Nested frequency analysis as an alternative processing method for settlement plates

Current method:

* Plate photo
  + Meant to be done in the field, on **ALL** plates
  + Visual record to go back to
  + Often not great (lighting issues, canopy species hide everything anyways, not truly nadir)
* Simple visual scan for well-known AIS
  + Meant to be done in the field on **ALL** plates
  + Non-destructive
  + Some of the species on the scan sheet make no sense (not actually species, and can’t be ID’d in the field anyways)
  + Presence data
* Point-intercept count
  + 49 gridded points (+1 random), everything at point identified including cover/canopy and order recorded (primary, secondary, etc).
  + Done on random 50% of plates
  + Will detect AIS not observed on scan
  + “abundance” data
  + Destructive

Proposed method:

* Plate photo
  + Done in the lab with proper lighting, true nadir
  + Canopy removed (usually hydroids), noted on species ‘list’ below
  + **ALL** plates
* Nested frequency analysis of photo (using SampleFreq)
  + Prior to destruction of plate when possible
  + Requires a predetermined species list (up to 60 sp./taxa)
  + “abundance” data
  + **ALL** plates
* Species list (maybe?)
  + Pick apart the plate and note all species/taxa seen and VOUCHER anything tricky
  + Presence data
  + **ALL** plates???

DON’T need to demonstrate the validity of Nested Frequency Analysis in general, just its applicability to plates (the point-intercept method is widely used).

Using deployments in Prince Rupert (2 sites) and Vancouver (2 sites) AND MAYBE LADYSMITH to test all 6 methods (although NFA photos should be done for all plates regardless).

**Table 1: pluses and minuses of all methods**

2021 season we need to do a bit of both the current and proposed methods so we can compare:

* Data/accuracy gained
* Data/accuracy lost
* Effort (more or less) NEED AN EFFICIENT WAY TO LOG TIME TAKEN PER TASK

Also refer to this [doc](Summary%20of%20main%20questions%20being%20asked%20in%20comparing%20plate%20analysis%20methods.docx) (cleaned up version of most stuff below).

**Question 1: Variation**

One big problem is that, to be really useful, NFA has a recommended minimum of 20 plates, per site, to capture variation in frequencies. But we only put out 10 usually (sometimes fewer on a small dock).

*Frequency precision = 100%/n, and thus the method requires large sample sizes, on the order of 20–50 plots, to achieve useful detection precision. For example, 20 plots yields a detection precision of 100%/ 20 = 5%, but changes in frequency < 5% will be undetectable. For ± 1% precision, 100 plots are required.*

* + Really can’t do much to test effect of plate # over time this year, can only assess usefulness for within-year questions
  + Makes sense if research question is about differences across ‘regions’ (e.g. HG vs Salish Sea, or PRPA vs Port of Van.)
  + Can you pool across sites? By treating sites (e.g. marinas) as replicates within ‘region’ are we violating important assumptions of a nested design

*Thus, within the constraints of a balanced, nested design, there are 3 design features that can be adjusted when collecting frequency data: the number of randomly located sites (n), the number of frequency plots per site (m), and the size of each plot (as measured by the mean number of plants per plot, d).*

n = # of sites (e.g. marinas per ‘region’) – not actually random?

m = # of plates

d = quadrat size (always optimized using nesting)

If organisms are quite uniform, then whether we have 10 plates or 50, the animal should still occur at the same frequency, and you might as well just put out 10 plates. So what level of precision is acceptable for our study system?

1. Frequencies are the same, regardless of number of plates

Avg. freq of species/taxa X:

|  |  |  |  |
| --- | --- | --- | --- |
|  | 10 plates | 20 plates | 30 plates |
| Small site | 0.4 +/- 0.1 | 0.4 +/- 0.1 | 0.38 +/- 0.1 |
| Medium site | 0.4 +/- 0.1 | 0.4 +/- 0.1 | 0.38 +/- 0.1 |
| Large site | 0.4 +/- 0.1 | 0.4 +/- 0.1 | 0.38 +/- 0.1 |

1. Frequencies are variable with number of plates
   1. This is because species is heterogeneous, more plates reduces variation

Avg. freq of species/taxa X:

|  |  |  |  |
| --- | --- | --- | --- |
|  | 10 plates | 20 plates | 30 plates |
| Small site | 0.6 +/- 0.3 | 0.55 +/- 0.2 | 0.52 +/- 0.1 |
| Medium site | 0.6 +/- 0.3 | 0.55 +/- 0.2 | 0.52 +/- 0.1 |
| Large site | 0.6 +/- 0.3 | 0.55 +/- 0.2 | 0.52 +/- 0.1 |

* 1. This is because species are more heterogeneous the larger the site

Avg. freq of species/taxa X:

|  |  |  |  |
| --- | --- | --- | --- |
|  | 10 plates | 20 plates | 30 plates |
| Small site | 0.6 +/- 0.1 | 0.55 +/- 0.1 | 0.52 +/- 0.1 |
| Medium site | 0.6 +/- 0.2 | 0.55 +/- 0.2 | 0.52 +/- 0.2 |
| Large site | 0.6 +/- 0.3 | 0.55 +/- 0.3 | 0.52 +/- 0.3 |

|  |  |  |
| --- | --- | --- |
| Rushbrook (L) | 21211 | 30 |
| Atlin (M) | 4235 | 20 |
| Aero (S) | 546 | 10 |
| RVYC-Jericho (L) | 36288 | 10 |
| Deep Cove Marina (M) | 4561 | 30 |
| Lynnwood (small area) (S) | ??? | 20 |
| Victoria FW (L) | 24133 | 20 |
| Ladysmith FW (M) | 6530 | 10 |
| Maple Bay (small area) (S) | ??? | 30 |

\*very approx. size in m2

Compare variability of point counts to variability of NFA (over time? Between sites? Relative to variability of native species?)

**If you’re putting 30 plates in how much do we standardize inter-plate distance (some docks smaller than others). Or is that part of the question?**

**Question 2: Diversity**

Do you lose significant amount of information on biodiversity (NFA vs Point Count)?

For every point-counted plate, also do freq. analysis and if possible full scans **with time estimates.** For all plates with all three, use for this analysis (doesn’t matter where they’re from)

**Question 3: Abundance**

Do point counts and frequencies agree on most abundant species?

**Question 3: AIS Detection/Rarity**

In theory,NFA is better for detecting rare species, which is esp. important with AIS (compare all four methods)

**Application 1: Within-year spatial comparison of frequency AND percent cover (compare) of AIS between PRPA and Port of Vancouver**

Do actual analysis

**Application 2: Spatial and temporal trends over multiple seasons**

Use existing past photos (although not great) at one or two sites to make some figures of freq. over time

* Use some sort of bootstrapping to increase old sample sizes?
* Would come with a lot of caveats

Ideas:

* Depth of plate (help determine if difference between what’s caught on camera vs missed species) or scrape and weigh (may not work with preserved plates)
* Take off all the mussels!!
* Take our usual shitty photos this year too to see how important the fancy set up matters

**Test sites:**

Rushbrook:

Port Ed:

Mosquito Creek:

Reed Point:

Ladysmith: