The Archaeological Record

The scatter of artifacts in their matrices near and on the surface of the earth.

Two ways to think about the record:

-Traditionally:

-Sites vs. empty space.

-Sites are “natural” empirical units.

- Recently:

- A continuum of artifact densities: high density to low density to zero density,

- *Sites are analytical units, created by researchers to answer specific questions about the past.*

Archaeological Survey

- The process of finding archaeological sites.

- The process of investigating patterning in the archaeological record at large spatial scales (i.e. > 100 m).

    - A part of "landscape archaeology"
        - "the mountain is the site"
        - "0's are data"

Kinds of Survey
Three Dimensions of Variation

1. Total spatial coverage/ Spatial samples

2. Surface/ Subsurface

3. Site/Non-site

Kinds of survey (1)
Coverage

- Total coverage: the study area is investigated in its entirety, usually using a single set of methods (e.g. STP's, surface walkover)

- Sample-based: the study area is exhaustively divided into multiple sampling units, only some of which are investigated.

- choice of units: random, systematic, purposive.

- shape of units: transects, quadrats, irregular.

- units may be draw from 2 or more strata:

  e.g. -upland vs. lowland strata

  -5 1-km quadrats randomly chosen within each

Kinds of Survey (2): Surface vs. Subsurface

- **Surface survey**: inspect surface of the ground

  decisions to make:

  - amount of surface exposure
  - spacing of surveyors
  - speed of movement

- **Subsurface survey:** dig subsurface probes

  decisions to make:

  - probe spacing
  - probe size (Auger holes, STP's, quadrats).
  - screens ?

Kinds of survey (3)
How are artifacts provenienced?

- **Site survey:** "sites" are designated in the field, artifacts are provenienced by "site".

- **Non-site survey**: artifacts are provenienced without regard to whether they occur in "sites"

Shelter Island:

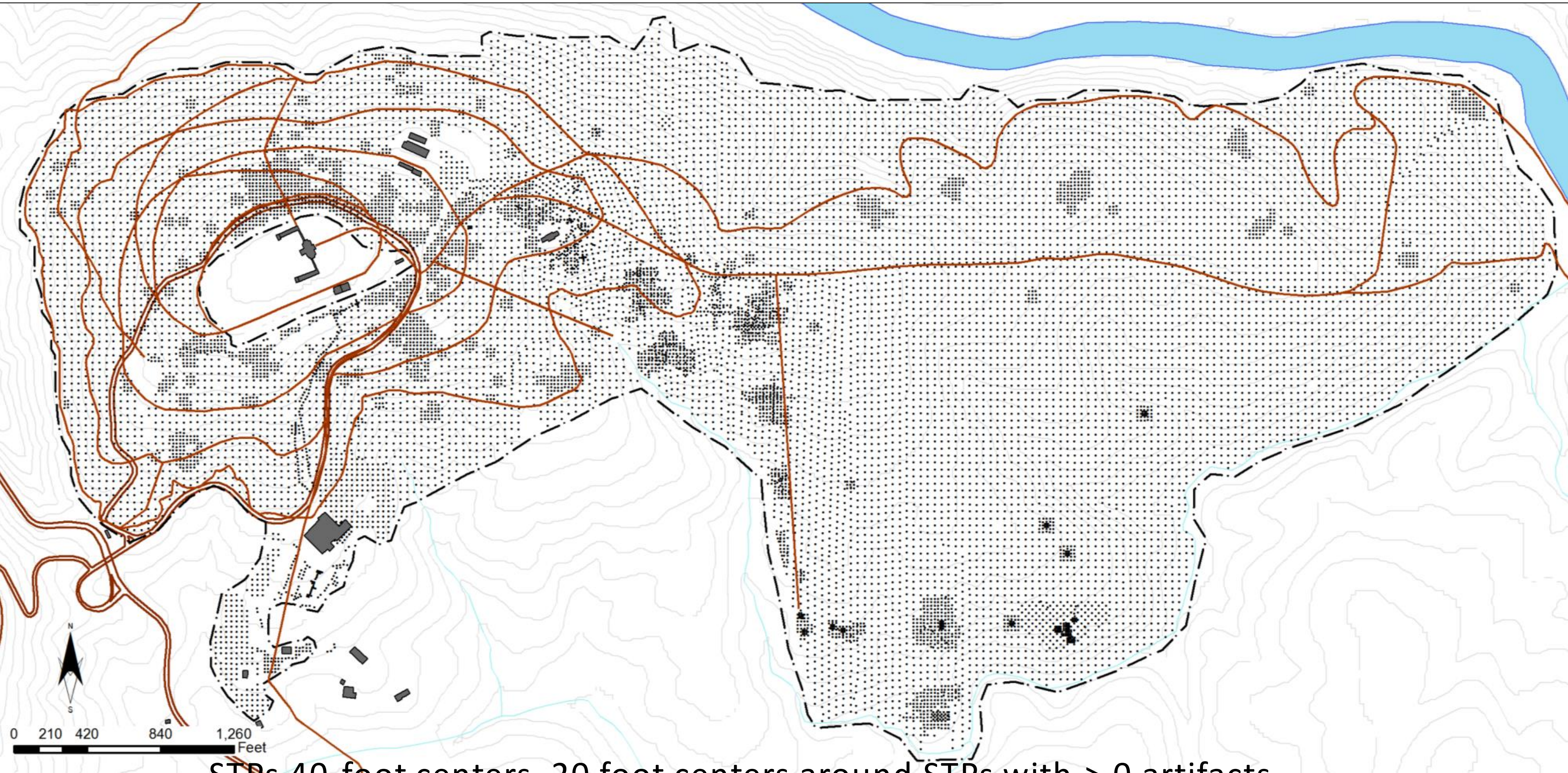
When artifactual material was found in a test probe, we then laid out an "iron cross"—a survey configuration that greatly enhanced our ability to differentiate isolated finds from sites. This procedure consisted of excavating test probes every 2 m in the four cardinal directions (cf. Chartkoff 1978; McManamon 1981a:205). If no further cultural material was located in the "iron cross," we defined the initial probe material as an isolated find. It was collected, its location noted on the topographic base map, and a brief description of the find recorded. By noting the spatial distribution of such isolated finds, we were able to define several low-density scatters (non-site manifestations) characterized by one or two artifacts for every 100 to 500 m^2 covered by survey crews, i.e., one or two artifacts for approximately every 18 to 90 shovel probes excavated.

Pinedale:

Some artifact distributions appeared to represent non-site manifestations (S. Plog et al. 1978: 388–389; Thomas 1975), i.e., sparse concentrations of cultural material with broad spatial dispersion. At Pinedale, non-site manifestations were characterized by a dispersal of one or two artifacts per 50–100 m^2 area surveyed. Other cultural materials were found in definable clusters that appeared to represent discrete loci of more spatially restricted activity areas. Here a concentration of artifacts, often characterized by an artifact density of one or more per square meter, as well as occasional architectural features were delimited. These places were defined as sites. Differentiating site boundaries from more amorphous non-site manifestations necessitated difficult field decisions in some cases. We defined sites as all loci containing cultural materials of sufficient quantity and quality to provide a good potential for interpreting the range of activities that once occurred there (see also S. Plog et al. [1978:389]).

Monticello Plantation Survey?

Monticello Plantation Archaeological Survey



- STPs 40-foot centers, 20 foot centers around STPs with > 0 artifacts.
- STPs mapped on the Virginia State Plane with a totalstation.
- Each STP get a unique ID
- 1/4 inch mesh screens for uniform artifact recovery rates.
- Artifacts provenienced by STP

Kinds of Survey…

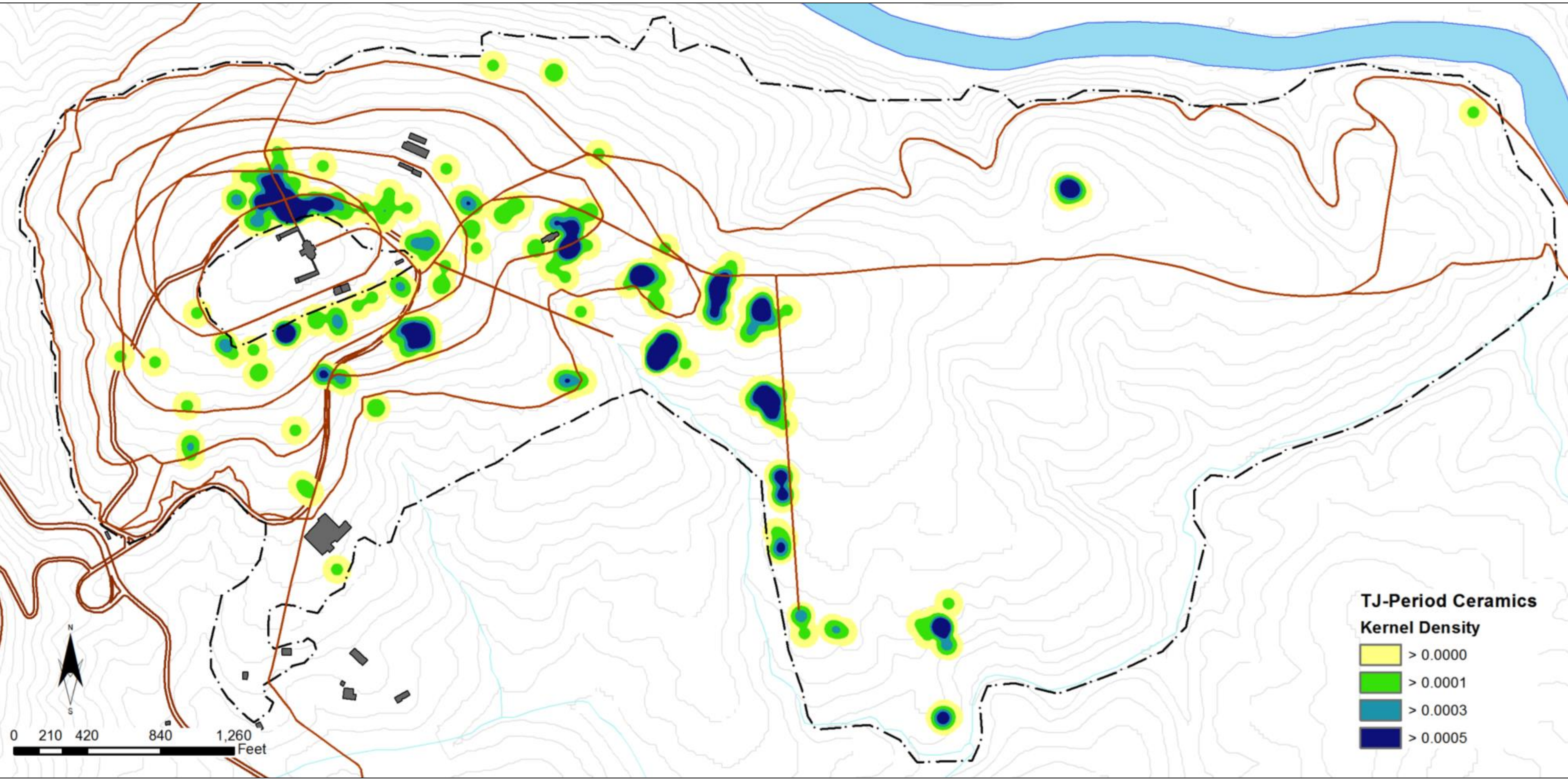
Where does MPS fit?

1. Total coverage/ Samples
2. Surface/ Subsurface
3. Site / Non-site

Advantages of the non-site approach?

1. Creation of “sites” is purpose driven and transparent.
2. Possible for others to evaluate the results.
3. Possible to try other ways.

For example….

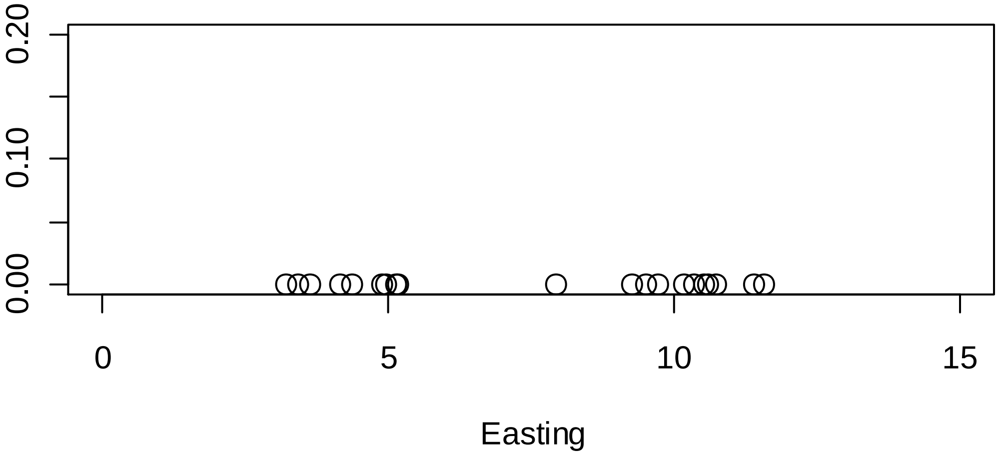


Kernel density estimates from artifact counts in STPs

Kernel density estimation

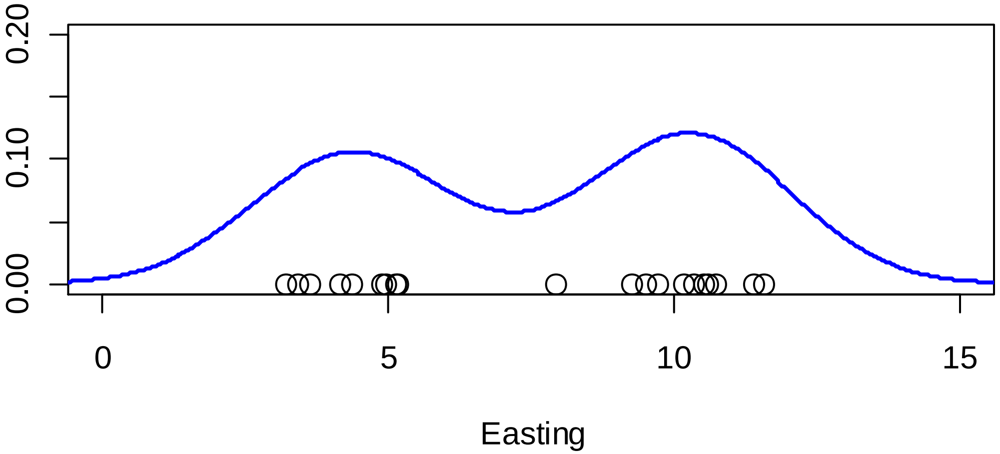
The basic idea (in one dimension):

We want to go from this:

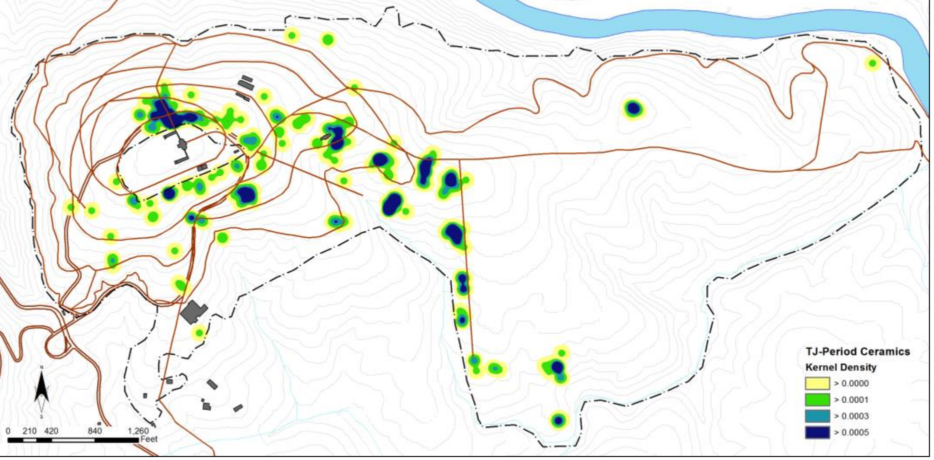


Where each point is an artifact, whose location is plotted in space (in this case, the Easting coordinate)

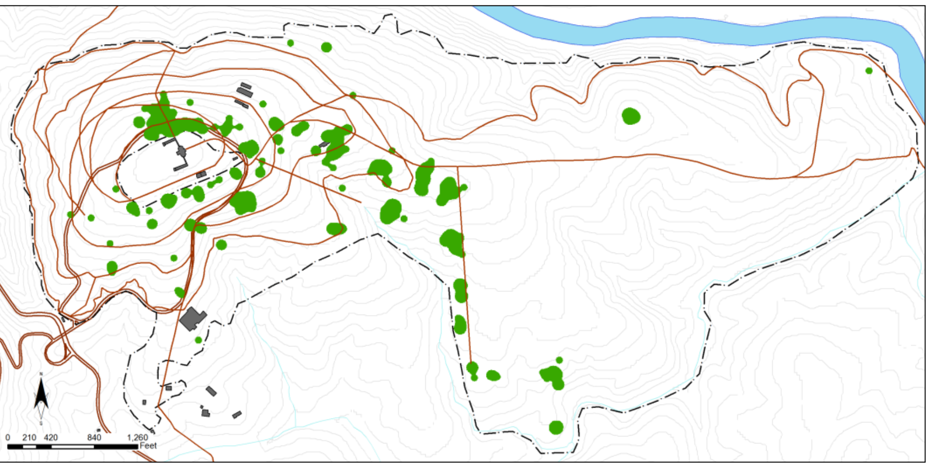
To this:



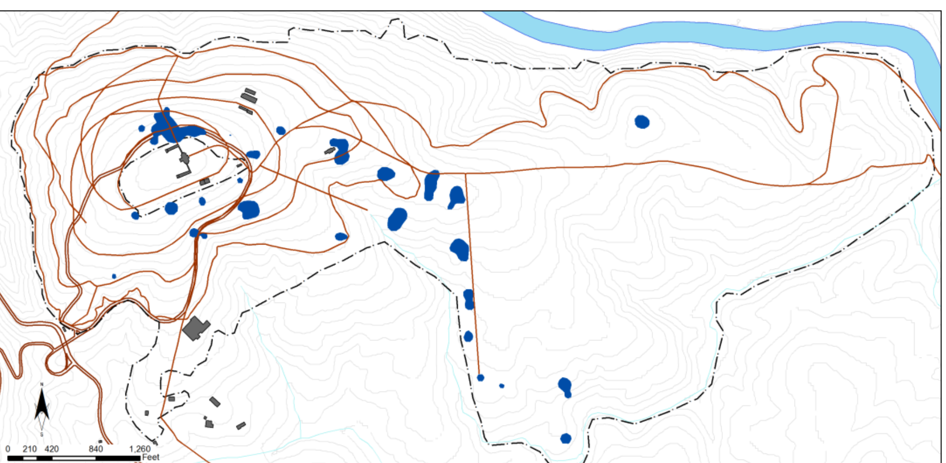
Where the height of the blue line is an estimate of the density of artifacts at a given point in space (in this case, the Easting coordinate)



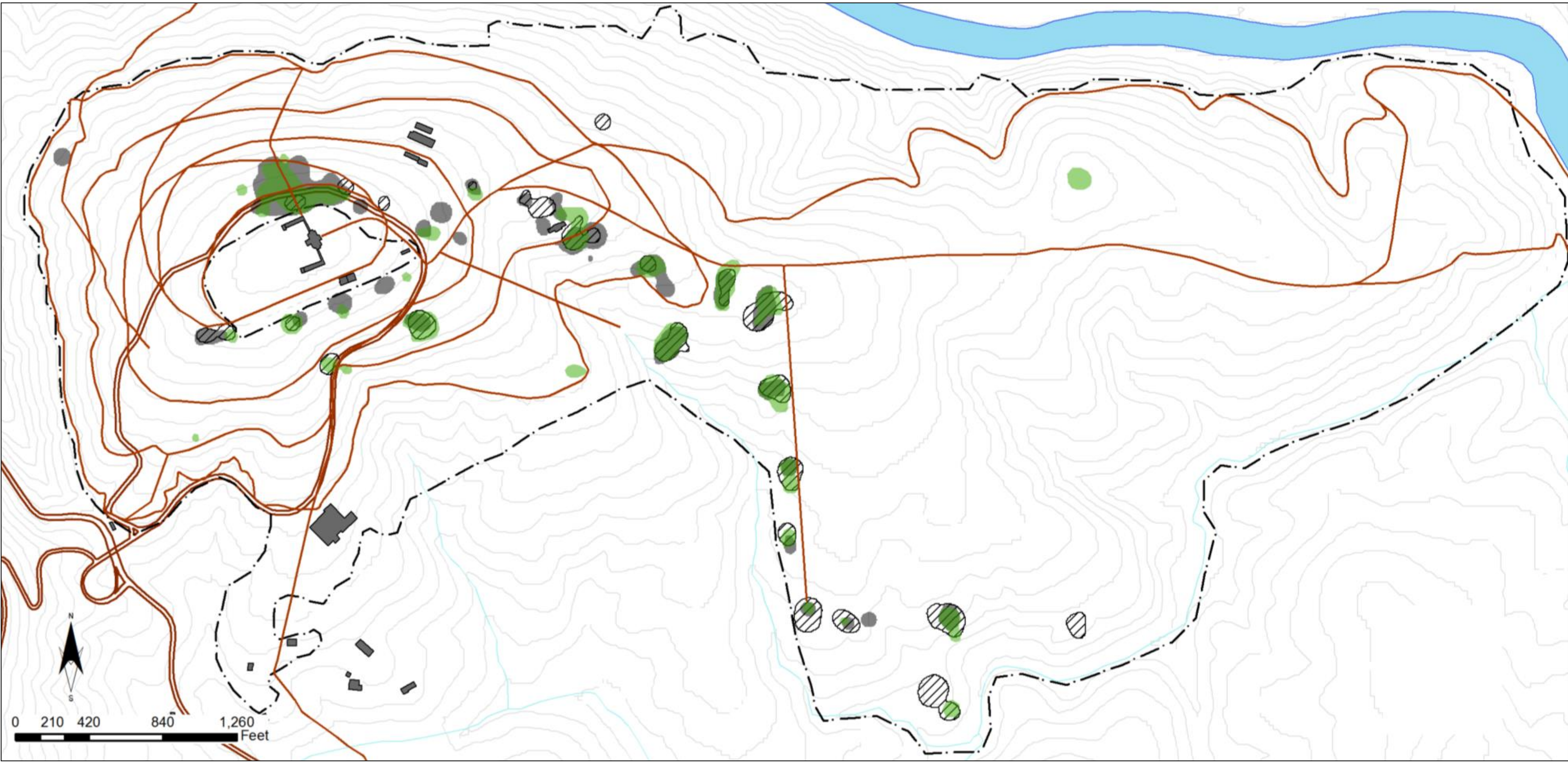
A kernel density surface of **Jefferson-period ceramics** with a cell size of 5 and a radius of 80 feet.



Individual polygons characterize areas with a greater than or equal to **0.0001 kernel density value** of Jefferson-period ceramics .



Individual polygons with a greater than or equal to **0.0003 kernel density value** of Jefferson-period ceramics.



Jefferson-period ceramics: Green polygons

Wrought nails: Hatched polygons.

Wine bottle glass: Grey polygons

Modeling Sub-surface Survey

"all models are wrong, some are useful"
-George Box

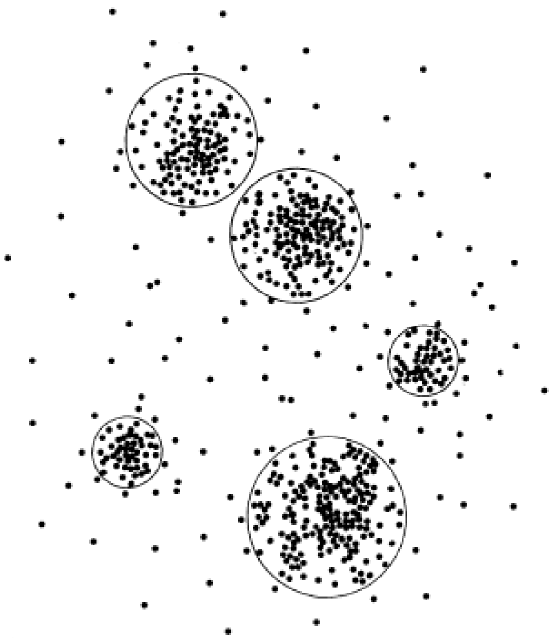
The question: how close together should the STPs be?

1. Assume “sites” and “non-site areas”

2. What is the probability of intersecting a site?

3. What is the probability of finding one or more artifacts given that you intersected the site?

Modeling Sub-surface Survey



Assume "sites" and "non-site areas":

1. What is the probability of intersecting a site?

- site size
- STP spacing

2. What is the probability of finding one or more artifacts given that you intersected the site?

- site artifact density (mean and variance)
- screens
- STP diameter

Modeling Sub-surface Survey

1. **Site intersection probability~**

E(n) = Expected (number of intersections)

s = STP interval
r = radius of the site

$$E(n) = (\pi r^2)/s^2$$

$$E(n) = \pi(r/s)^2$$

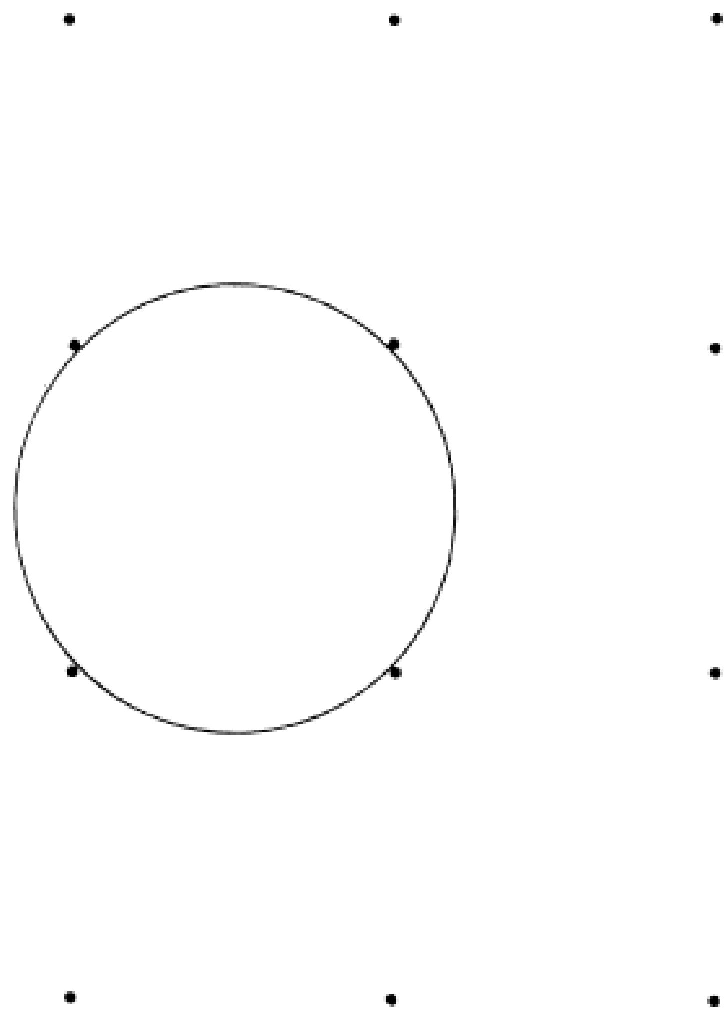


Figure 1. Circular site in center of square formed by four shovel-test units, showing largest site that can escape detection in a shovel-test survey. Circle radius equals i√2.

Modeling Sub-surface Survey

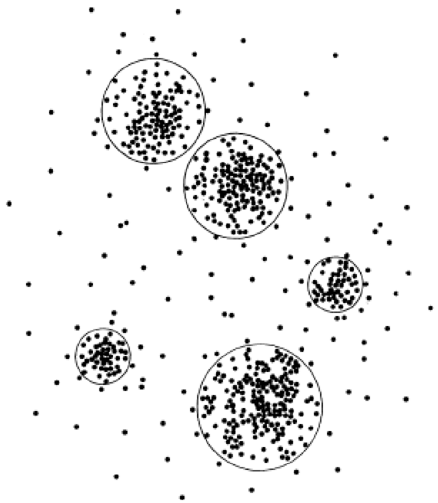
2. Probability of finding artifacts

Lambda = mean artifacts / STP
= (artifacts/square foot) x (STP area in square feet).

Say ***Lambda=.5***,

What is the probability of getting 0, 1, 2 ,3, 4… artifacts in an STP?

- we can get an answer using the ***Poisson distribution.***



Modeling Sub-surface Survey

The Poisson Distribution

Used to model "rare events"

- rare in space: number of Creamware sherds in a 1-m. quadrat

- rare in time: number of soldiers killed by mules in the Prussian army each year

- rare per unit of sampling effort or exposure: number of deer killed in a week, month, year. In this case *lamba*= (density of deer/temporal unit) x (number of units)

If you expect a "ceiling" on total number of counts, use the binomial, otherwise use the Poisson

In the spatial context (e.g. quadrat sampling within a site), a Poisson distribution of artifact count in quadrats implies ***spatial randomness.***

Modeling Sub-surface Survey

The Poisson Distribution

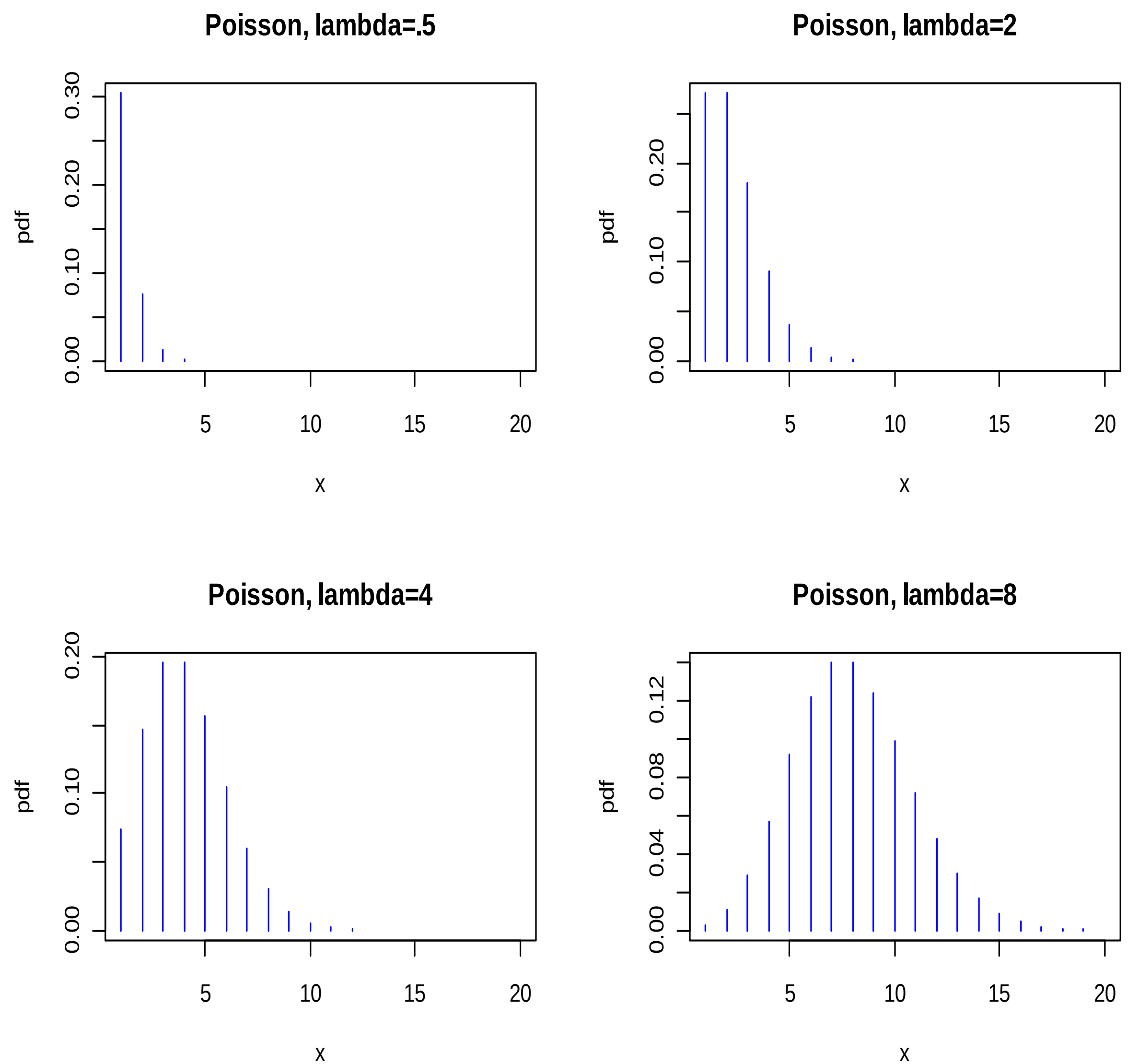
Developing our Poisson intuition:

- skewed for small mean.

- as mean increases, Poisson become Gaussian.

- but because mean=variance. variation is ALWAYS constrained.

$$p(N) = \frac{\lambda^n}{N!} e^{-\lambda}$$



Modeling Sub-surface Survey

2. Probability of finding artifacts

- Assume STP diameter is 1 foot.

- Lambda: mean artifact density/ square foot,

- *Say Lambda= .5* what is the probability of getting *N= 0, 1, 2 ,3, 4*… artifacts in an STP?

If the artifact scatter is random, the answer is given by the ***Poisson distribution:***

$$p(N) = \frac{\lambda^N}{N!} e^{-\lambda}$$

$$p(N = 0) = e^{-\lambda}$$

$$p(N \geq 1) = 1 - e^{-\lambda}$$

Algebra refresher. *1) Any number raised to the 0'th power=1.*
2) The factorial of 0 = 1.

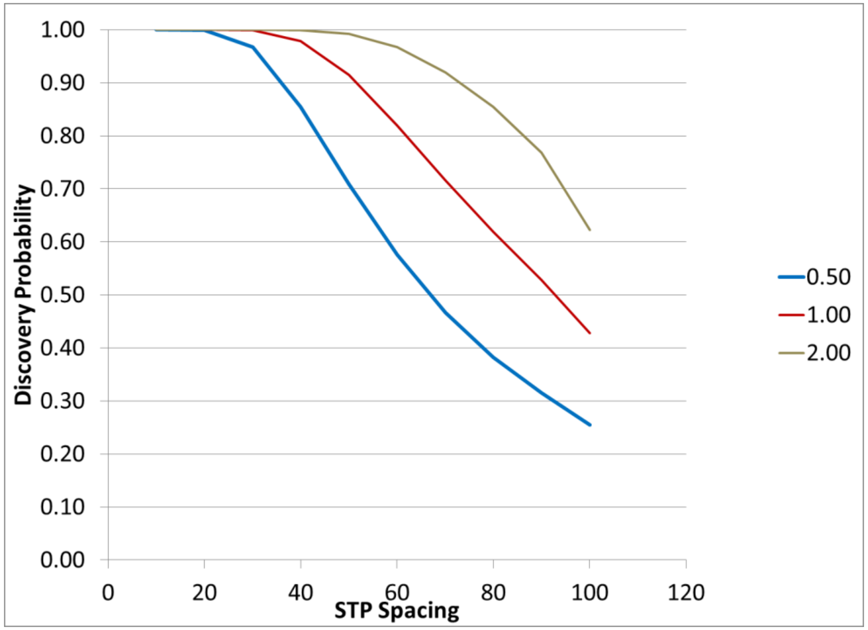
Putting it all together…

3.1 when E(n) < 1

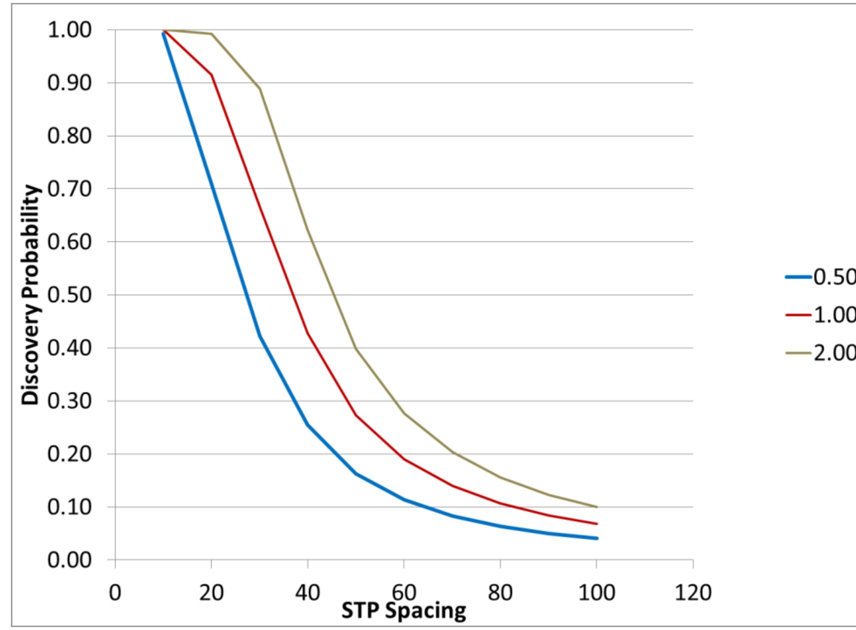
Prob(site detection) = $\underbrace{(1-e^{-\lambda})}_{\text{Prob finding one or more artifacts}}\pi\underbrace{(r/s)^2}_{\text{Prob that 1 STP intersects the site}}$

3.2 when E(n) > 1

Prob(site detection) = $$1-\left(\underbrace{\left(e^{-\lambda}\right)}_{\text{Prob finding NO artifacts}}^{\underbrace{\pi(r/s)^2}_{\text{Expected number of STPs intersecting the site.}}}\right)$$

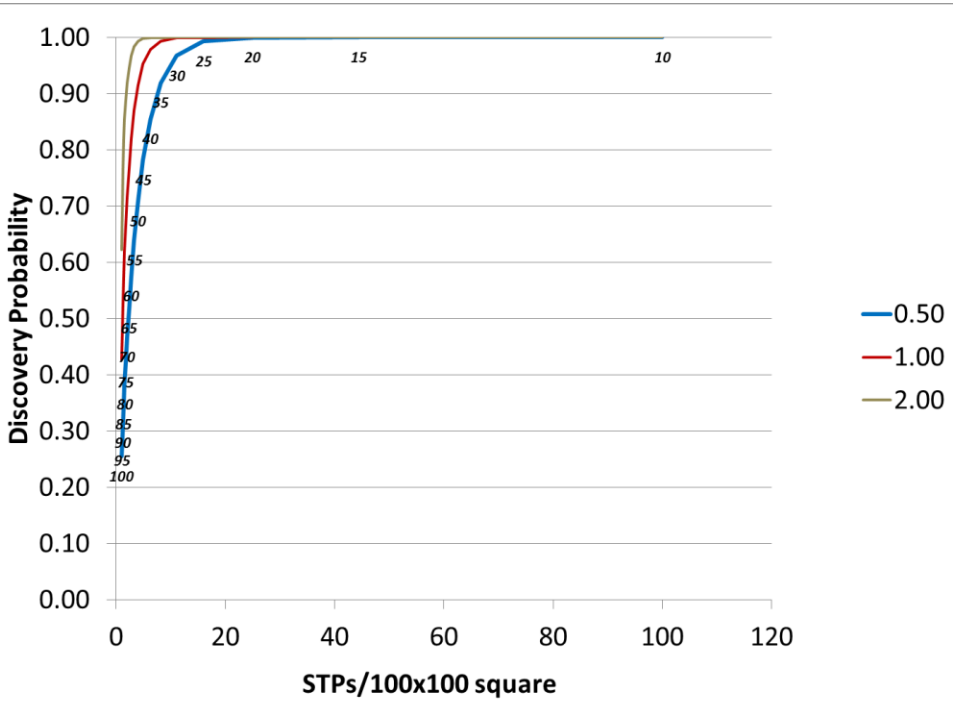


Site Radius= 50

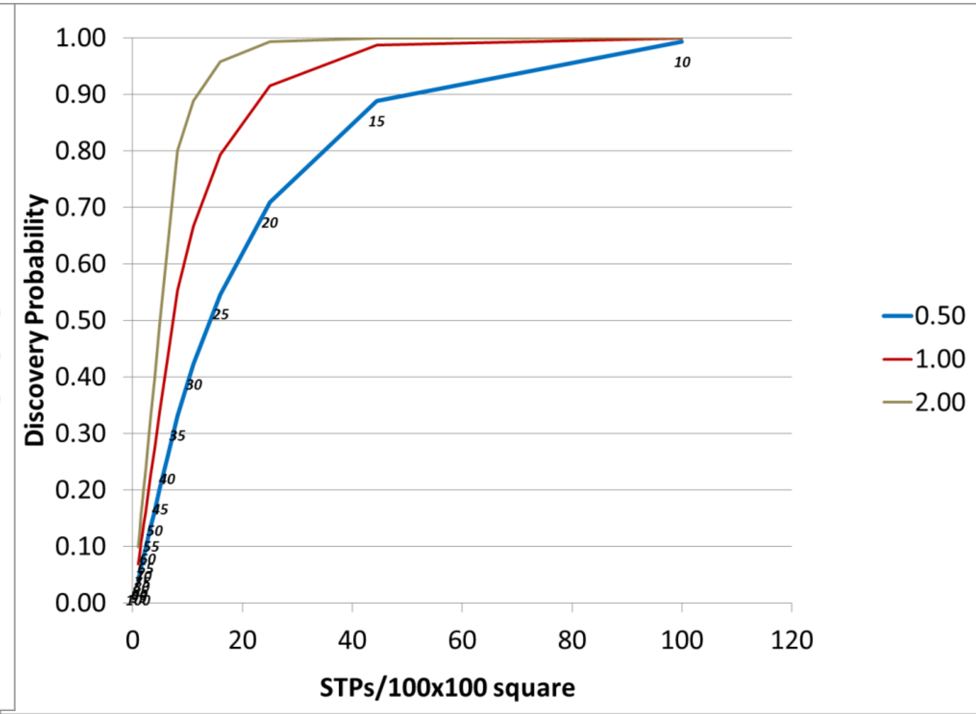


Site Radius= 20

Site discovery probabilities as a function of STP spacing.

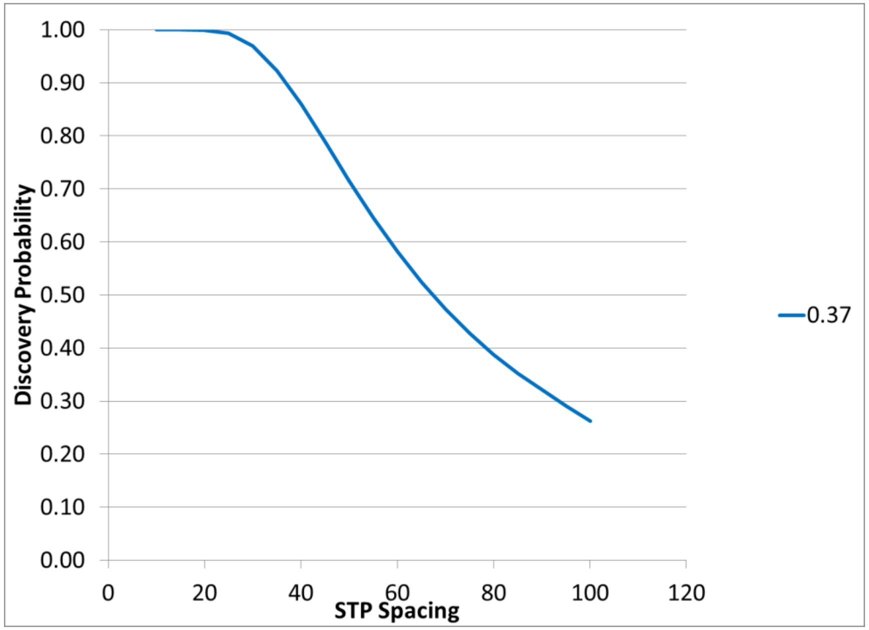


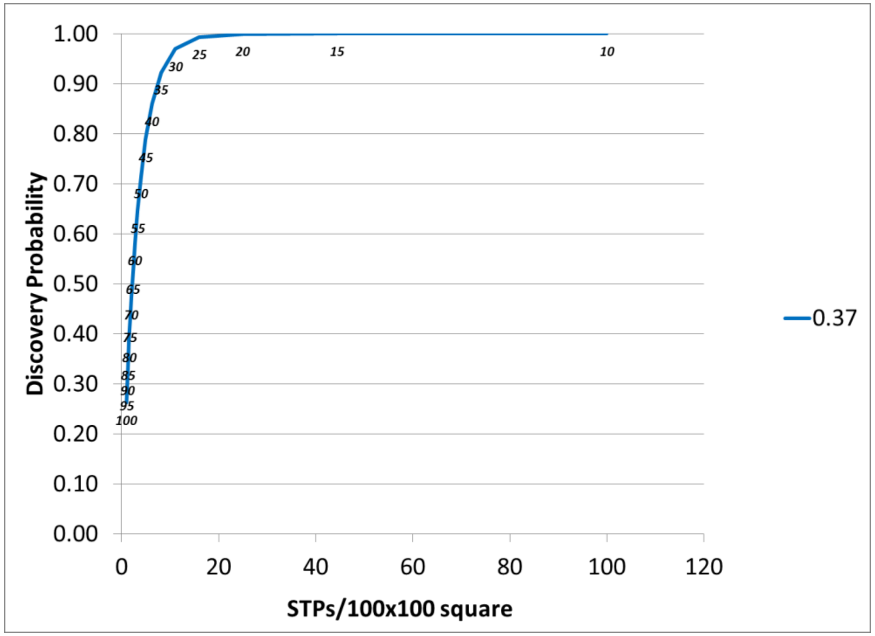
Site Radius= 50



Site Radius= 20

Site discovery probabilities as a function of survey effort.





Betty Hemings Site:
-density cutoff = .1 artifacts/sq. foot
-effective radius = 52 feet
-mean density = .37