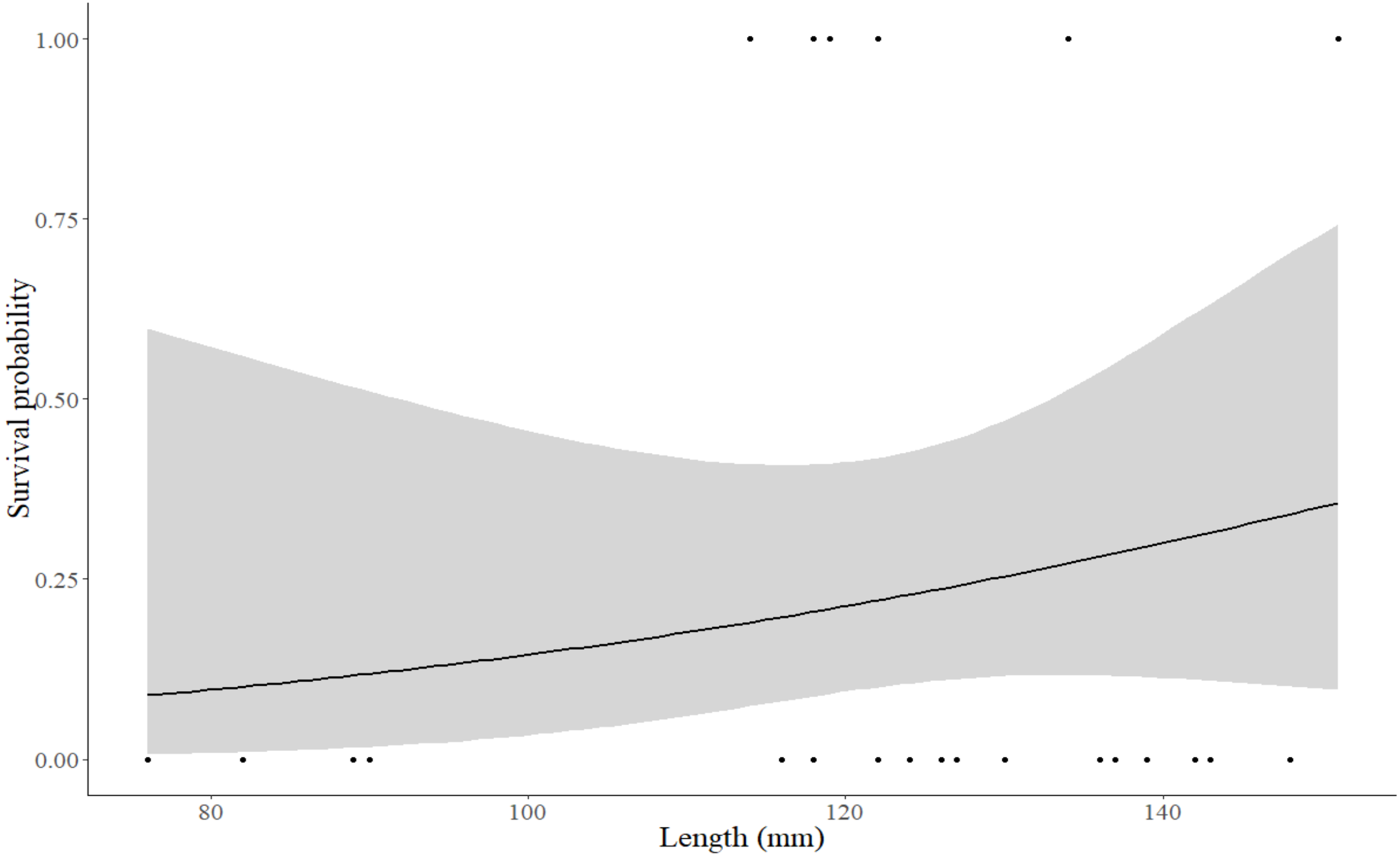
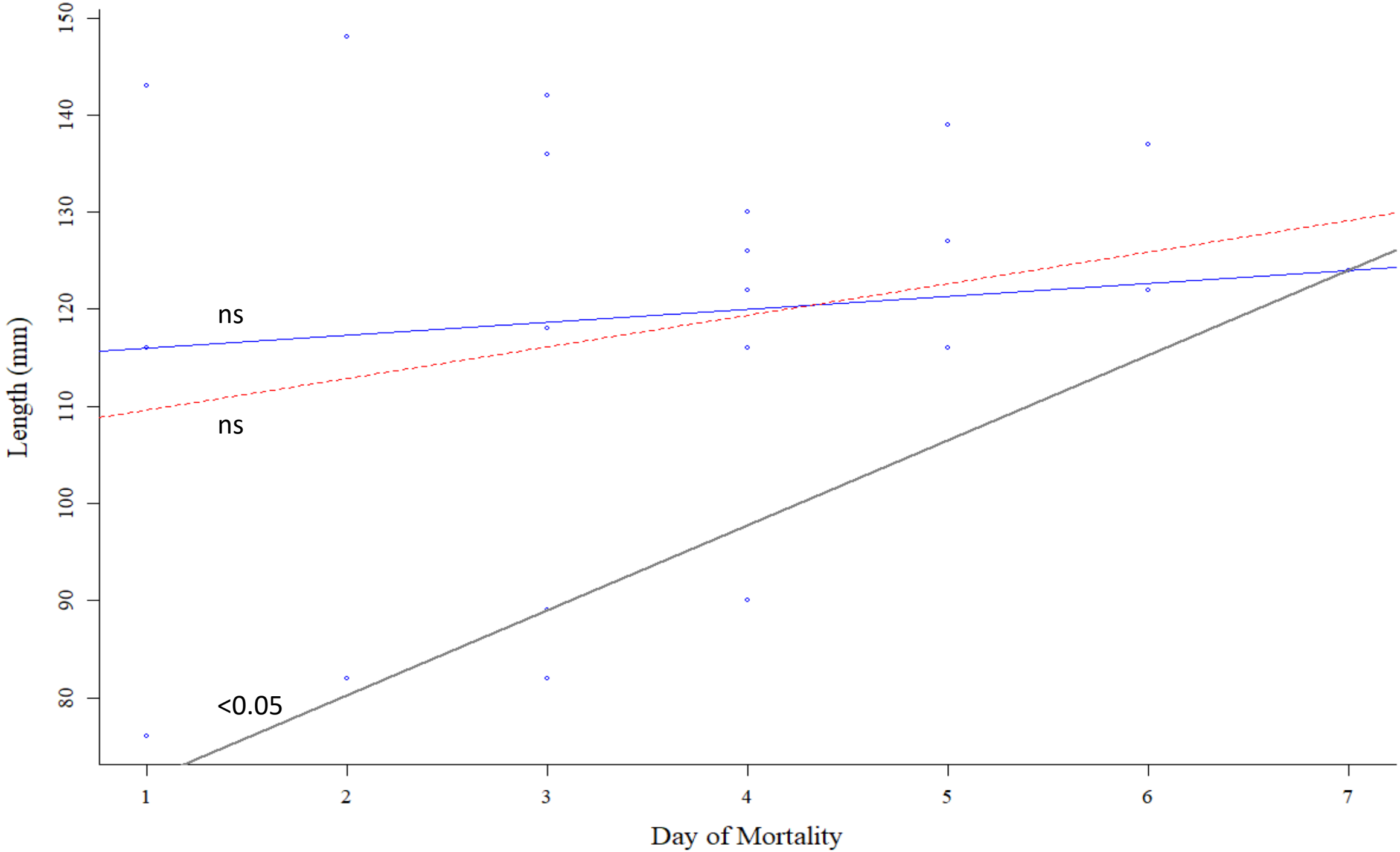
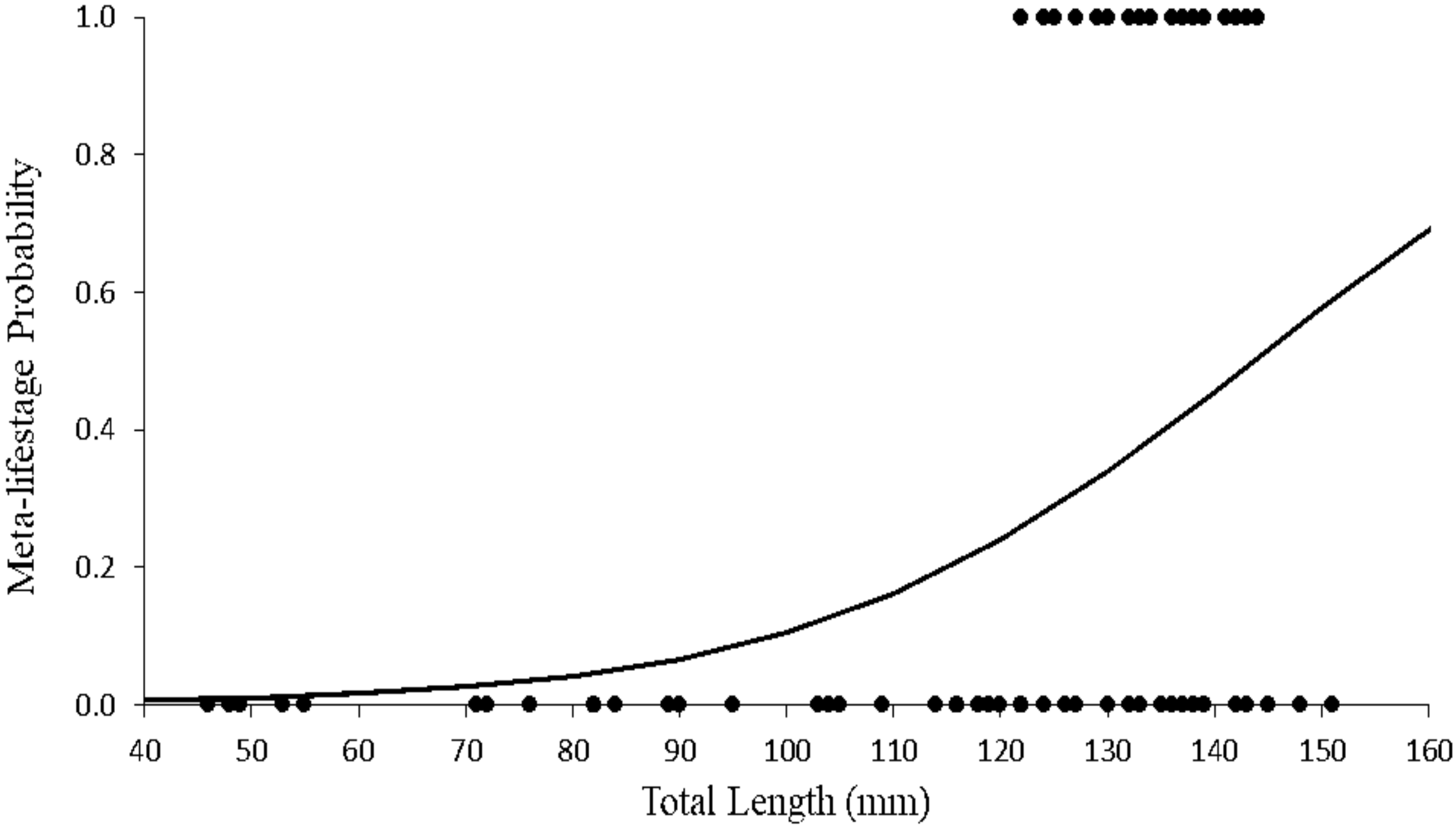
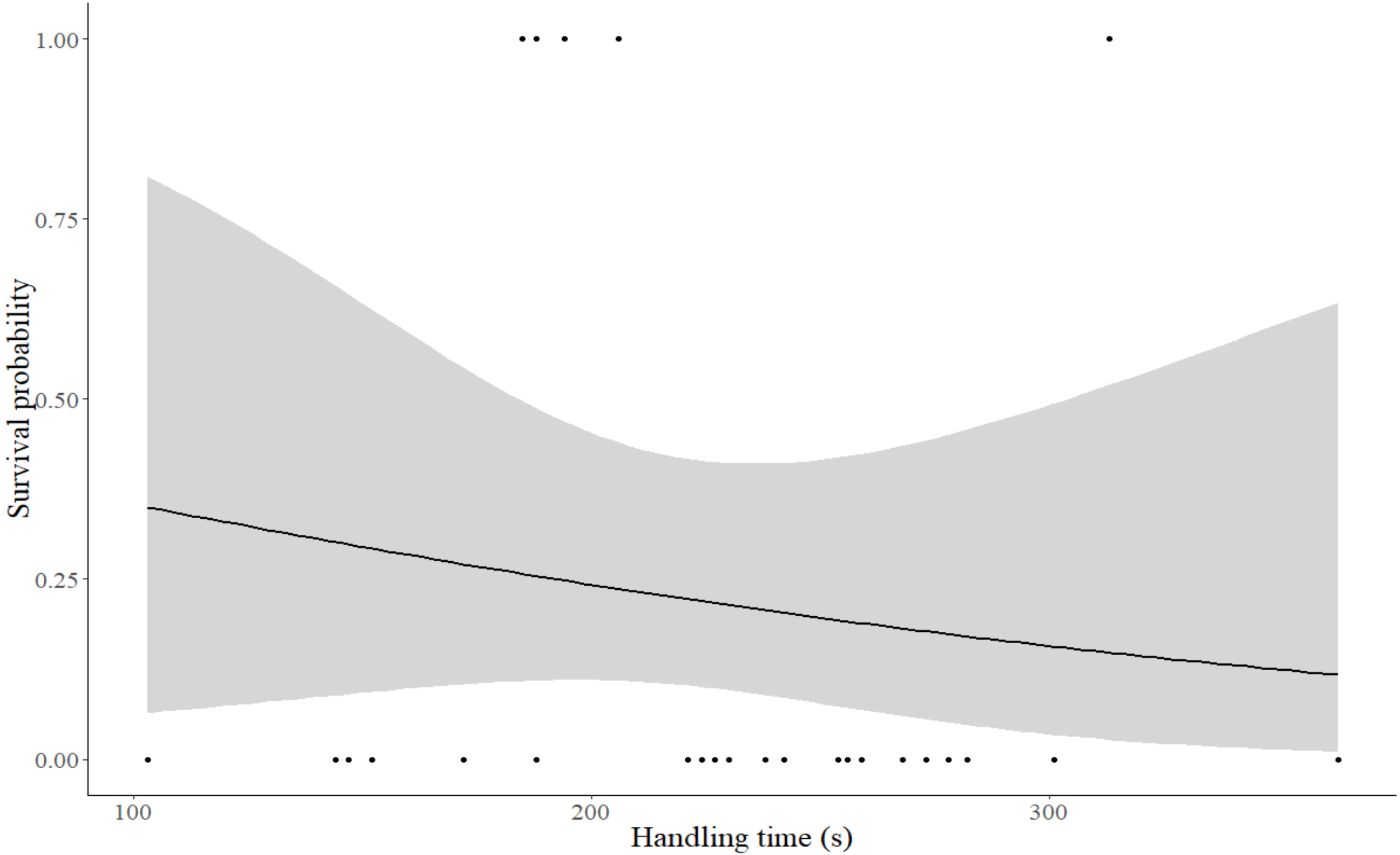

1.00
0.75
0.50
0.25
0.00
Survival probability
80
100
120
140
Length (mm)


Length (mm)
150
140
130
120
110
100
90
80
ns
ns
<0.05
1
2
3
4
5
6
7
Day of Mortality


Meta-lifestage Probability
1.0
0.8
0.6
0.4
0.2
0.0
40
50
60
70
80
90
100
110
120
130
140
150
160
Total Length (mm)


1.00
0.75
0.50
0.25
0.00
Survival probability
100
200
300
Handling time (s)