Operation of DIDSON: Sub-Sampling

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Two Approaches to Estimating Escapement Using a DIDSON

- Escapement estimates:
  - Total census.
  - Sub-sampling.

Total Census or Sub-sample?

- Decision will be influenced by expected run size.
- Estimation error from sub-sample:
  - Error can be estimated in larger populations.
  - Realistically, it may not be possible to estimate error in small populations.
  - Small observational errors in estimating escapement in small populations may be unacceptable.

Sub-Sample of Larger Populations

- Temptation is to conduct a total census.
  - However a total census is not practical and is not the best use of staff time.
- Sub-sampling temporally allows for:
  - An estimate of escapement.
  - Calculation of confidence intervals on the escapement estimate.
  - Evaluation of sub-sample size (number of minutes).

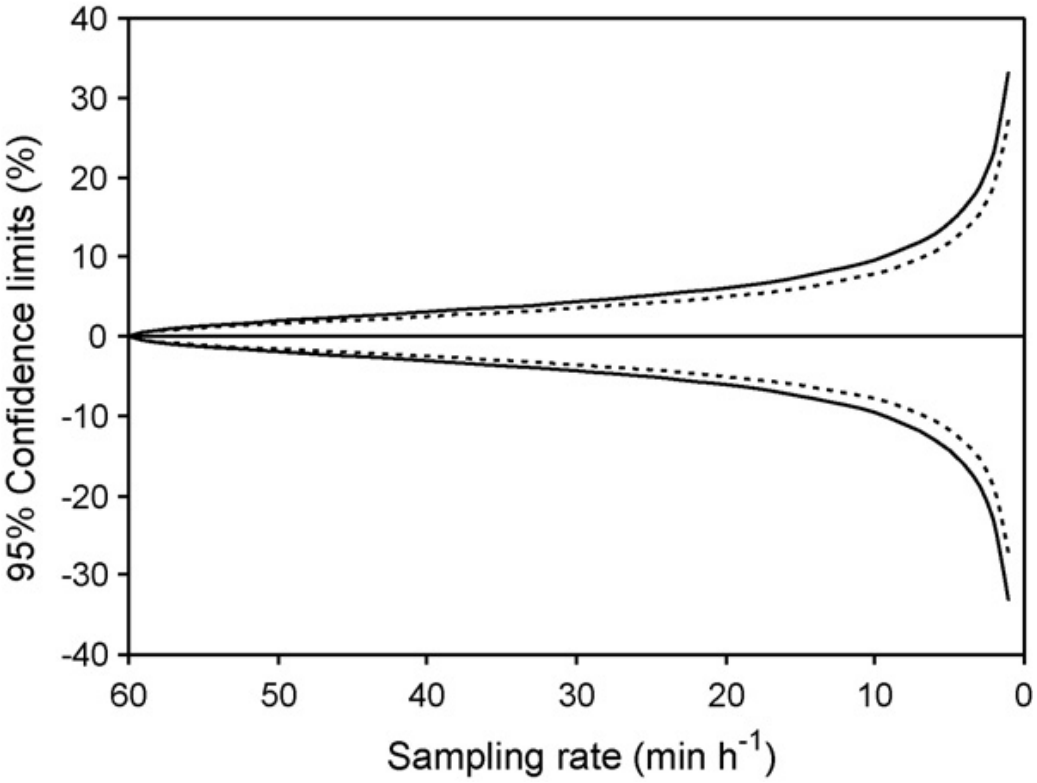
Sub-Sample of Larger Populations

- Assumptions in sub-sampling:
  - There is no “fine scale” variation in fish migration, fine scale being < 1 hour.
  - Counts are not biased by undetected fish. Undetected fish being those moving behind obstructions, beyond the range of DIDSON detections, etc.

DIDSON Sampling Effort

Confidence intervals for total fish passage estimates with different sampling rates. Solid curves are based on 1st 10 min count, dotted curves are based on 2nd 10 min count.

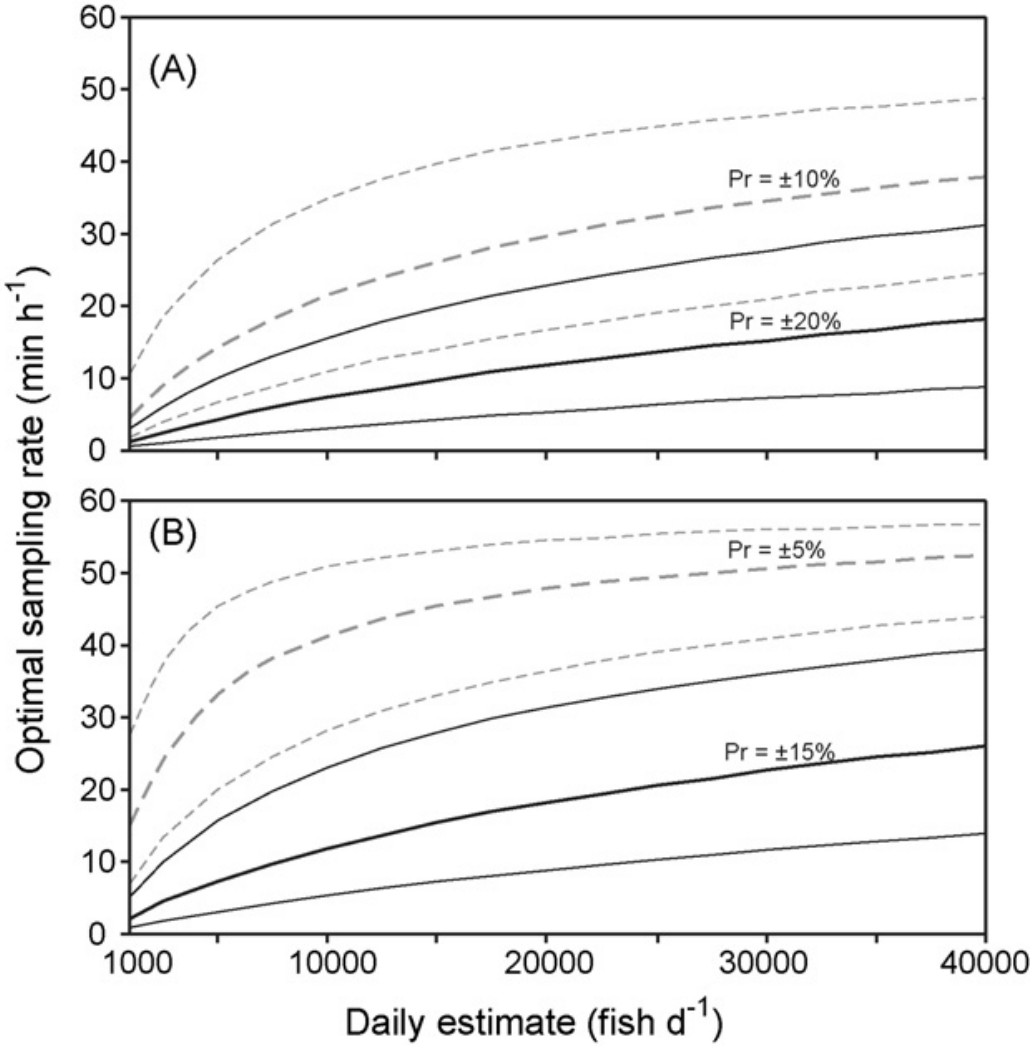
Lilja et al. (2008). Fisheries Research 90:118-127.



DIDSON Sampling Effort

Optimized sampling rate
at four levels of precision.
Values plotted are medians,
+ 95% confidence intervals.

Lilja et al. (2008). Fisheries
Research 90:118-127.



Net Upstream Migration or Flux of Salmon

$$F = U - D$$

Where: F = net upstream flux of fish
U = upstream detections
D = downstream detections

Expanding Net Upstream Flux

$$F_{xi} = \left[6_{x1}, 6_{x2}, 6_{x3}, \ldots, 6_{xN}\right]$$

Where: N = total number of 1-hour sample periods, and
x_i = the net upstream fluxes of fish during 10 minute sampling periods.

Variance of Total Fish Passage Estimate (F_{hat}), or Flux Upstream

$$v(\hat{F}_{xi}) = \frac{N^2 s_z^2}{n_z}(1 - f)$$

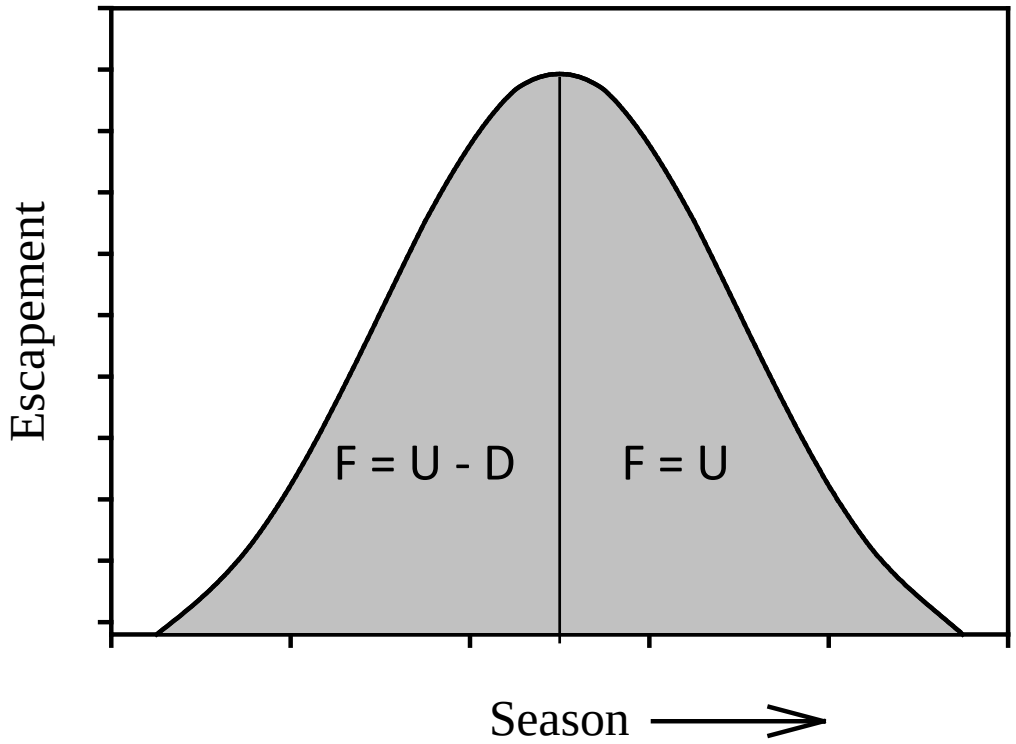
Where: N = total number of 1-hour sample periods,
n_z is the total time sampled in hours (sum of subsamples),
f = the sample fraction (n_z/N) and
s^2_z = the sample variance of the F_{xi} count.

Variance of the Flux Estimator

$$s_z^2 = \sum_{i=5}^{N} \left(\frac{F_{xi}/2 - F_{xi-1} + F_{xi-2} - F_{xi-3} + F_{xi-4}/2}{3.5(N-4)} \right)^2$$

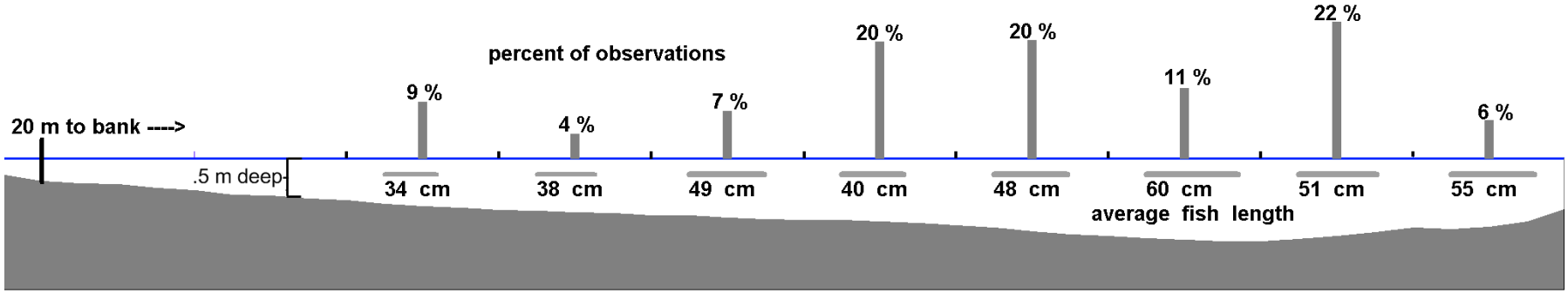
Where: s^2_z = the sample variance of the F_{xi} count.
N = total number of 1-hour sample periods,
Fxi = the estimated net upstream flux of fish during hour i based on the subsample (10 or 20 minutes).

Net Upstream Migration or Flux of Steelhead



DIDSON

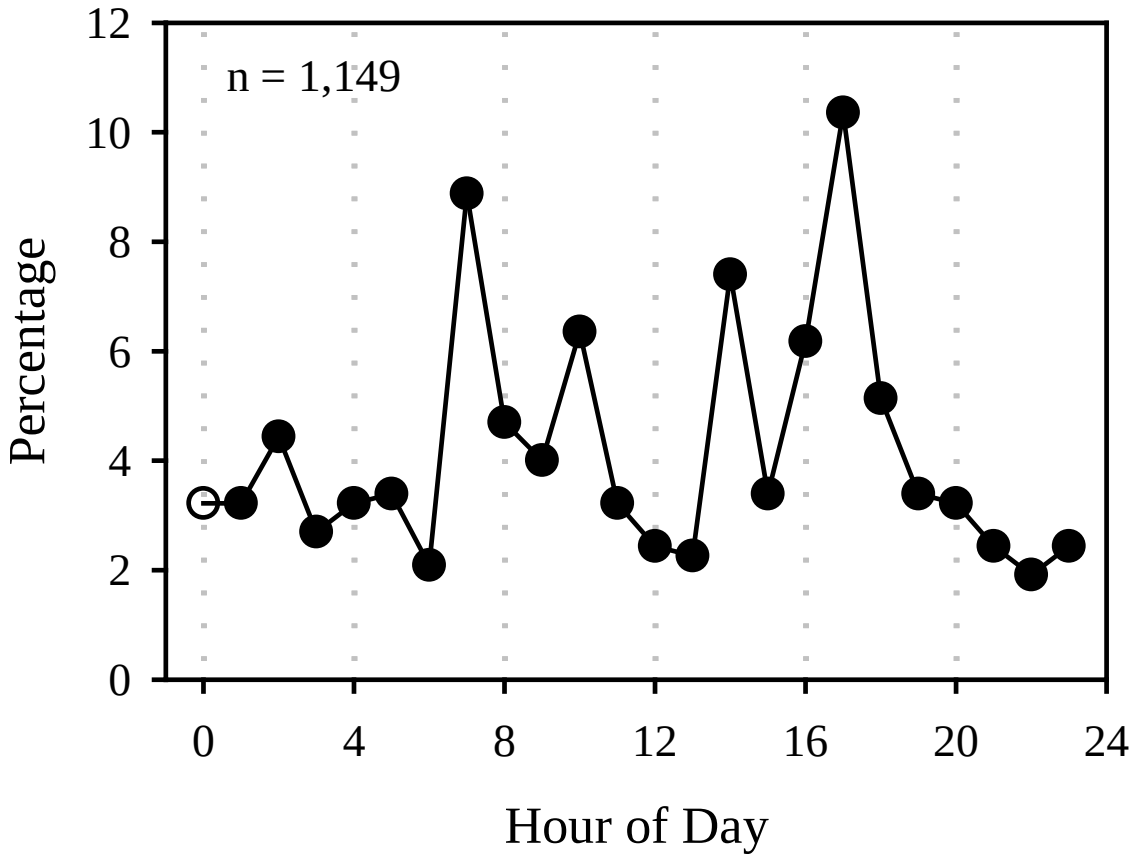
Cross Section of Redwood Creek DIDSON Site and Occurences of Fish (below 500 cfs)



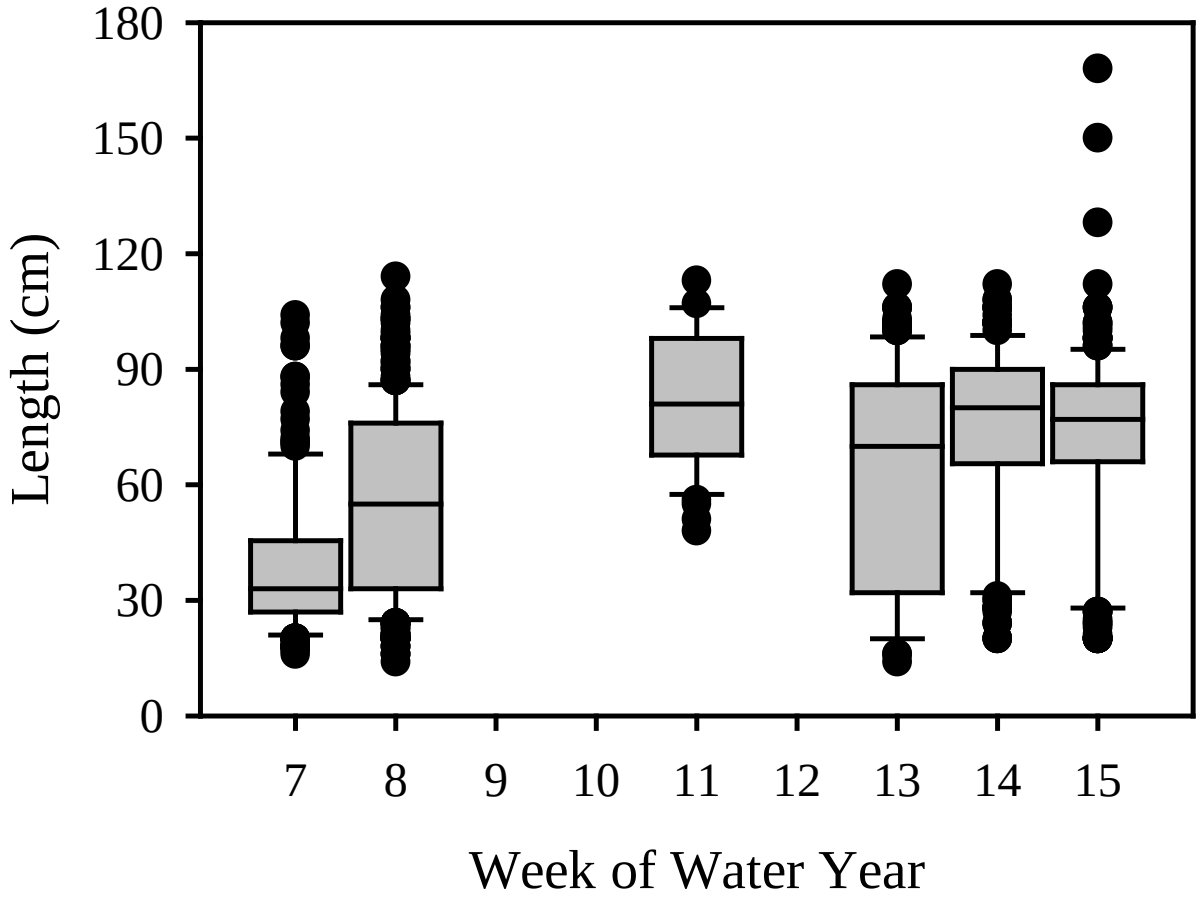
<----- East

West ----->

Temporal Migration in Redwood Creek, Nov. 2009 – Jan. 2010



Size of Fish Migrating in Redwood Creek during Nov. 17 – Jan. 14.



Discussion and Questions