

WHAT'S IN A NUMBER?

RIVER HERRING NETWORK ANNUAL MEETING

THURSDAY NOVEMBER, 2, 2017

BEN GAHAGAN, MASSACHUSETTS DIVISION OF MARINE
FISHERIES

Marine Fisheries
Commonwealth of Massachusetts



2019 River Herring Counts

Location	River Herring Count (as of 5/24/2019)	2018 Total Count
Acushnet	14,895	6,354
Essex	9,100*	28,260
Herring Brook Pembroke	482,634	348,634
Herring River Harwich	1,099,030	864,748
Monument River	500,741	316,618
Stony Brook	330,487	131,851
Weymouth-Back River	285,000	333,209

*Concluded for the season

WHY COUNT?

- Local knowledge, participation, stewardship
- Harvest (largely in past in MA)
- State and coast-wide management
 - Higher data quality threshold that demands counts that are more accurate* than visual extrapolations and typically 10 years in length



VISUAL COUNTS

- Visual counts are an appropriate index for local knowledge, limited management, and wonderful tools for community outreach and stewardship.
- Visual methods, even those based on Rideout or Nelson, are statistical extrapolations of a limited number of observations.
 - Mostly limited to daylight hours
 - Data on diel migratory timing essential, but often not available
- Interstate management requires high accuracy, high quality, and long time series



VISUAL COUNTS

ADVANTAGES

- Informs the public and increases awareness and stewardship
- Relatively cheap to organize and run
- Adaptable to runs of all sizes
- Appears to provide reliable estimates of population trends

DISADVANTAGES

- Need to assemble and train volunteers
- Volunteers are not always dependable
 - Lack of control by organizer
 - Burnout
- Accuracy/precision of counts affected by weather conditions, water conditions, volume of passage, effort, statistical design, etc. leads to unreliable population estimates

SR-1601 ELECTRONIC RESISTIVITY COUNTER

ADVANTAGES

- Real time count
- 24-hr count
- Adaptable to runs of all sizes
- Low power requirements
- Not affected by turbidity
- Good for outreach
- Low long term costs



DISADVANTAGES

- Cannot determine fish species
 - Good for rivers dominated by river herring without larger fish of concern
- Moderate initial cost (12-15k)
- Sensitive to fluctuations in conductivity and flow
- Can bottleneck migrations if not properly installed and maintained or under high volumes of passage

VIDEO

ADVANTAGES

- 24 hr count (using IR light)
- Can speciate many fish
- Can operate in presence of all species
- Great for outreach
- Should not bottleneck migrations

DISADVANTAGES

- Count 'lag'
- High investment in processing video to produce a count (100s of hours)*
- High power demands
- Sensitive to turbidity
- Difficult to count fish during periods of high passage volume
- Very time consuming to produce high confidence estimate of run size for migrations greater than 100,000 fish*

*Considering current state of technology and study.

Both problems being examined.



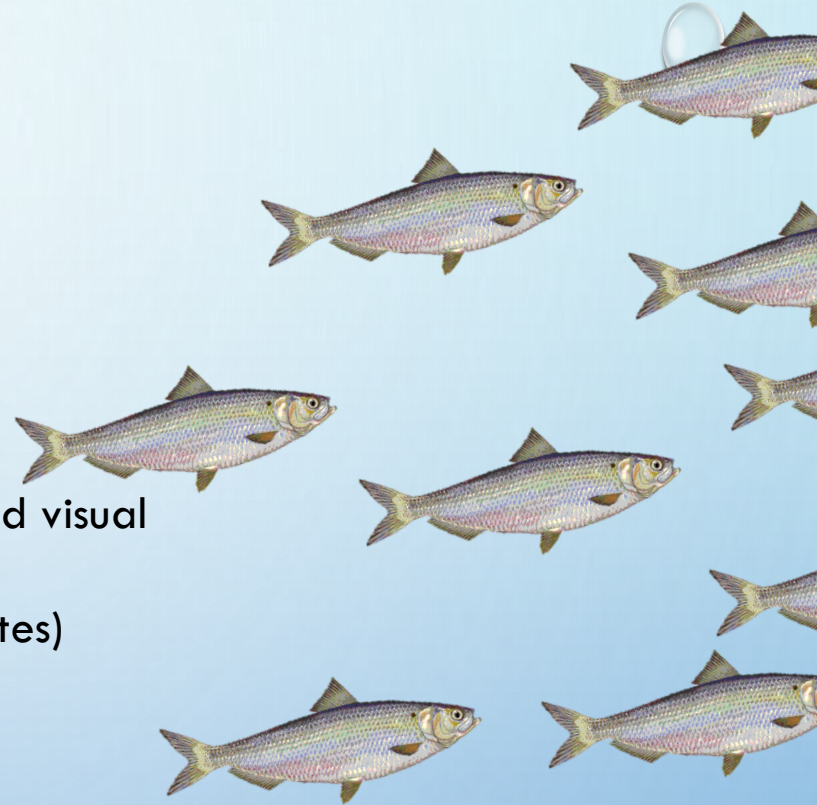
A BEST OPTION?

- THERE IS NO PERFECT COUNT!
 - All methods will have sources of error and their own unique difficulties
- Comparisons between methods are sparse
- Video and ERC thought to be higher accuracy, but not yet thoroughly examined



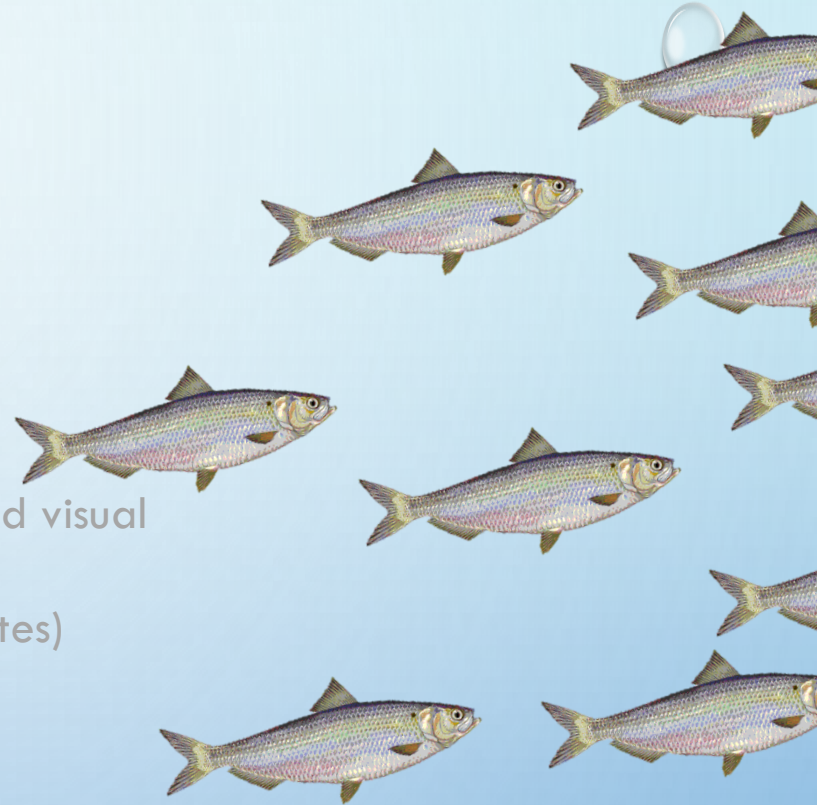
TAKING STOCK

- Parker River (Byfield)
 - 2014-2019: Video and visual
- Ipswich River (Ipswich)
 - 2016-2019: Video and visual
- Mystic River (Medford)
 - 2017-2019: Video (Modeled results) and visual
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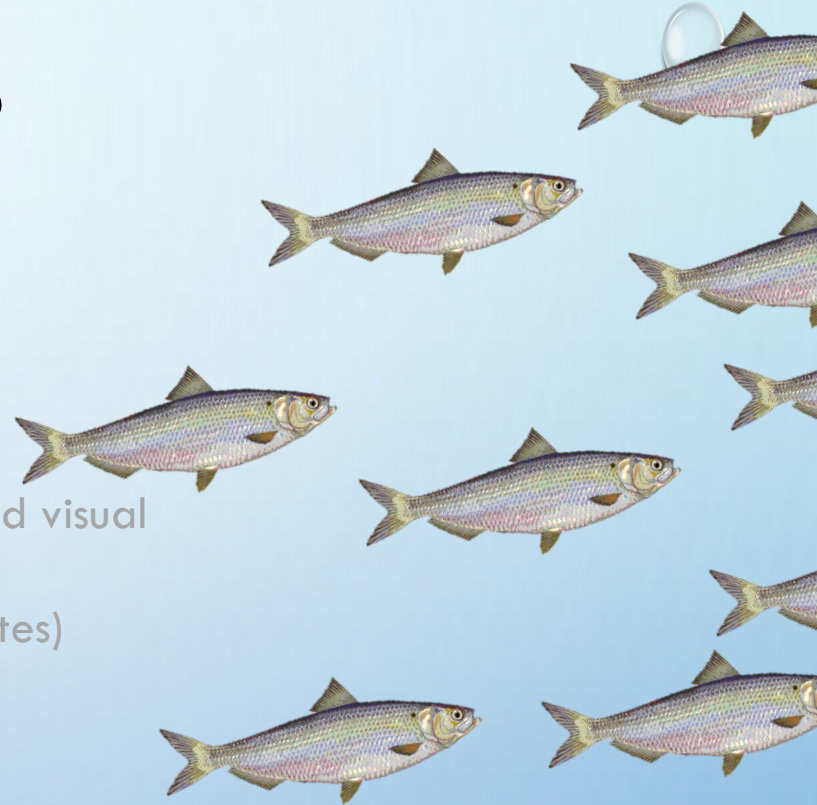
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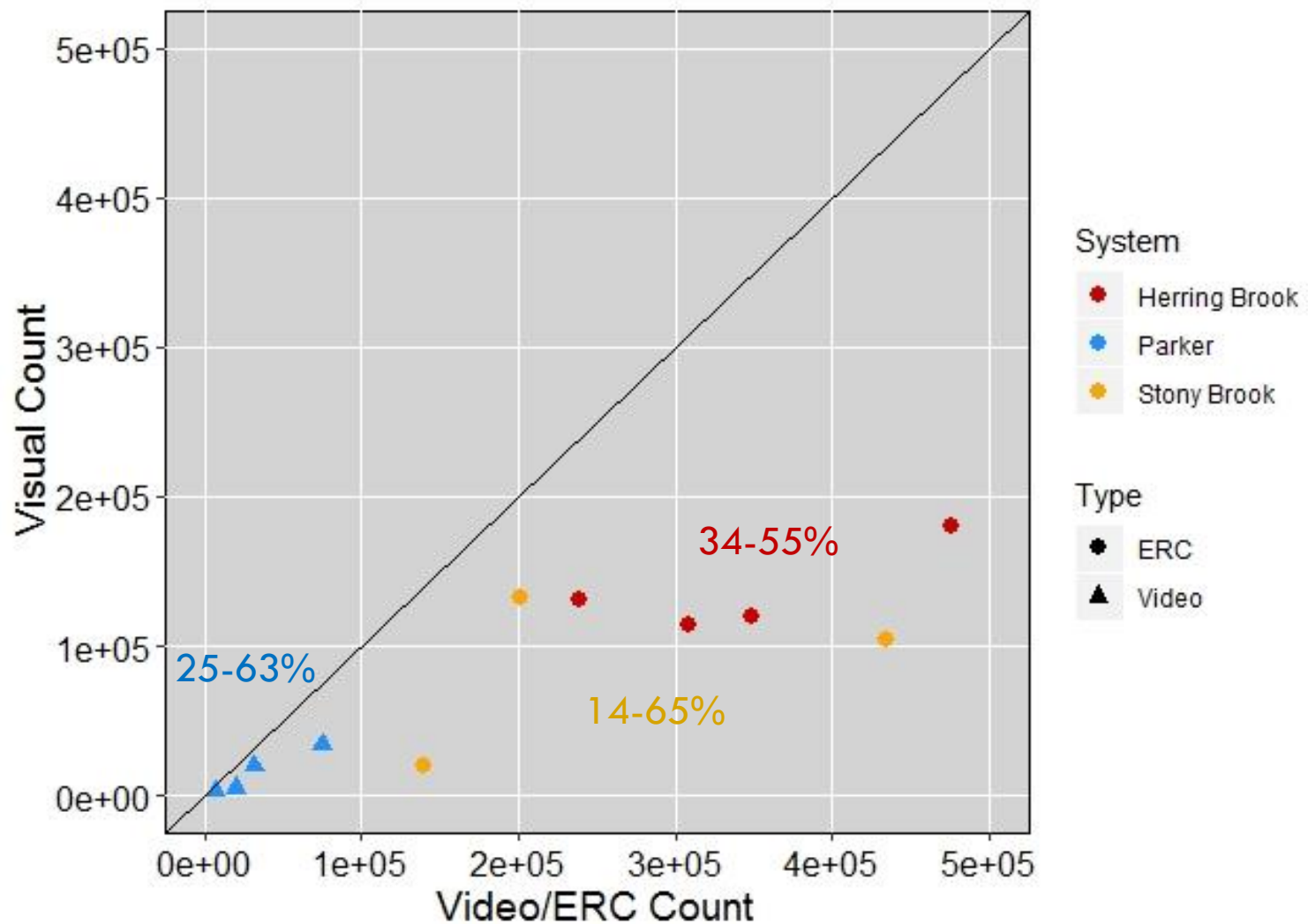


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ANNUAL COMPARISON



Recommendations to Community Groups

A.

20 min interval

How Many Time Intervals Should Be Sampled?

The number of time units that have to be sampled will depend upon the desired level of precision for the total run size. A prior estimate of mean number of fish passing per time units and associated sample variance either for the whole run (for SRS) or for a number of days (for St1WRS, St2WRS, StSYS, or St2STRS) is needed before sample size can be determined. Initial guesses of the estimates can be obtained from scientific papers that have conducted similar studies or from a preliminary study.

Hour

1 2 3

0700
00
00

■		

Sampling

Three deficiencies that seriously affect the accuracy and precision of run size estimates were identified in a review of efforts made by several watershed groups; these were 1) low sample sizes, 2) patterned sampling, and 3) interpolation of daily counts for missing days. Often, volunteers

Per

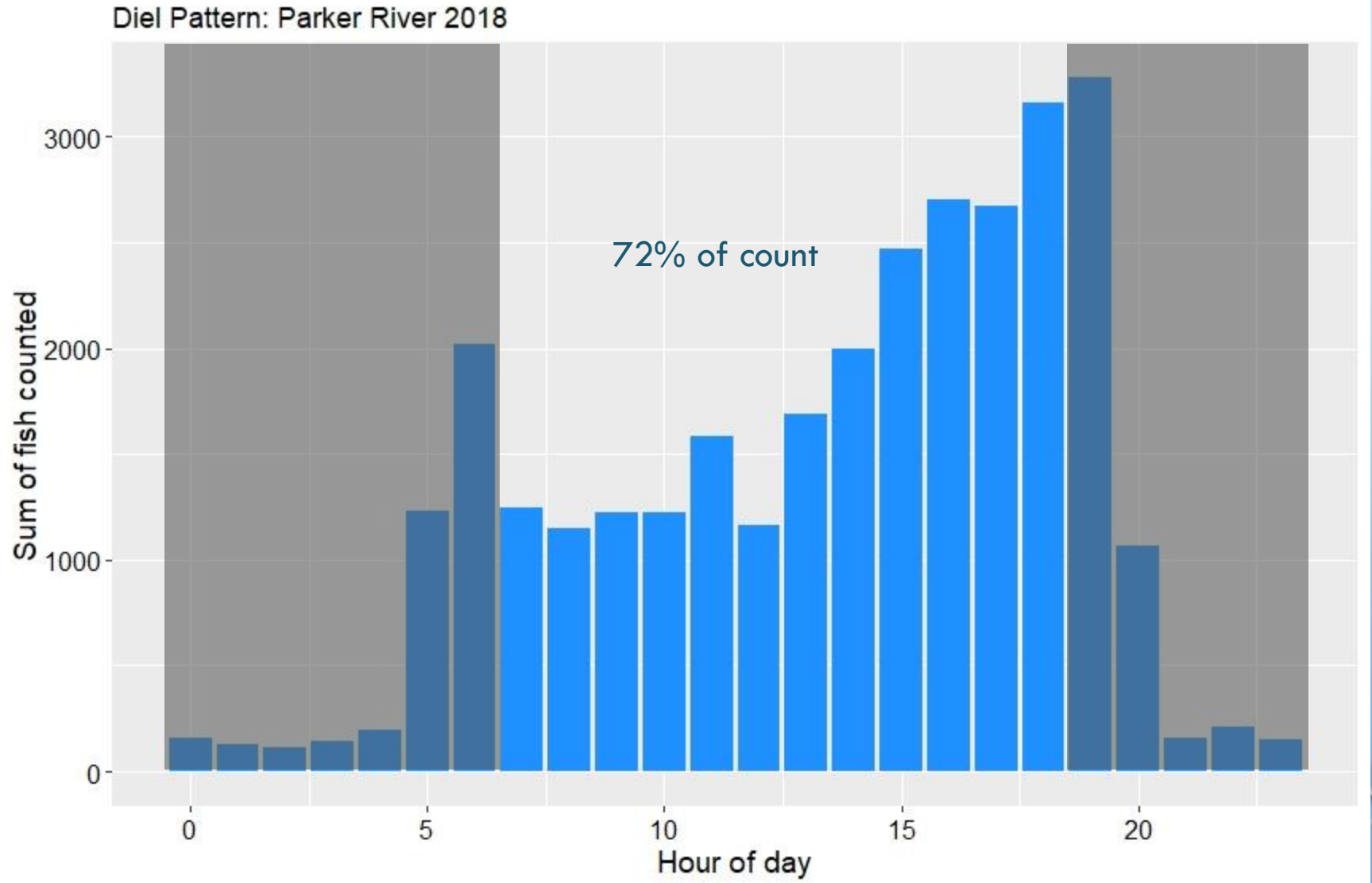
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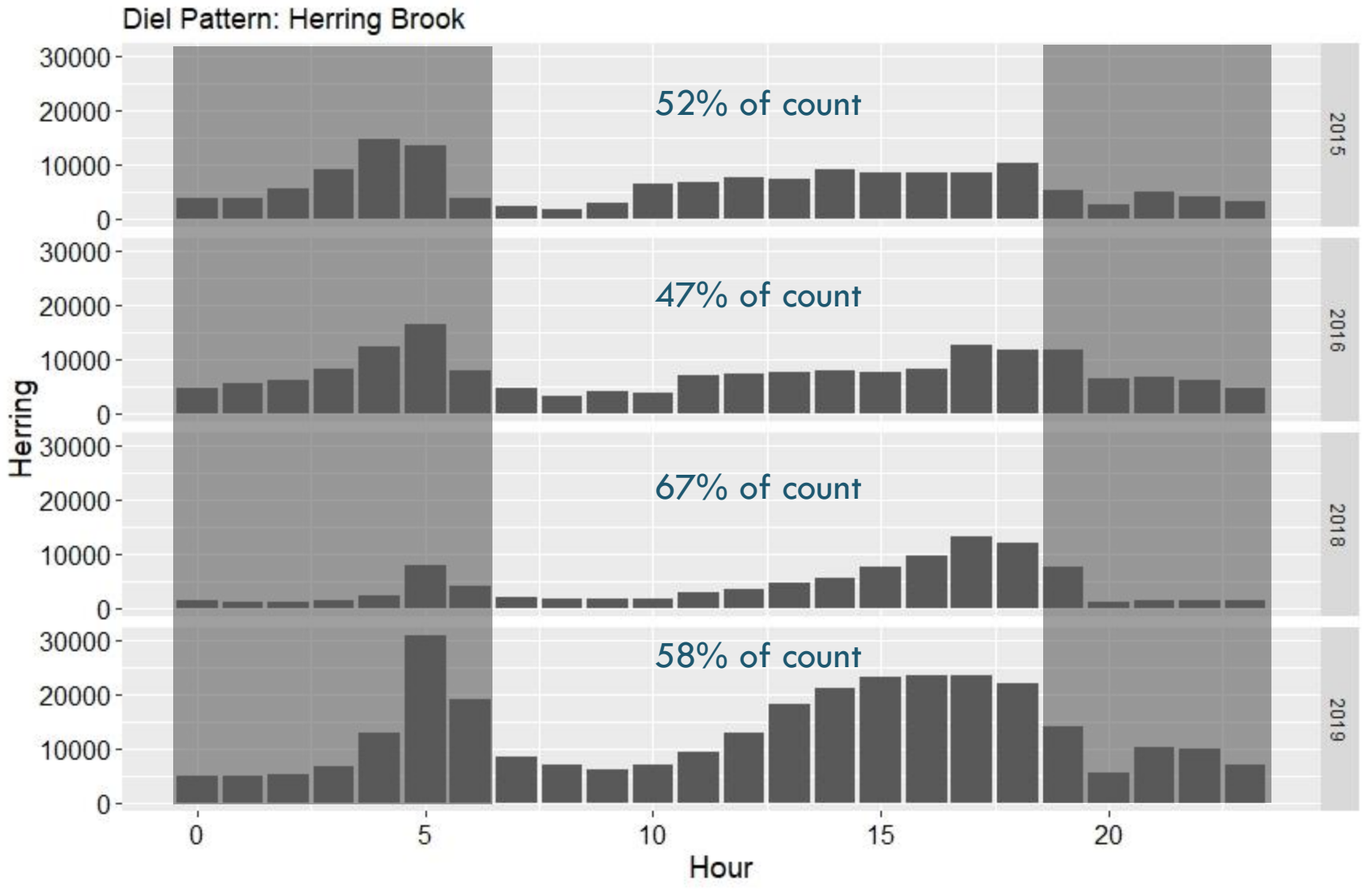
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initiated correctly and it will ultimately produce biased estimates.

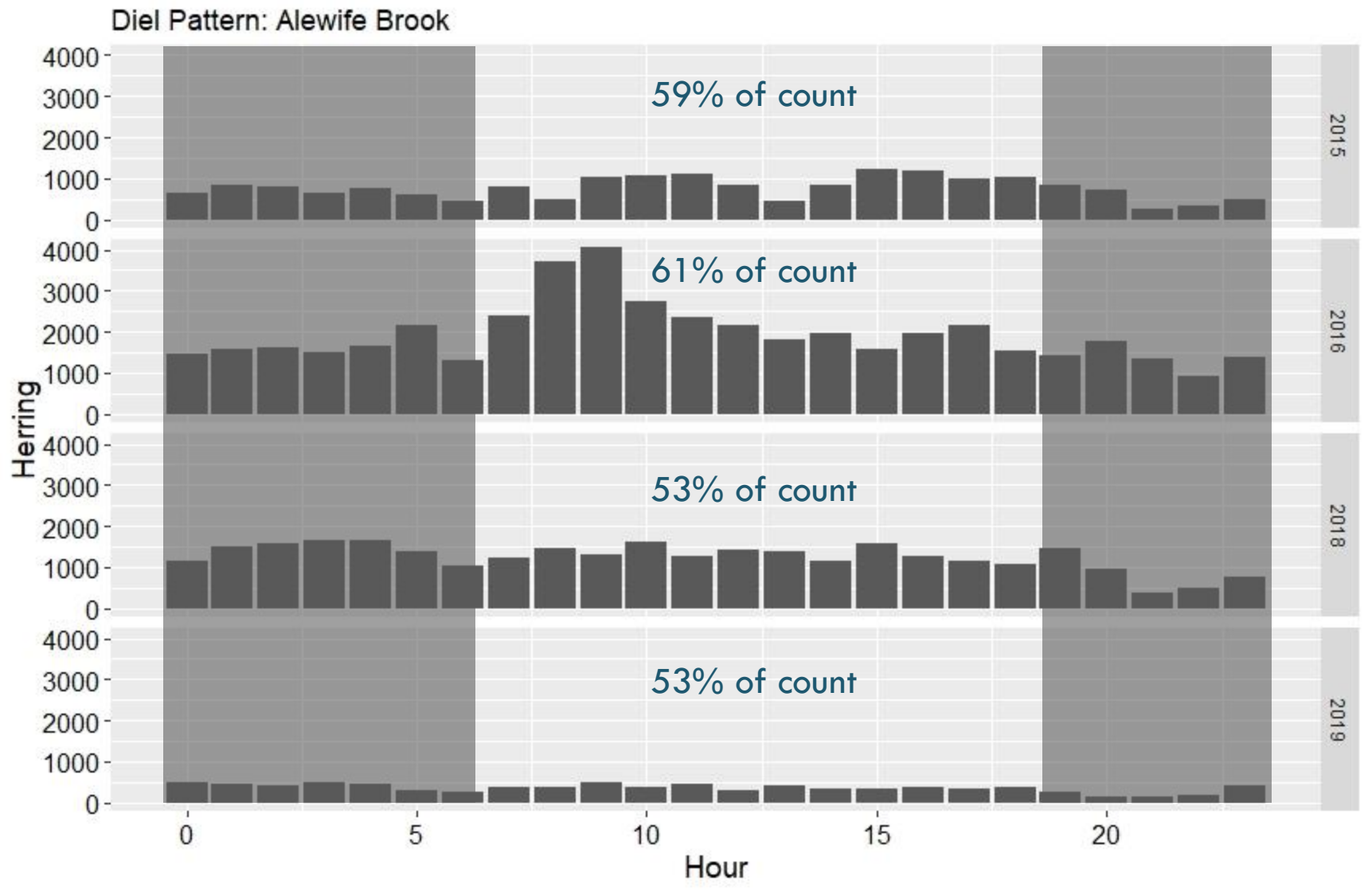
DIEL PATTERNS: PARKER



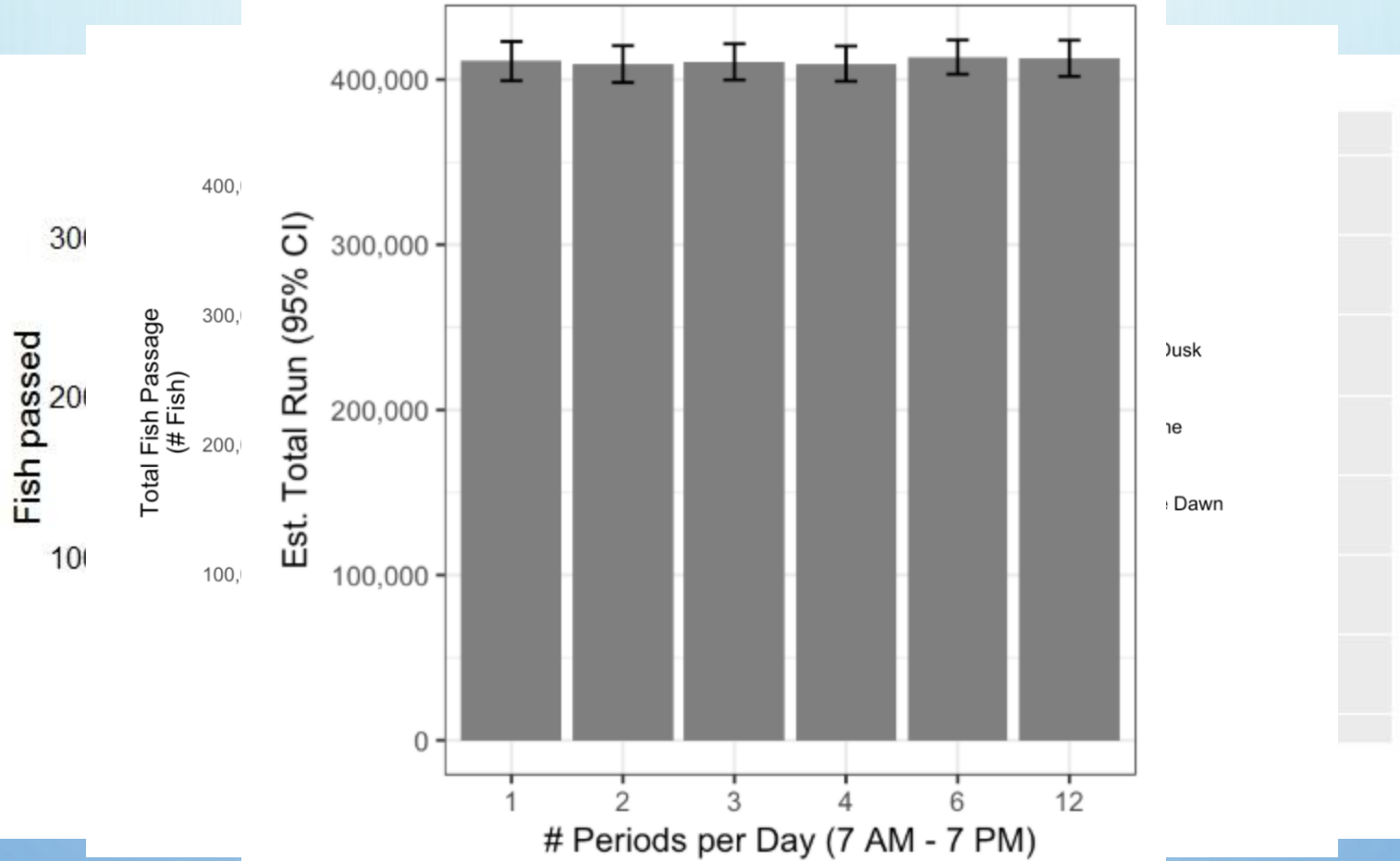
DIEL PATTERNS: HERRING BROOK



DIEL PATTERNS: ESSEX



CHARLES AND MYSTIC



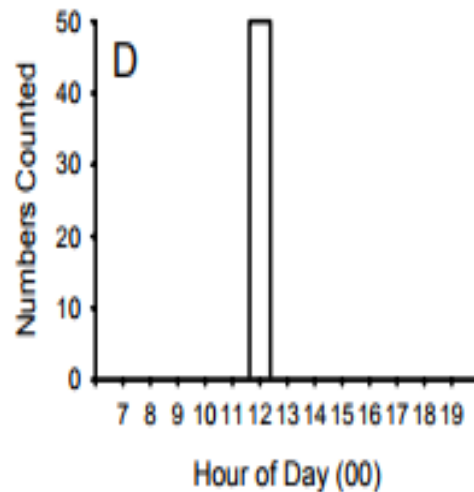
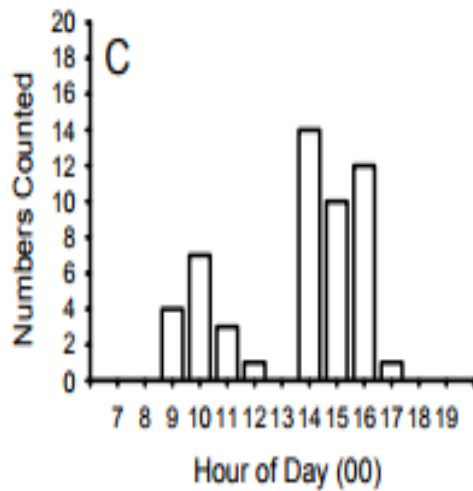
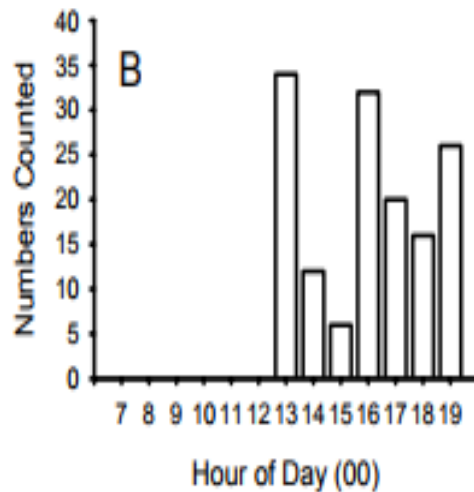
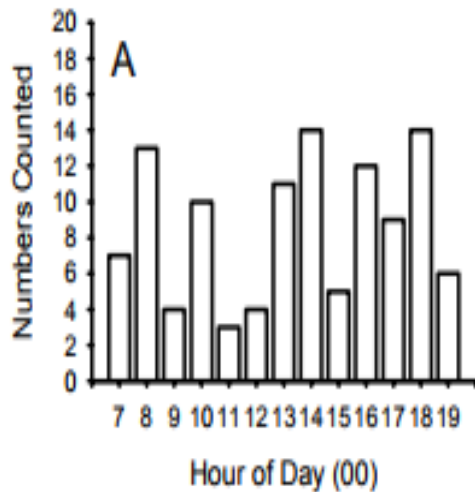


Figure 2. Hypothetical daily herring counts demonstrating possible hourly patterns in migration: A) no pattern, B) afternoon migration, C) bimodal migration, and D) single-hour migration

Recommendations to Community Groups

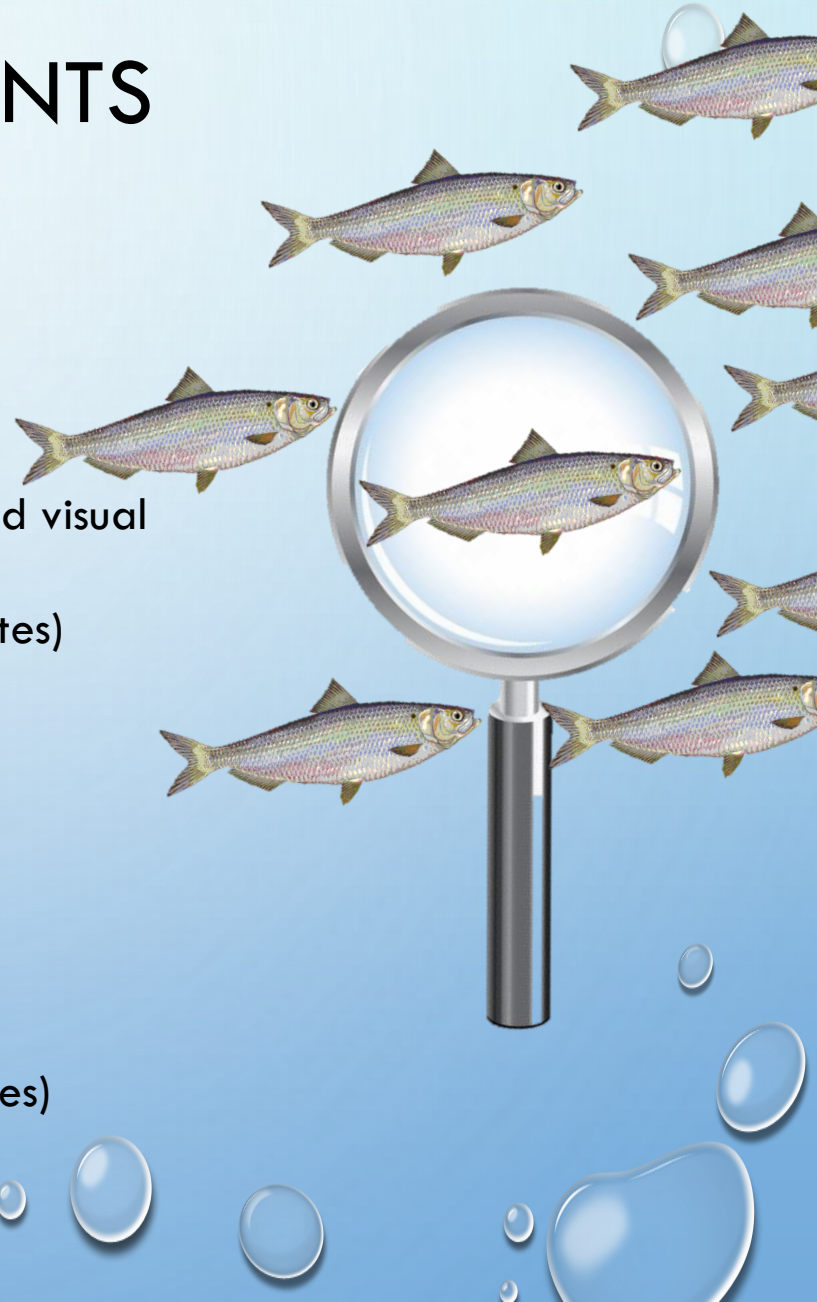
There are many choices of statistical designs offered in this document to suit each program and volunteer behavior. However, it may be difficult deciding which design and level of counting are right for your group. At the herring counting workshop held at the Massachusetts Division of Marine Fisheries' Annisquam River Field Station on February 2, 2005, it was recommended that counting groups use the two-way stratified random sampling design to help overcome problems discussed earlier and to produce reasonably accurate and precise estimates of run size. The detailed recommendations are below:

<u>Counting Season:</u>	April 1st to mid-June.
<u>Counting Day:</u>	7 am to 7 pm (12 hrs.)
<u>Counting Periods:</u>	7-11 am, 11-3 pm, and 3-7 pm.
<u>Counting Interval:</u>	10 minutes.
<u>Counting Coverage:</u>	3 counts per period

There is no need to strictly coordinate the arrival times of volunteers by picking random intervals each day and then assigning each to a volunteer. As long as they arrive in somewhat of a random fashion and effort occurs in each period, the estimate should be reasonably accurate. What volunteers should avoid is setting arrivals at the same time each day. This would produce a systematic-like sampling design that has not been formulated correctly and it will ultimately produce biased estimates.

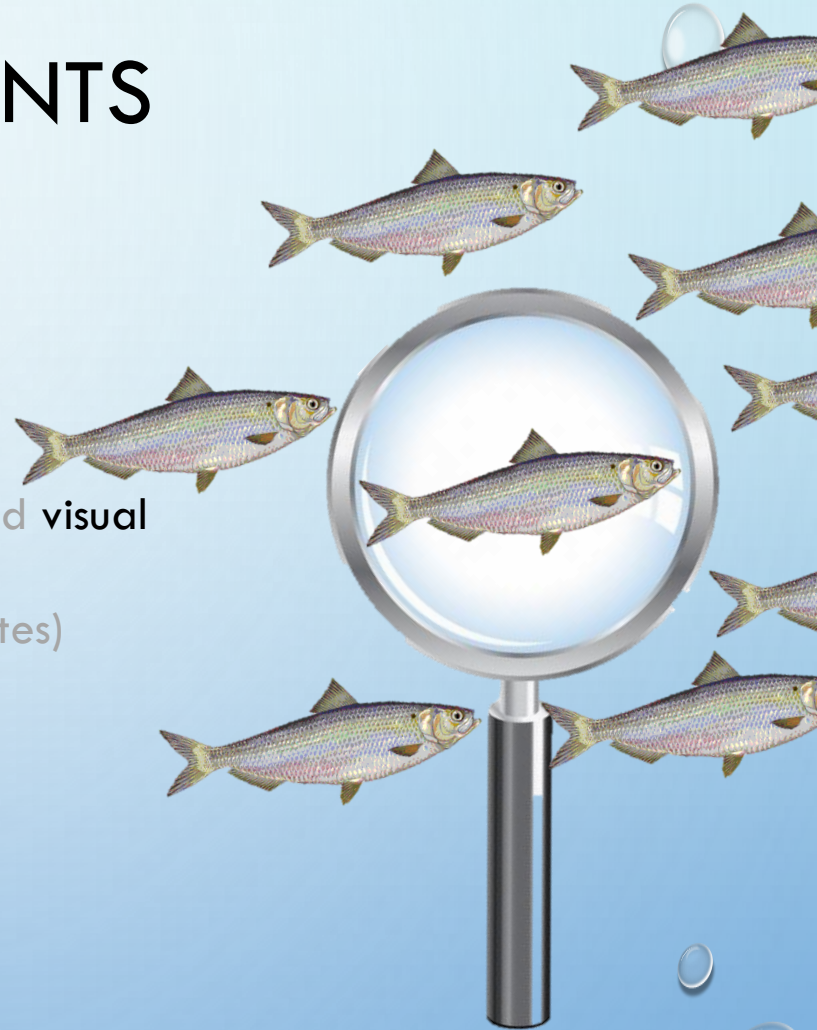
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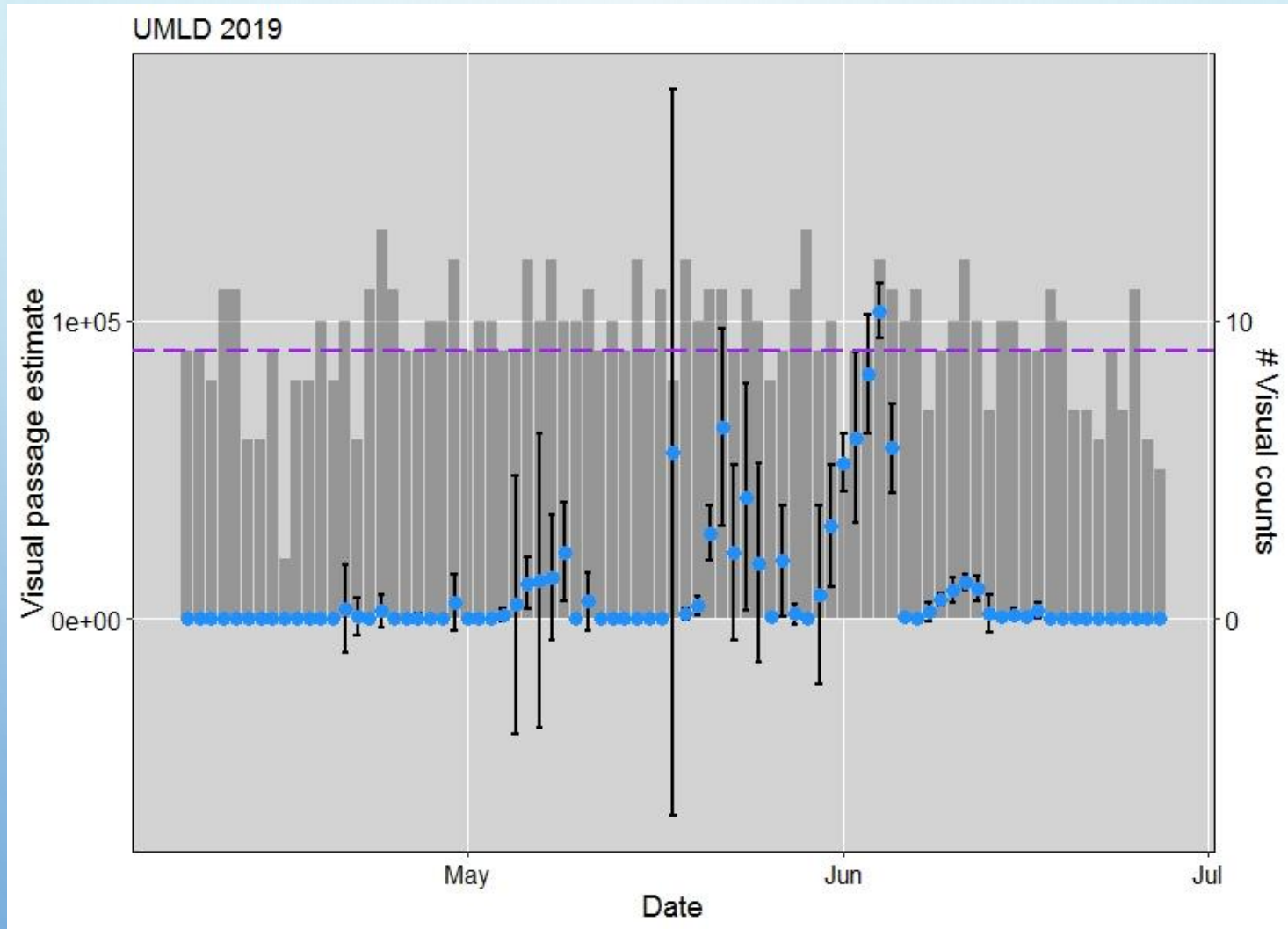


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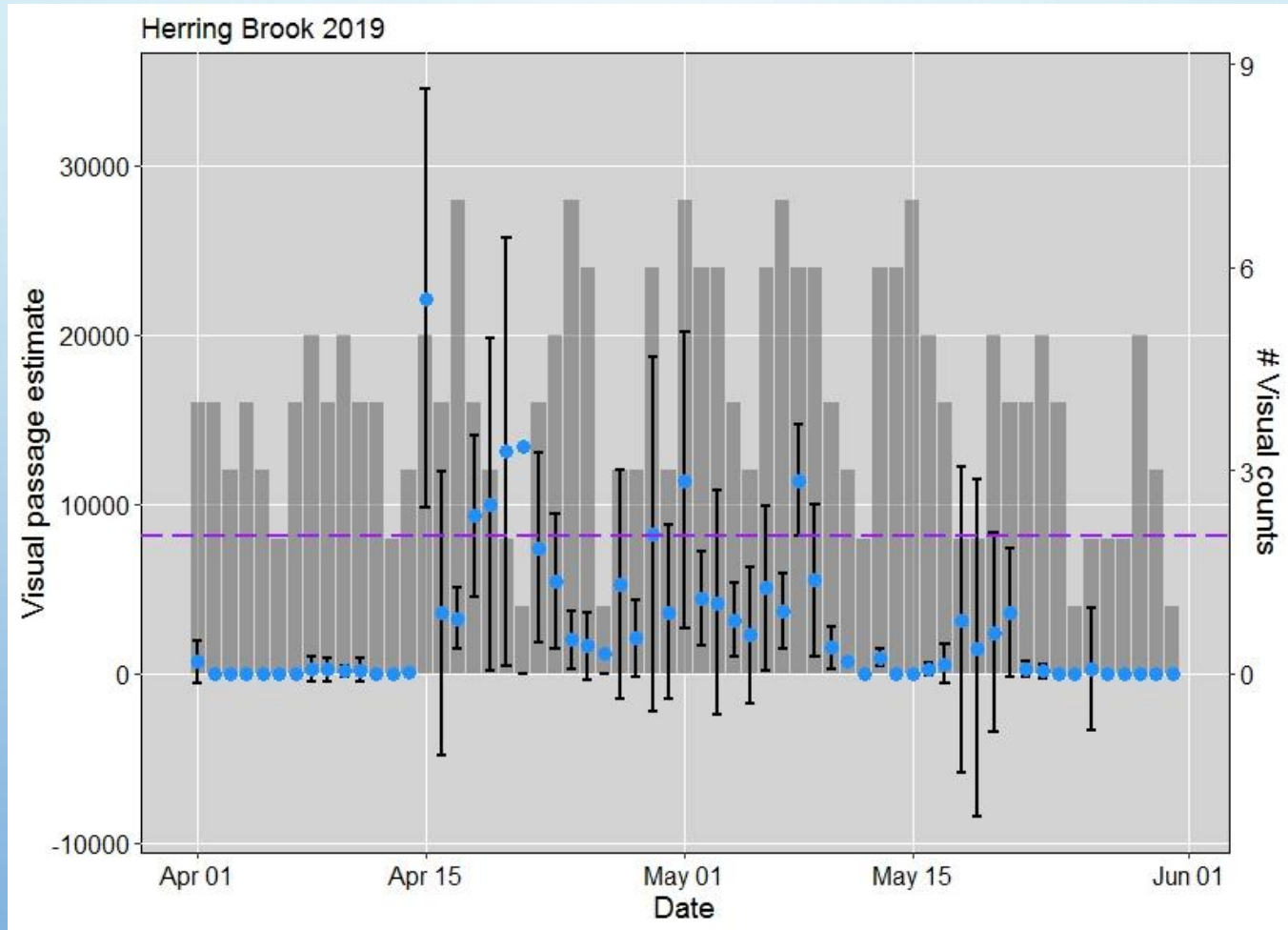


VISUAL COUNT ESTIMATES



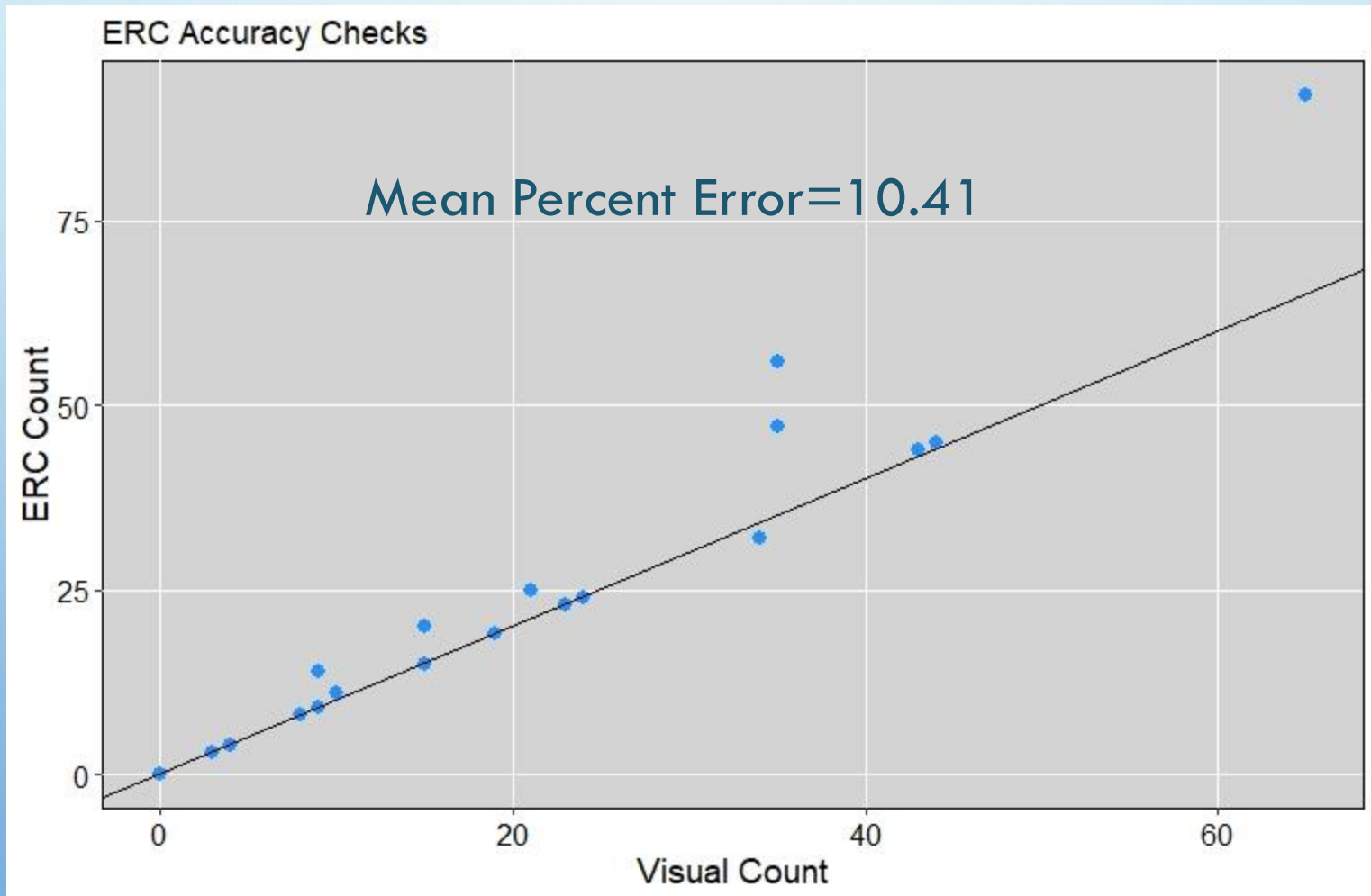
St2WRS, 3
counts per
period, 3
periods

VISUAL COUNT ESTIMATES

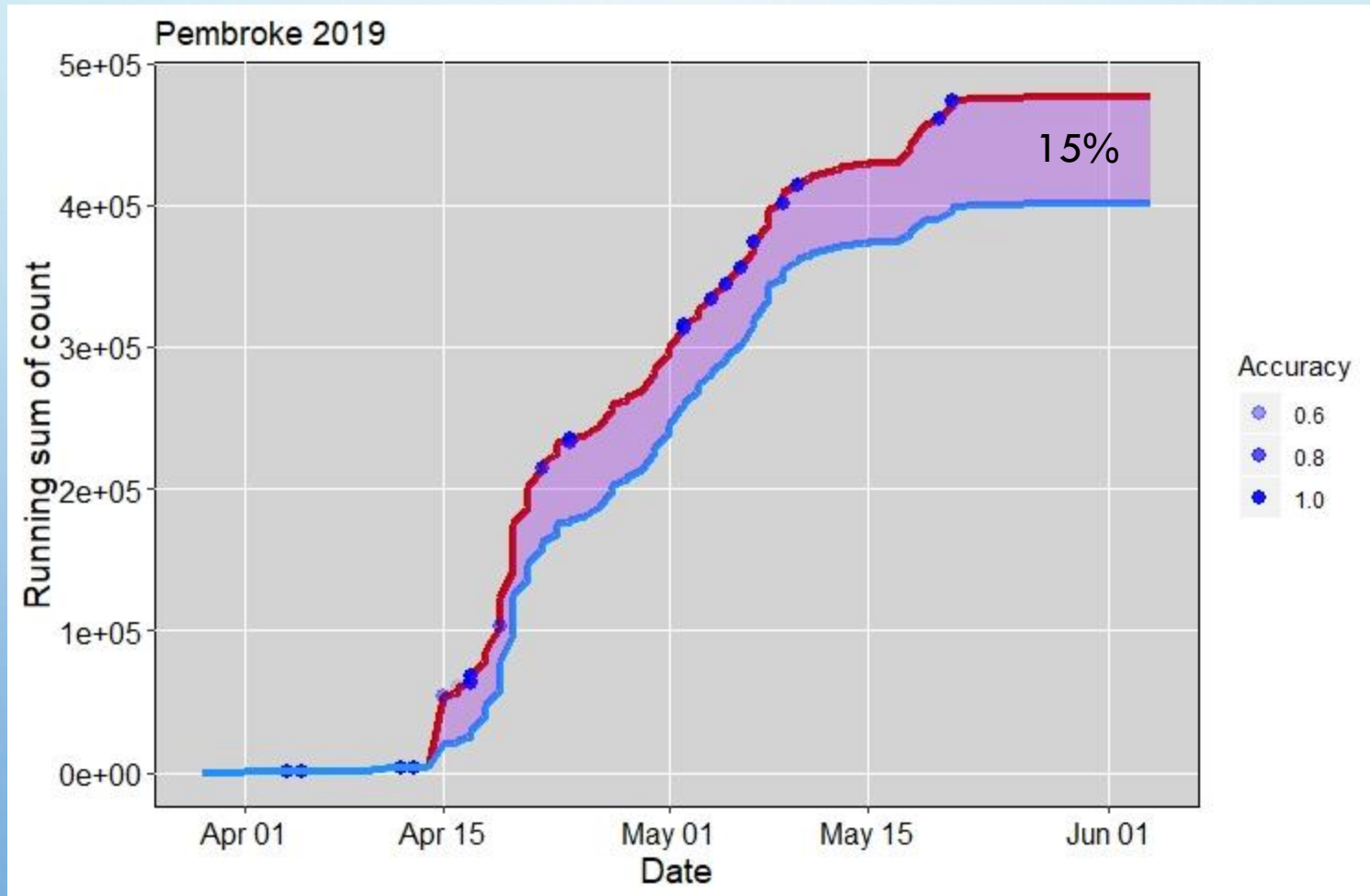


St 1 WRS, 2
counts per
period
(day)

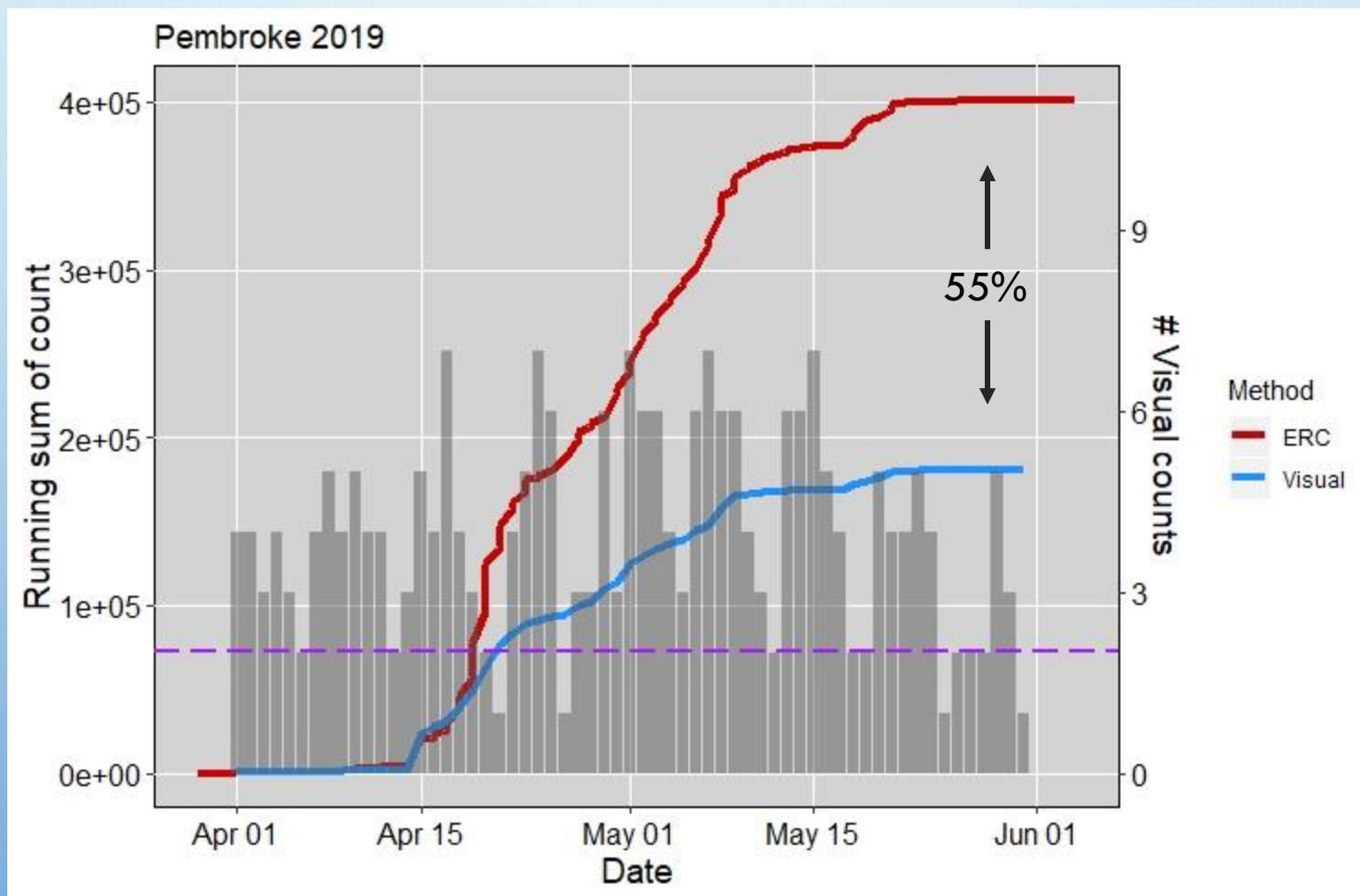
ELECTRONIC COUNTER ACCURACY



TRANSLATES TO:



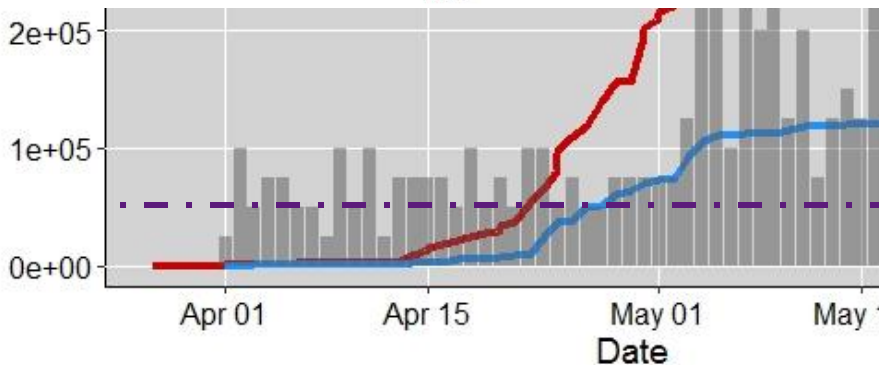
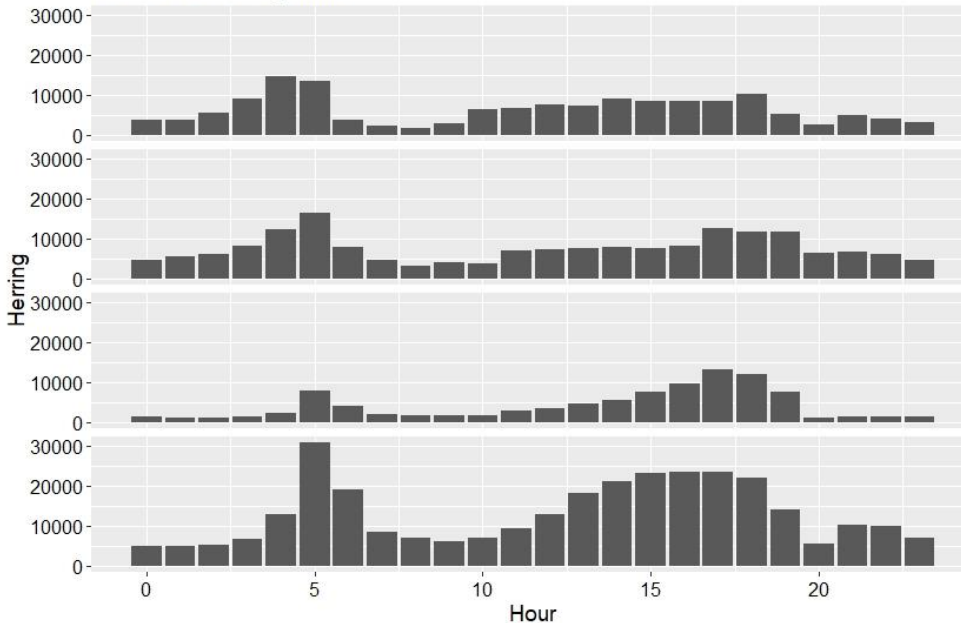
ERC TO VISUAL COMPARISON



PREVIOUS YEAR

Pembroke

Diel Pattern: Herring Brook



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CLOSING THOUGHTS

- DMF should improve “high accuracy” counting methods
 - Issues surrounding this are much the same as visual, i.e. undersampling, lack of design for accuracy
- Visual counts appear to mostly underestimate passage relative to video and ERC
 - Diel patterns are important!
 - Off hour passage
 - Sampling design: 1 vs 2 way, # periods
 - Sampling effort
- Visual counts likely achieve important purposes:
 - Detect trends
 - Yield ballpark estimates of run size
 - Increase stewardship of resources and habitats



ACKNOWLEDGEMENTS

All the visual counters, commissioners, and wardens who care enough to devote their time and energy!

John Sheppard, Andy Hrycyna, Dr. Jeff Walker, Dr. Rob Stevenson, all my seasonal technicians

.....and Lucy!

