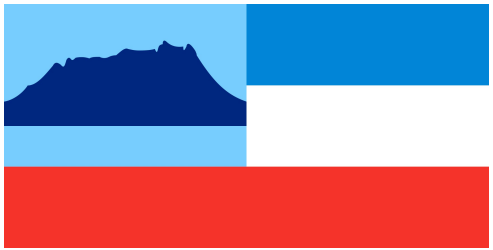
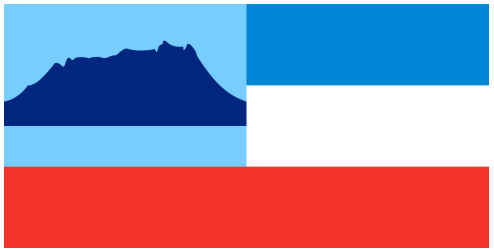
Which one are you?

non-  /



Which one are you?

/ non-

How long have you been working?

< 3yrs / > 3yrs

Have you ever seen orangutans up close?

YES / NO

Which one do you like more?

/

Which one do you like more?

/

Who will win the EPL this year?

/

Örang-utan surveys

Lukmann Haqeem (or Bob for short)
lalen@wwf.org.my
github.com/lukmannhaqeem

Content:

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1. **Introduction**
2. **Marked Nest Count (MNC) method**
3. **Field practical**

17/5

4. **Data management & analysis**

1. Introduction

Direct survey

i.e. actually seeing the animal in person

Indirect survey

i.e. observing signs of their presence

Direct survey

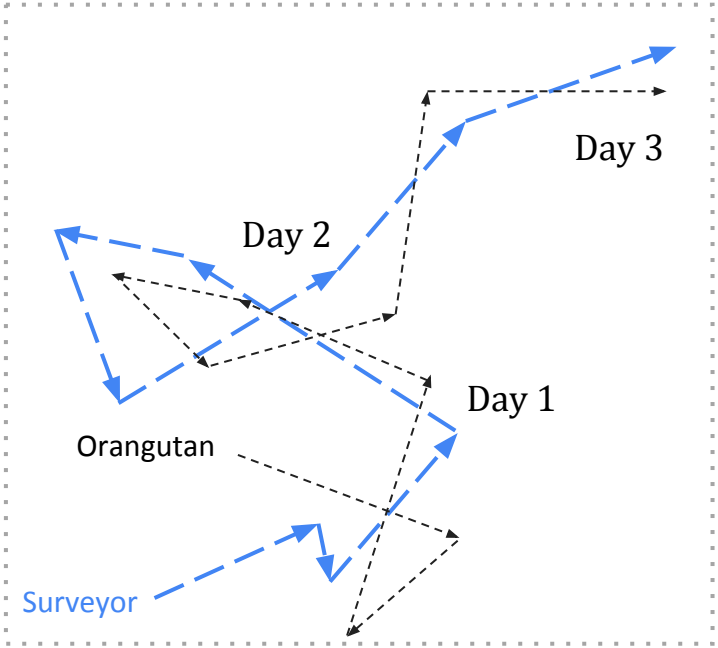
i.e. actually seeing the animal in person

- Count individuals using line transect
  - *Population density*

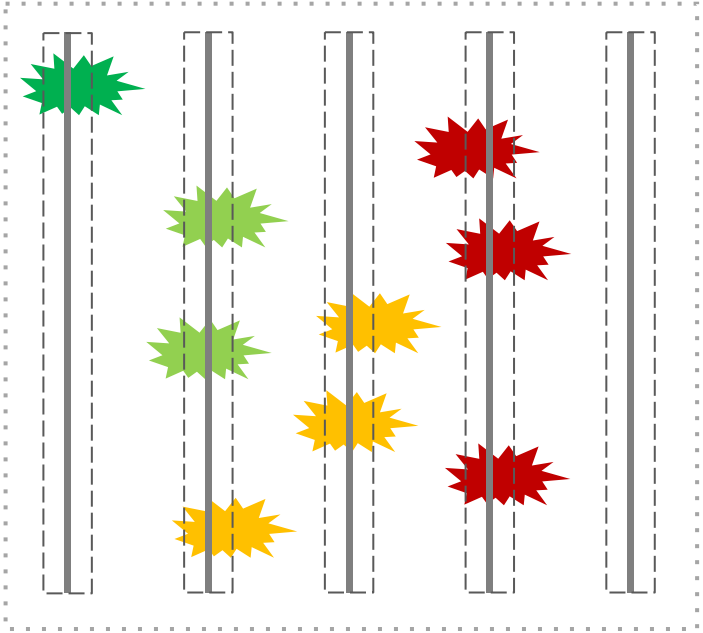
Direct survey

i.e. actually seeing the animal in person

- “Follow” orangutan
  - *Home range & Nesting frequency*



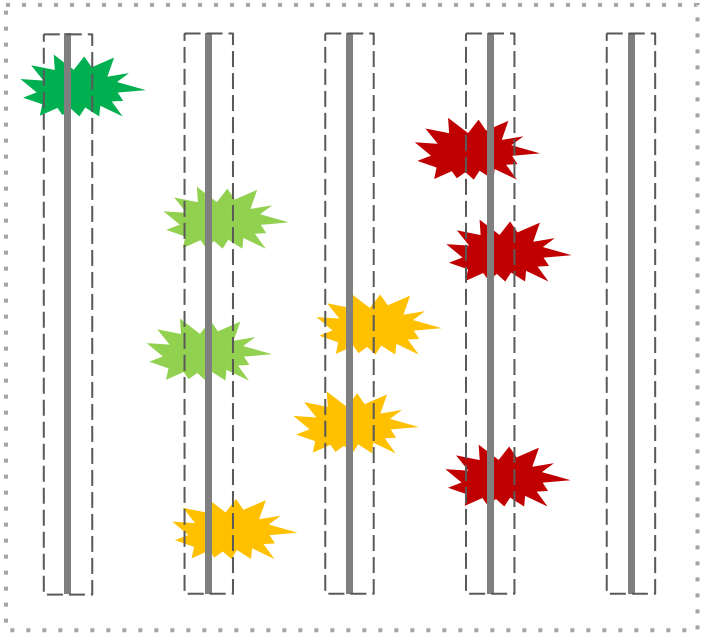
- Standing Crop Nest Count
- Marked Nest Count
- (both using strip transect)
  - *Population density*



Indirect survey

i.e. observing signs of their presence

- Standing Crop Nest Count
  - Only one survey required.
  - All nests encountered are recorded.
  - Use nest decay rate.



- Standing Crop Nest Count
  - Only one survey required.
  - All nests encountered are recorded.

Total number of nests observed

Detection probability

Nests observed by Team A

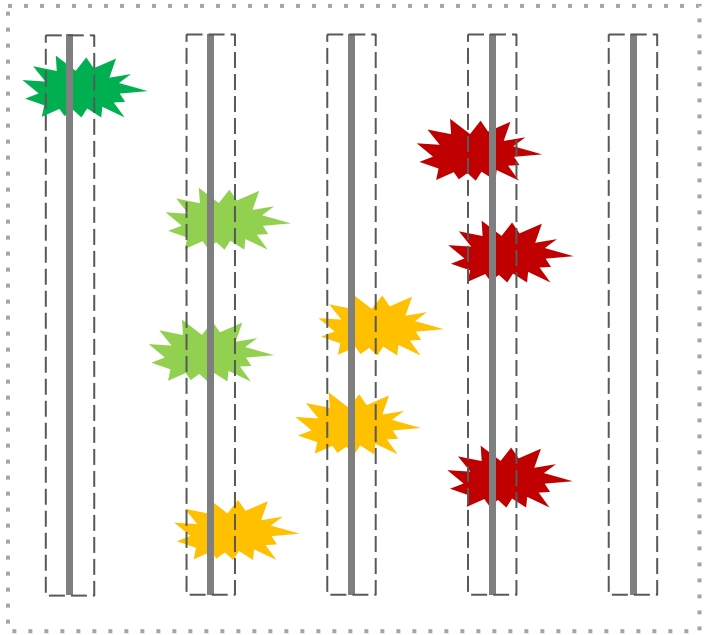
$$\mathrm{OU} = \frac{N \div P}{p \times r \times t} \quad ; \quad P = \frac{A}{A + B}$$

Proportion of nest-builders

Nest construction rate

Nest decay rate

Nests missed by Team A but observed by Team B



$$\boxed{\text{OU} = \frac{N \div P}{p \times r \times t} \quad ; \quad P = \frac{A}{A + B}}$$

$$= \frac{\mathbf{100}\ \cancel{nests}\ km^2 \div [\frac{\mathbf{80}}{\mathbf{80 + 20}}]}{0.85 \times 1.1\ \cancel{nests}\ animals^{-1}\ \cancel{day^{-1}} \times \mathbf{180}\ \cancel{days}}$$

$$= \frac{125}{168.3}$$

$$= 0.74\ animals\ /\ km^2$$

- Standing Crop Nest Count
  - Only one survey required.
  - All nests encountered are recorded.
  - Use nest decay rate.
  - Nest decay time varies greatly across time and space, making population density assessments impractical for areas in which decay rates are unknown.

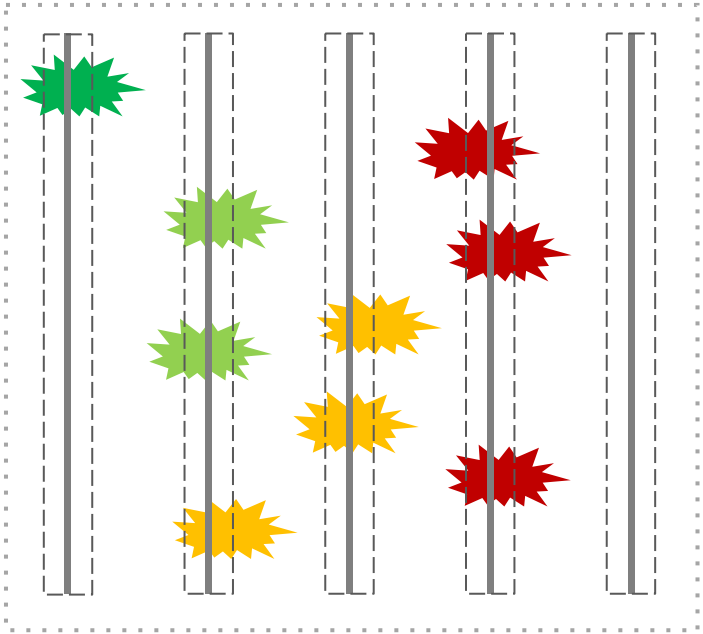


TABLE 5. Decay times for orangutan nests calculated using direct monitoring (DM) and Markov chain analysis (Markov) at sites in Borneo and Sumatra; findings from this study are in bold.

Location	Forest type	Study length (d): DM/Markov	Sample period	No. nests	Decay time (d)	
					DM	Markov
W. Kalimantan	lowland	1795/365	bimonthly	258	259	291.5
	peat	1795/365	bimonthly	35	399	424.4
Sabah, Malaysia	lowland	850†	21 days	115	202	N/A
Sumatra	transit swamp	850/850	monthly	735	206.4	246.4
	hills	850/850	monthly	470	227.7	249.4
	backswamp	850/850	monthly	601	192.7	234.1
	transit swamp	850/850	bimonthly	735	N/A	240.4
	hills	850/850	bimonthly	470	N/A	269.4
	backswamp	850/850	bimonthly	601	N/A	228.7
W. Kalimantan	peat	122‡	monthly	621	N/A	72§
C. Kalimantan	peat	30‡	monthly	86	N/A	284
W. Kalimantan	swamp	38‡	monthly	264	N/A	193.7
Sumatra	hills	~665†	monthly	45	319	N/A
	swamp	~665†	monthly	55	228	N/A
E. Kalimantan	lowland	43‡	43 days	79	N/A	319
Sumatra	lowland	31‡	monthly	83	N/A	118
	highland	31‡	monthly	35	N/A	247
	peat swamp	17‡	17 days	106	N/A	96
Sumatra	hills	~395†	monthly	30	81	N/A
E. Kalimantan	**lowland**	**547‡**	**monthly**	**663**	**N/A**	**676.95**

Note: "N/A" stands for not applicable.
† Only DM calculated for this study.
‡ Only Markov calculated for this study.
§ Not enough nests entered absorbing state; decay time only through three of four decay states.
¶ Cf obtained from van Schaik et al. (1995).
# Cf obtained from Johnson et al. (2005).

*Table extracted from Mathewson et al. 2008.

$$\boxed{\mathrm{OU} = \frac{N \div P}{p \times r \times t} \quad ; \quad P = \frac{A}{A + B}}$$

$$= \frac{\mathbf{100}\ nests\ km^2 \div [\frac{\mathbf{80}}{\mathbf{80 + 20}}]}{0.85 \times 1.1\ nests\ animals^{-1}\ day^{-1} \times \mathbf{180}\ days}$$

$$= \frac{125}{168.3}$$

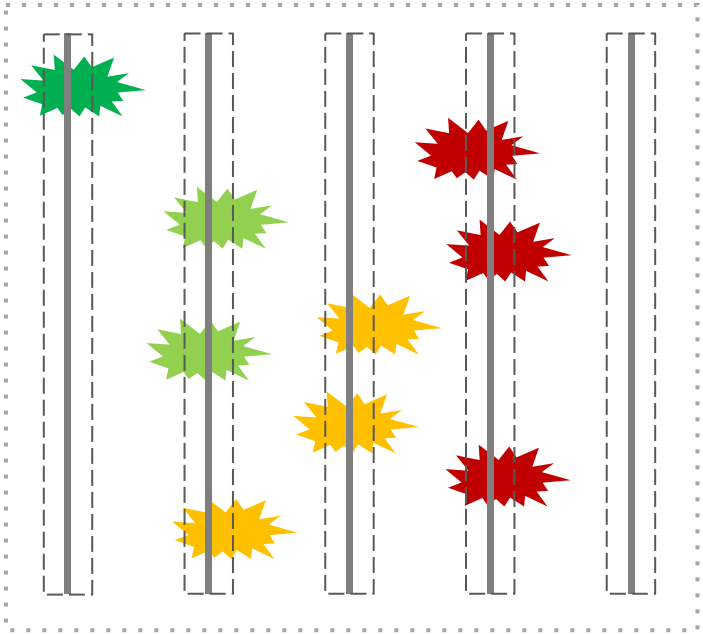
$$= \underline{0.74\ animals\ /\ km^2}$$

$$= \frac{\mathbf{100}\ nests\ km^2 \div [\frac{\mathbf{80}}{\mathbf{80 + 20}}]}{0.85 \times 1.1\ nests\ animals^{-1}\ day^{-1} \times \mathbf{80}\ days}$$

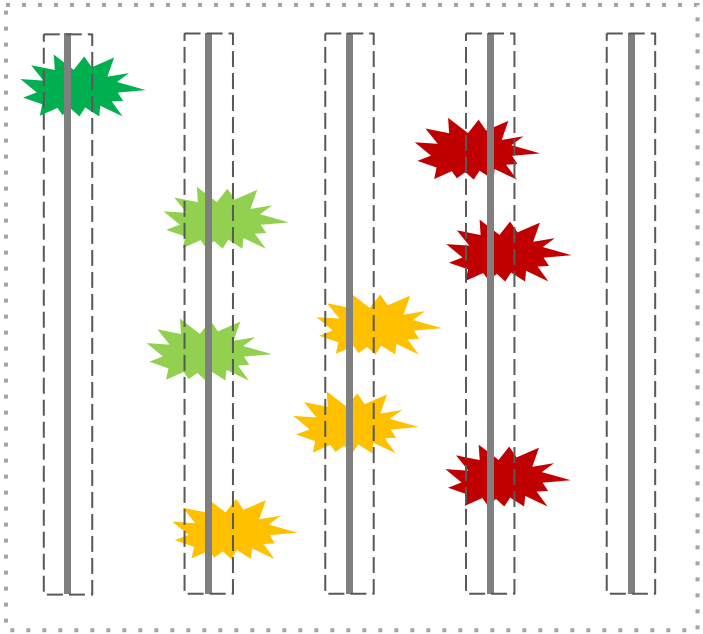
$$= \frac{125}{74.8}$$

$$= \underline{1.67\ animals\ /\ km^2}$$

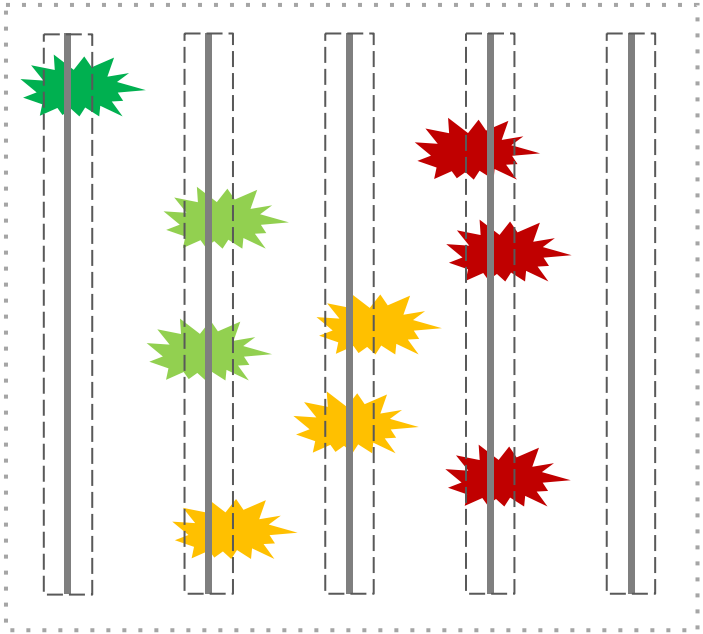
- Standing Crop Nest Count
  - Only one survey required.
  - All nests encountered are recorded.
  - Use *nest decay rate*.
  - Nest decay time varies greatly across time and space, making population density assessments impractical for areas in which decay rates are unknown.
  - Slow to detect population declines, particularly in areas with long nest decay times.
  - May not reliably capture an area's current population.



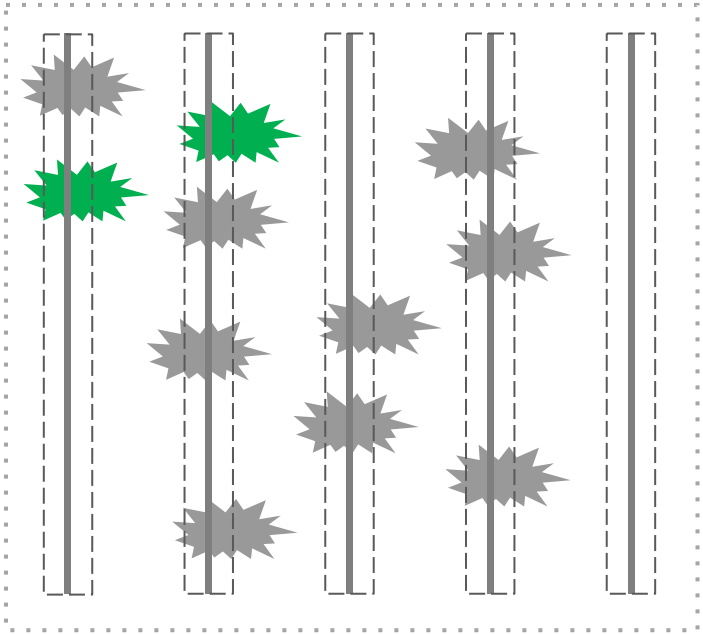
- Marked Nest Count



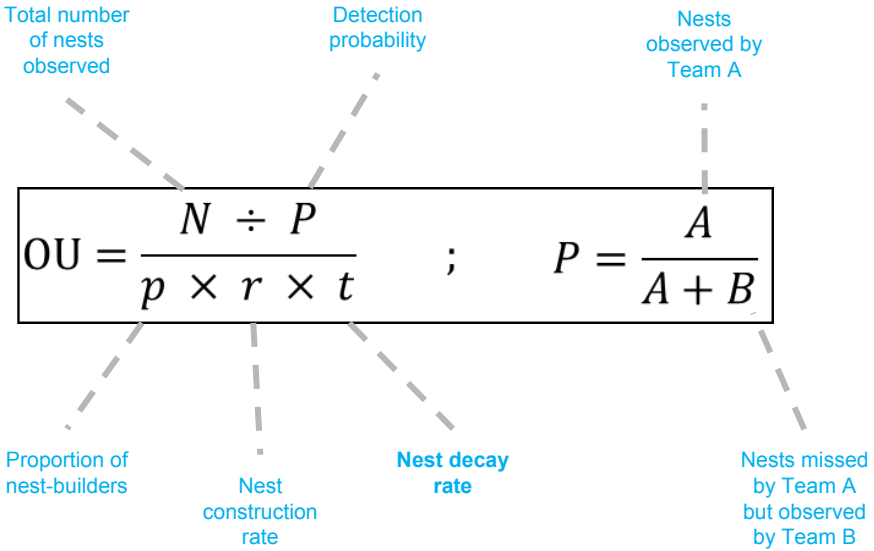
- Marked Nest Count
  - Require two surveys (at least).
  - Only new nests constructed between the initial and follow-up surveys are recorded.
    - Initial survey: Recording existing nests



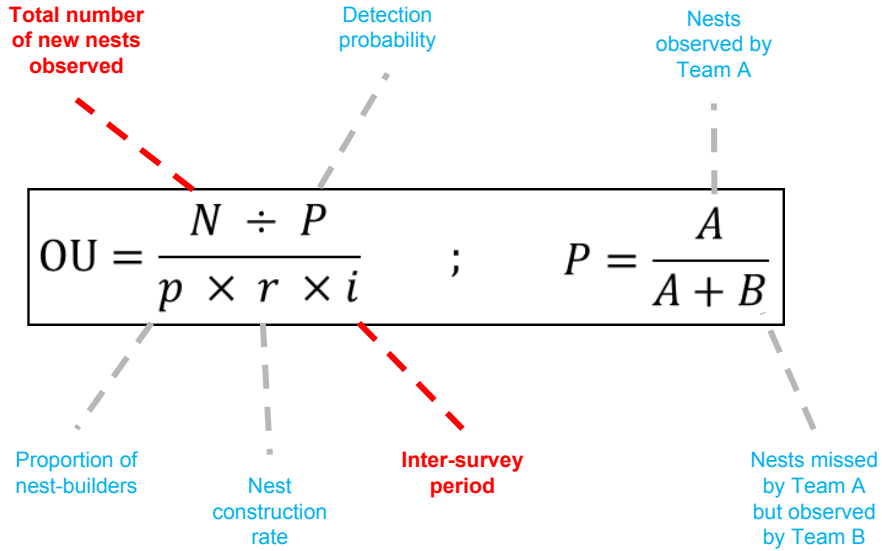
- Marked Nest Count
  - Require two surveys (at least).
  - Only new nests constructed between the initial and follow-up surveys are recorded.
    - Initial survey: Recording existing nests
    - Follow-up survey: Recording new nests produced since the initial survey.



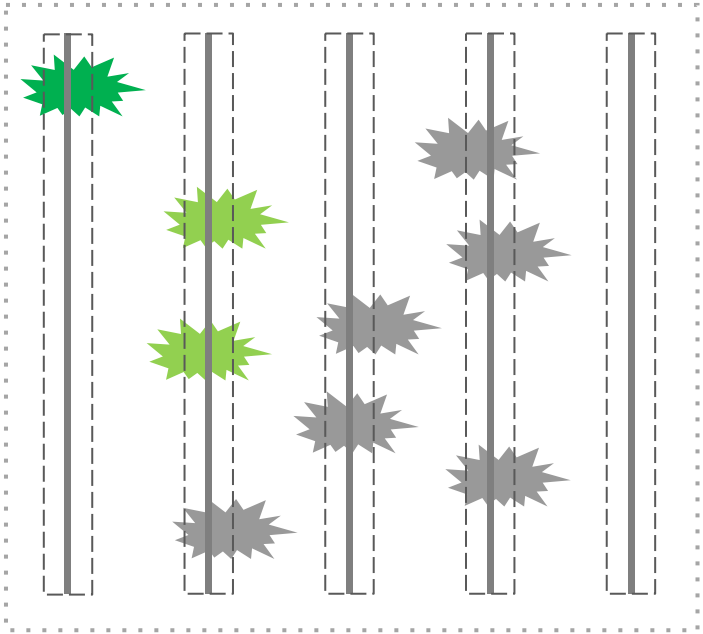
- Standing Crop Nest Count



- Marked Nest Count



- Marked Nest Count
  - Require (at least) two surveys.
  - Only new nests constructed between the initial and follow-up surveys are recorded.
    - Initial survey: How many nests currently exist?
    - Follow-up survey: How many additional nests have been constructed since the initial survey?
  - Replaces the variable of nest decay rate with the parameter of *inter-survey period*
  - may not be feasible in areas with low number of fresh nests



$$\boxed{\mathrm{OU} = \frac{N \div P}{p \times r \times i} \quad ; \quad P = \frac{A}{A + B}}$$

$$= \frac{\mathbf{28}\ \cancel{nests}\ km^2 \div \left[\frac{\mathbf{18}}{\mathbf{18 + 10}}\right]}{0.85 \times 1.1\ \cancel{nests}\ animals^{-1}\ \cancel{day^{-1}} \times \mathbf{42}\ \cancel{days}}$$

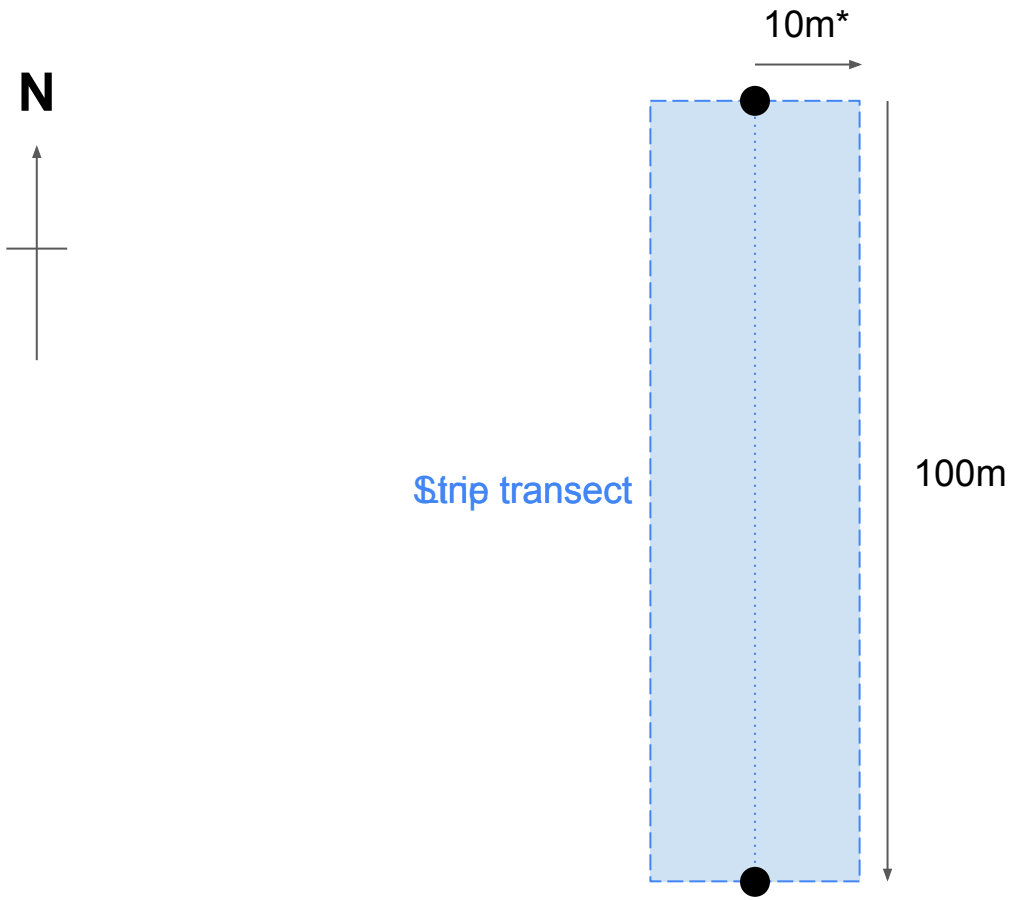
$$= \frac{44}{39.27}$$

$$= 1.12\ animals\ /\ km^2$$

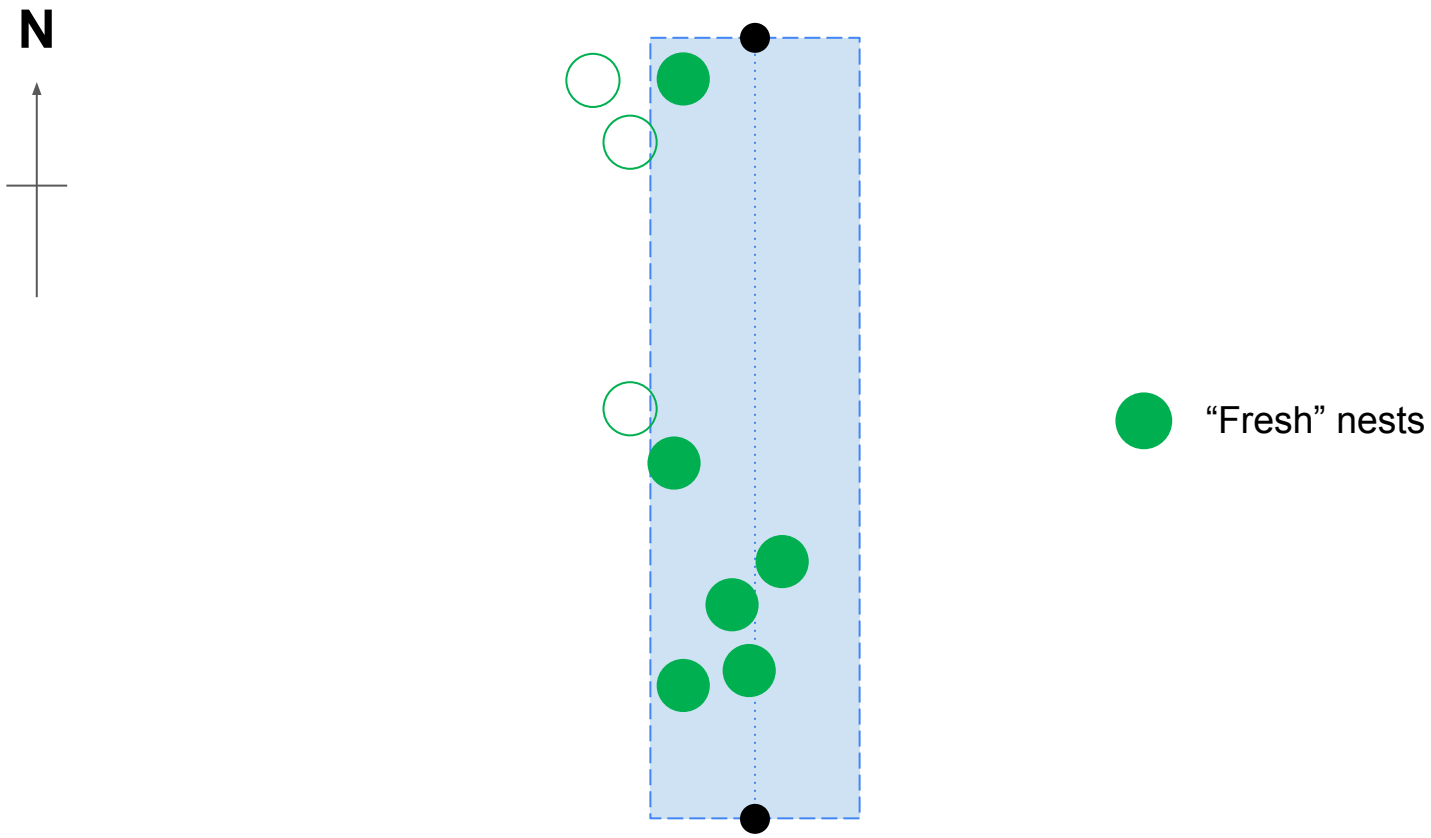
Summary

- Orangutan surveys are difficult, and **indirect surveys using signs of presence are more common**.
- However, these surveys may yield different density estimates due to sampling errors, including differences in methods, team skill, and difficulty estimating nest decay rate.
- **Nest decay rates vary due to various factors**, and generalizing decay rates from published studies can lead to errors in density estimation. Direct monitoring of nest survival is the most reliable method, albeit time-consuming.
- **Marked nest counts can estimate ape density without needing to estimate nest decay rates**. Nests constructed between two surveys are counted, assuming a short interval between surveys to ensure no nests have disappeared.

2. Marked Nest Count (MNC)



**The 10m Effective Strip Width (ESW) length adapted from Wich & Boyko (2011)*


N
“Fresh” nests

Stage A

- Fresh
- Leaves are still green

Stage B

- Leaves are mixture of pale green and brown leaves

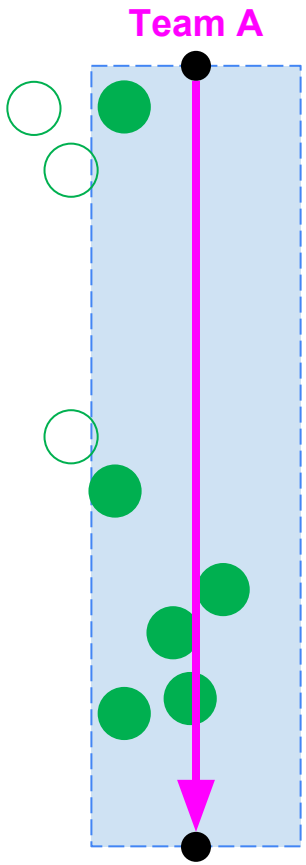
Stage C

- Older
- All brown leaves
- Leaves are gone and holes are visible in the nest

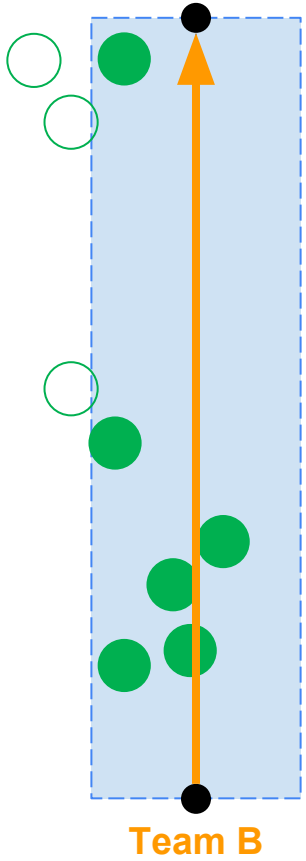
Stage D

- Very old
- Twigs and branches are still present, but no longer in the original shape of the nest

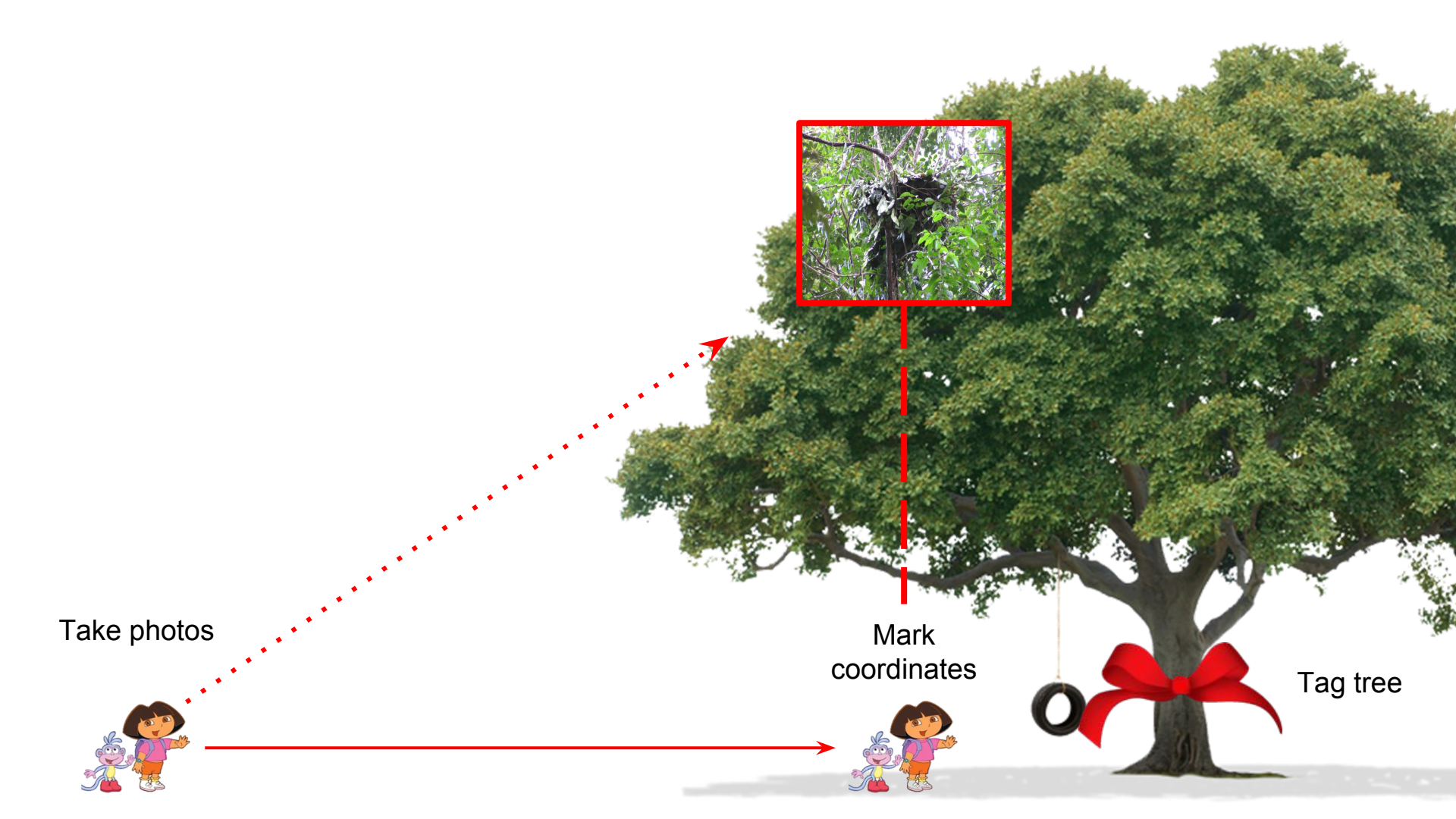
**Follows classification by Schaik et al. 1995. For MNC, only Stages A and B are considered in data analysis.*



- Team A (minimum of two people) should **walk slowly along the transect** and carefully search the canopy for orangutan nests.
- If a nest is found, **record its information** (nest ID, coordinates, nest class, tree name, and photo ID) on the data entry form.
- Only **trees with fresh nests should be marked** with ribbon. Write the nest information (nest ID, survey date, and nest class) on the ribbon.
- **Take photos** of the nest from the best angle possible.



- **After Team A finishes the survey, Team B should walk from the opposite direction** to increase the chances of finding more nests.
    - The number of nests missed by Team A will be used to calculate the detection probability.
- Team B should follow the same process as Team A when searching for and recording nests.

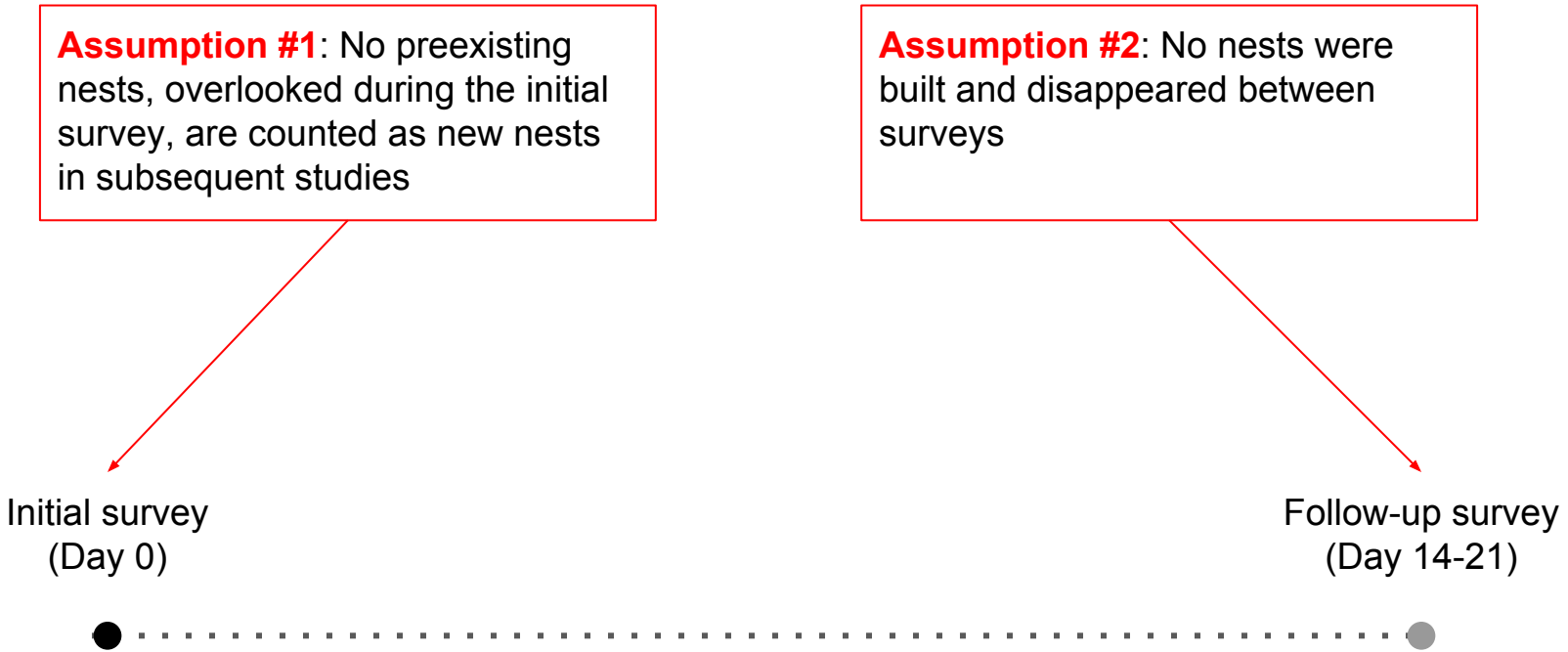

Take photos
Mark coordinates
Tag tree

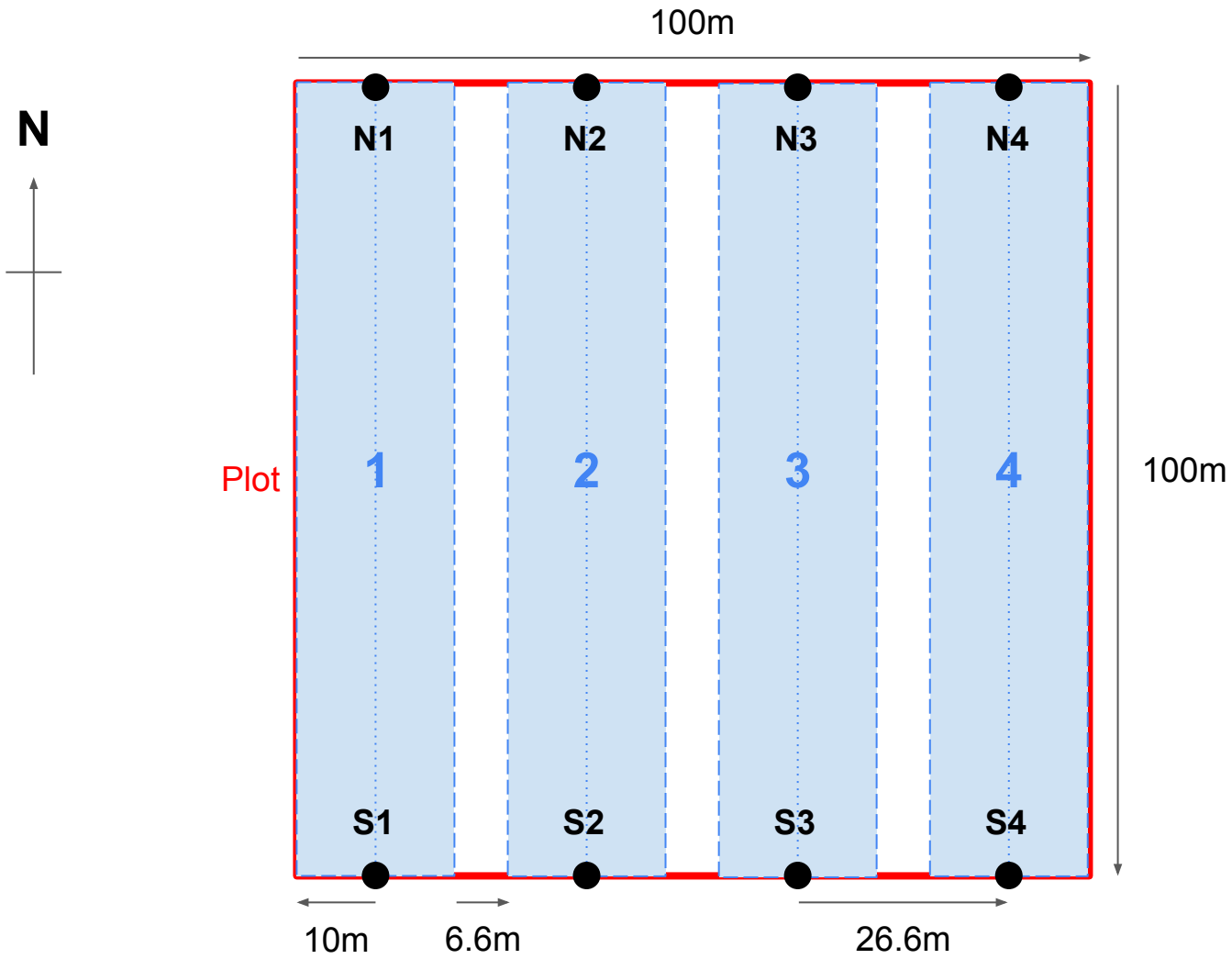
Date :.....
Observer(s) :.....
Plot ID :.....
Survey no. :.....

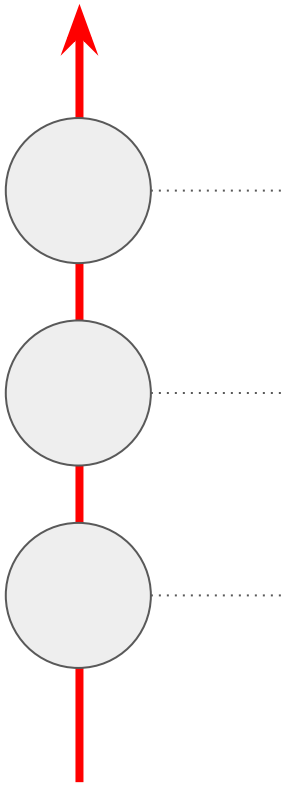
Nest ID	x_utm	y_utm	Time	Nest class				Transect				Tree name	Photo ID	Notes
				A	B	C	D	1	2	3	4			
LH001	154264	532983	1234		/			/				Ubah	IMG_2821	
LH002	154274	532346	1242	/					/			Kumpang	IMG_2832	
LH003	154216	532614	1243	/					/			Kumpang	IMG_2832	nest LH003 was constructed above nest LH002 and smaller than nest LH002

Nest classification:

Fresh nest		Old nest	
Stage A	Stage B	Stage C	Stage D
Fresh; leaves are still green	Older; Leaves are mixture of pale green and brown leaves	Old; All brown leaves; Leaves are gone and holes are visible in the nest	Very old; Twigs and branches are still present, but no longer in the original shape of the nest


Assumption #1: No preexisting nests, overlooked during the initial survey, are counted as new nests in subsequent studies
Assumption #2: No nests were built and disappeared between surveys
Initial survey (Day 0)
Follow-up survey (Day 14-21)

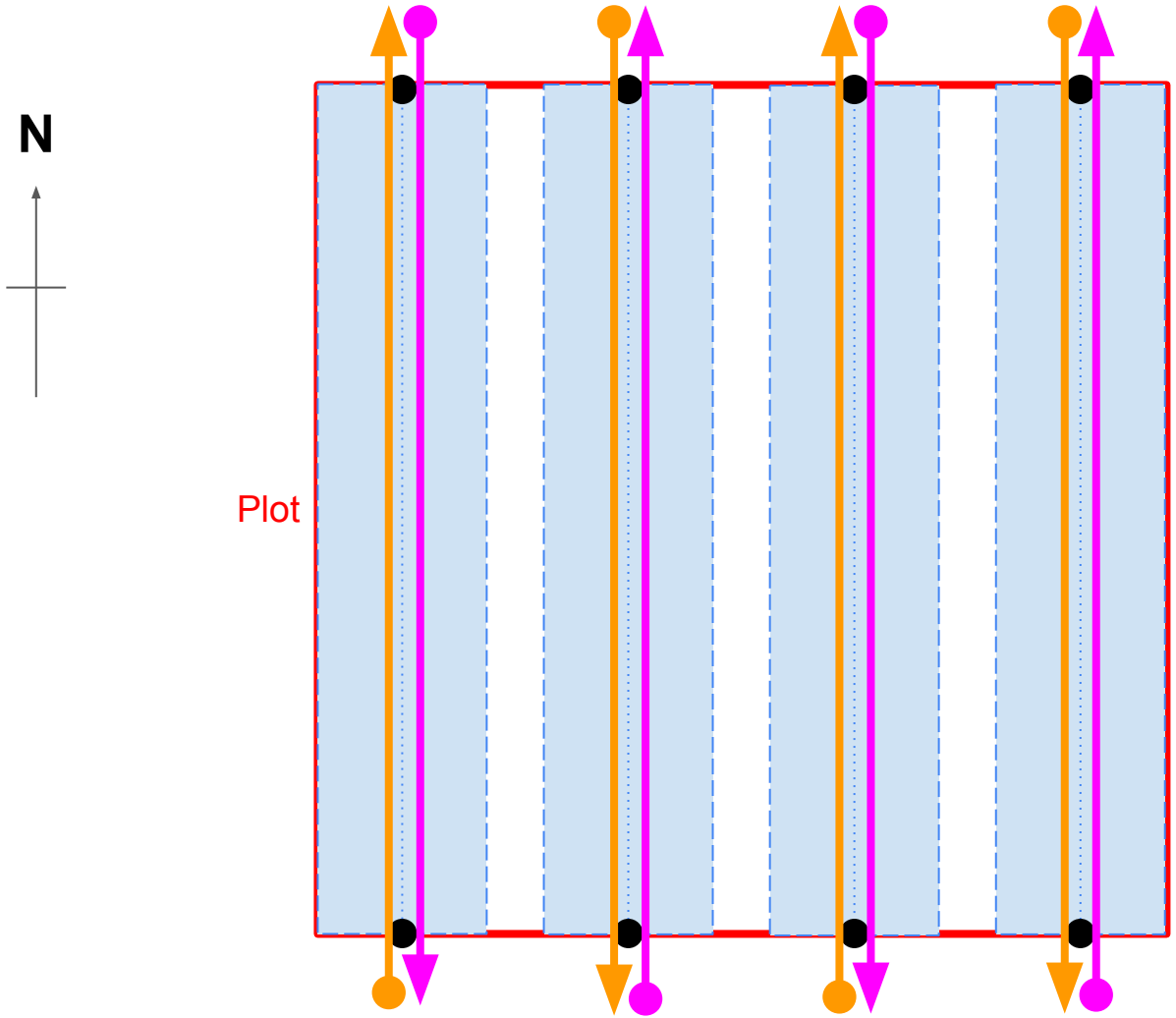

N
100m
N1
N2
N3
N4
Plot
1
2
3
4
100m
S1
S2
S3
S4
10m
6.6m
26.6m

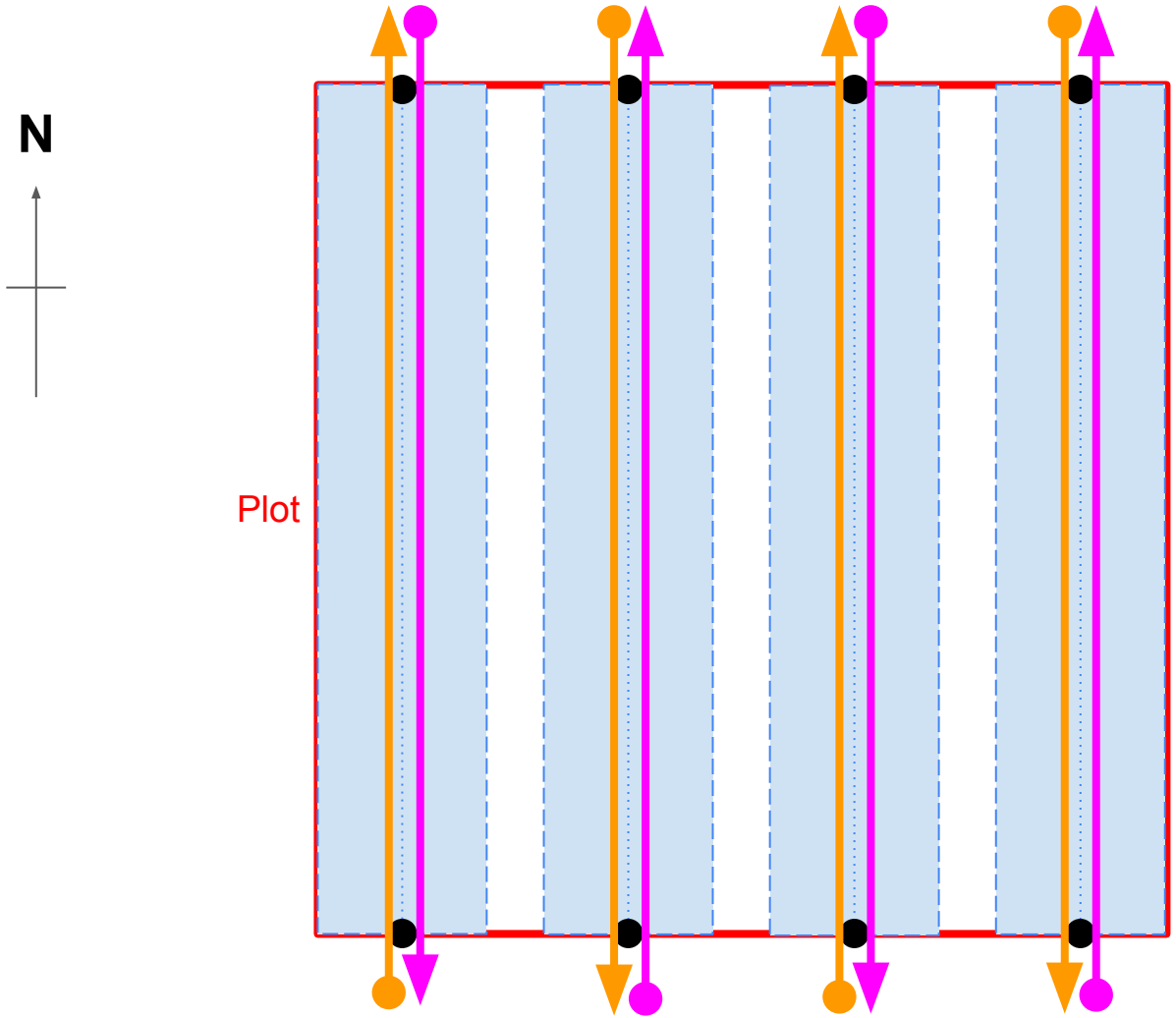


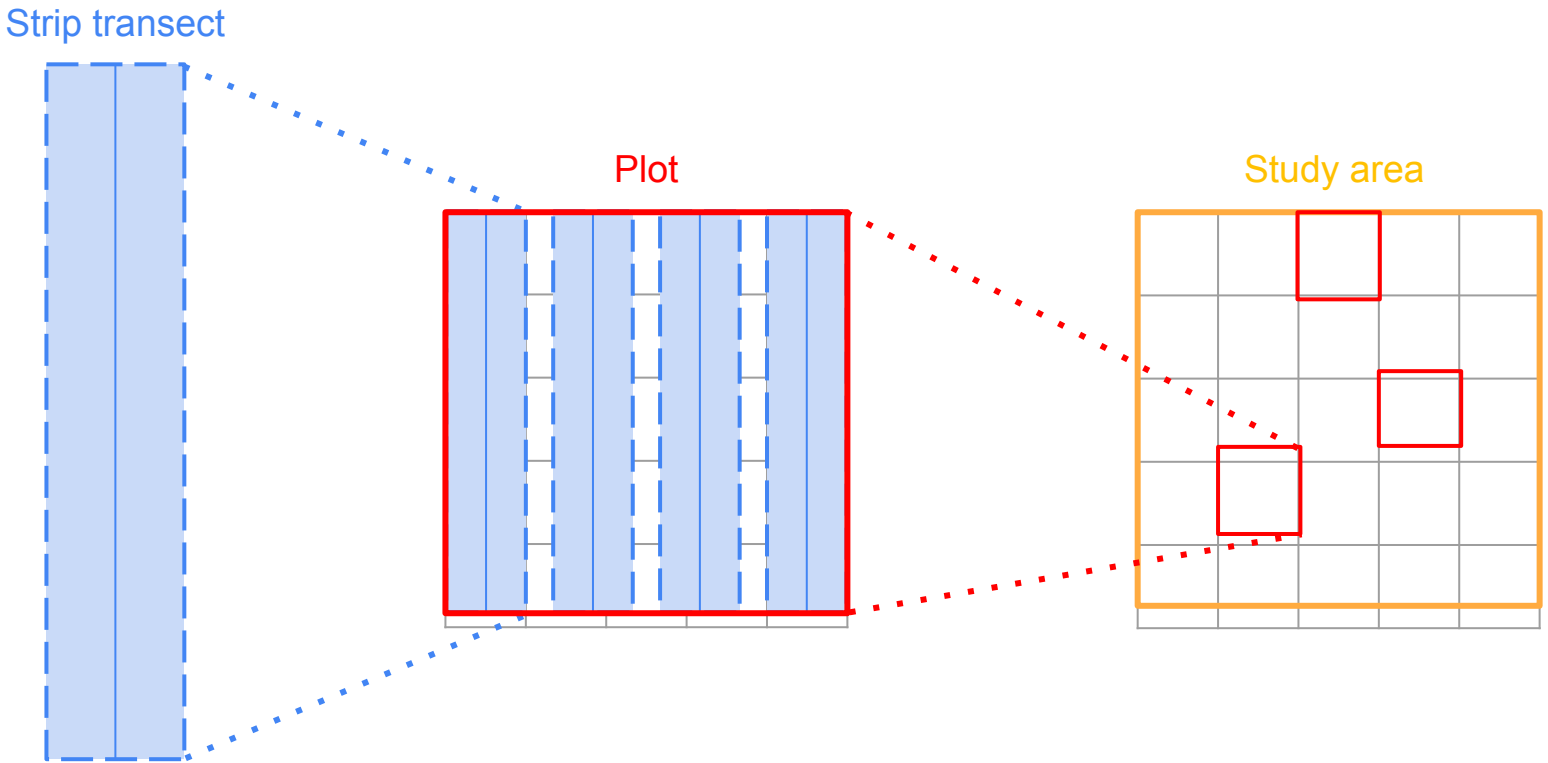
Trail setter
- *Cut and mark transects*

Navigator (person with a GPS)
- *Give direction to the trail setter*
- *Mark nests' GPS position*

Surveyor
- *Look for nests*
- *Record observations in survey form*


N
Plot


N
Plot


Strip transect
Plot
Study area

Study area size: 100km^2

Effort: 0.26% or 0.0026 (Boyko & Marshall 2010)

Survey efforts: 100km * 0.0026 = 0.26km^2

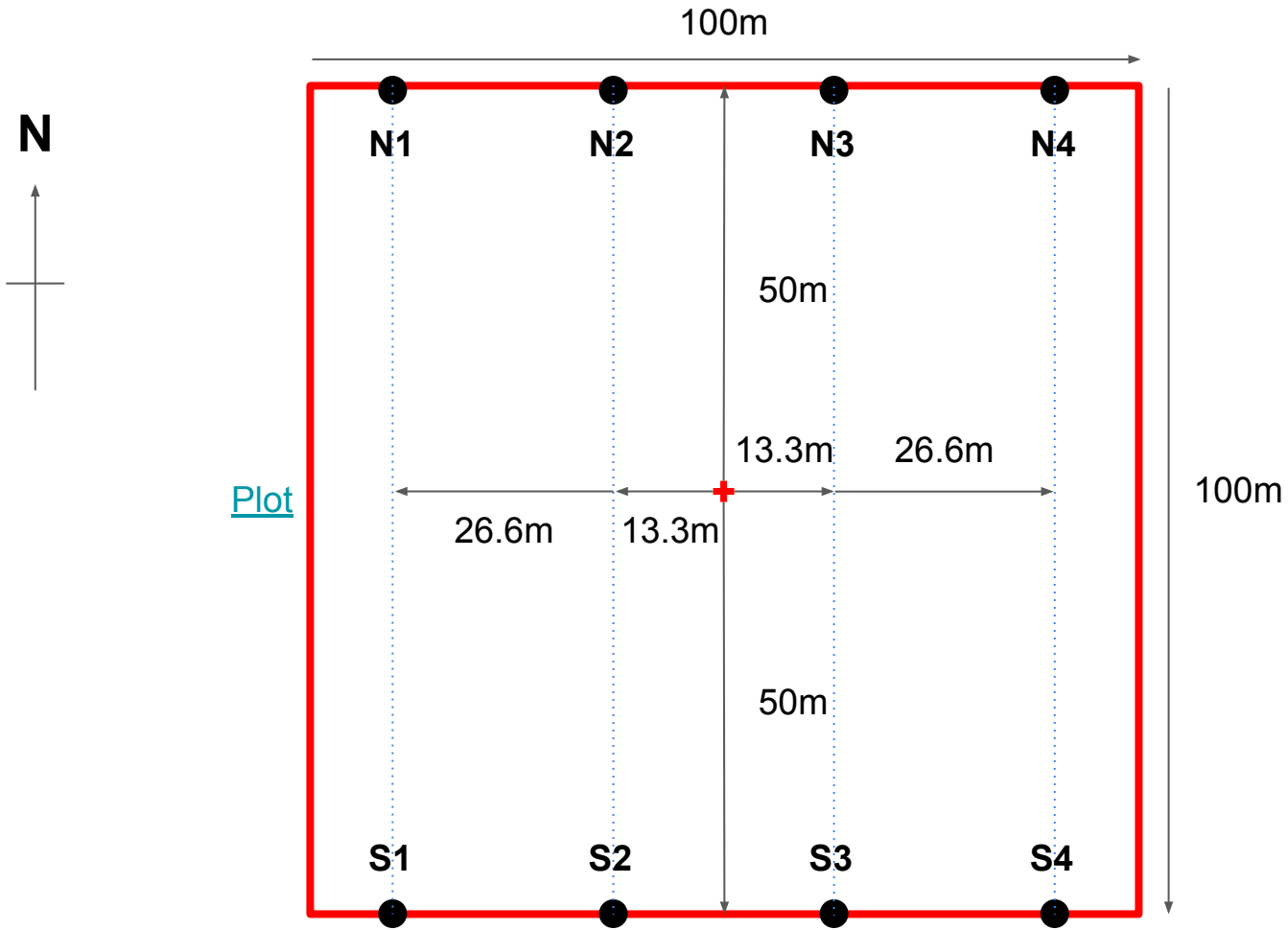
Plot size: 100m * 100m = 0.01km^2

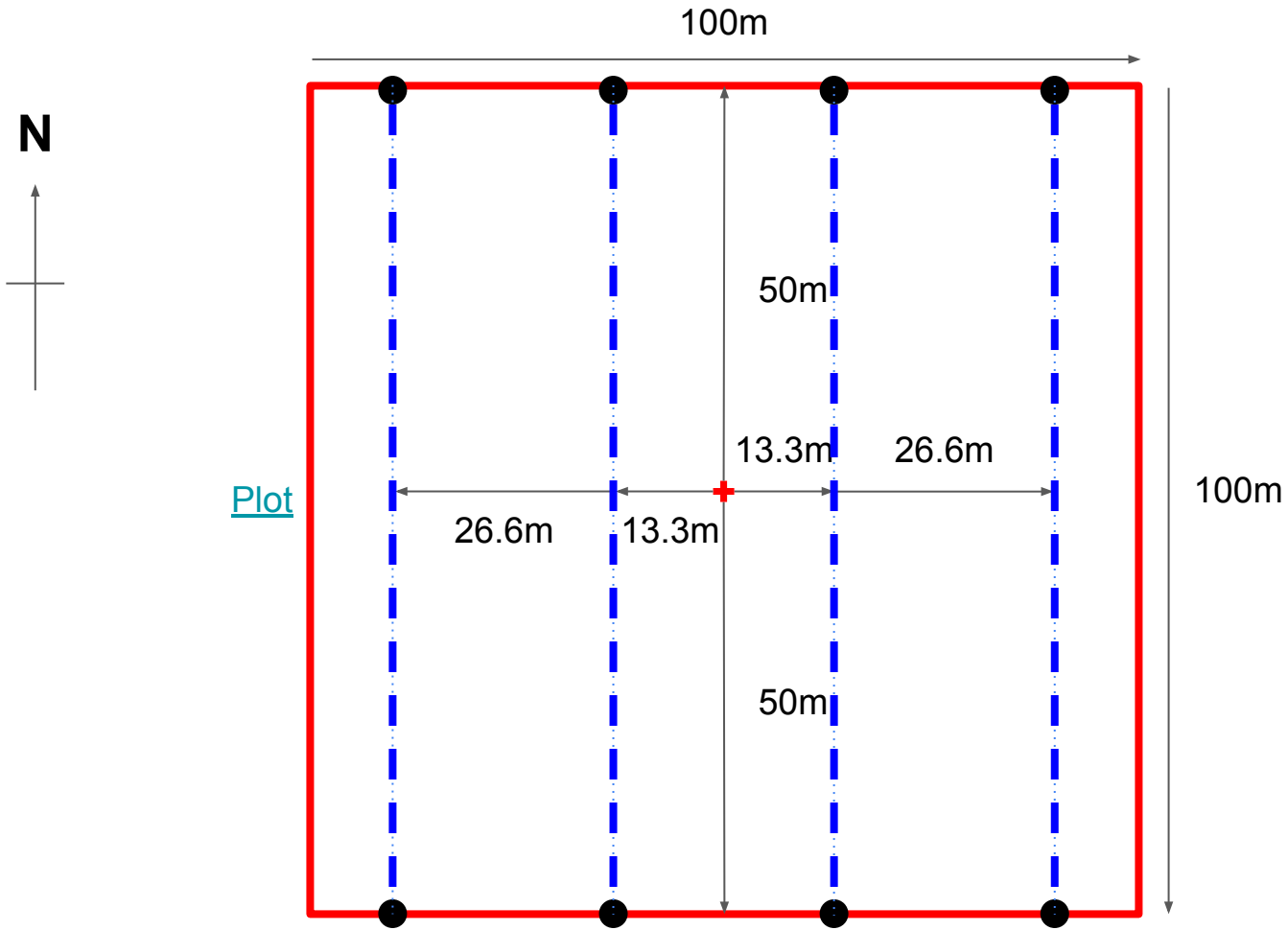
Number of plots: 0.26km^2 / 0.01km^2 = 26 plots

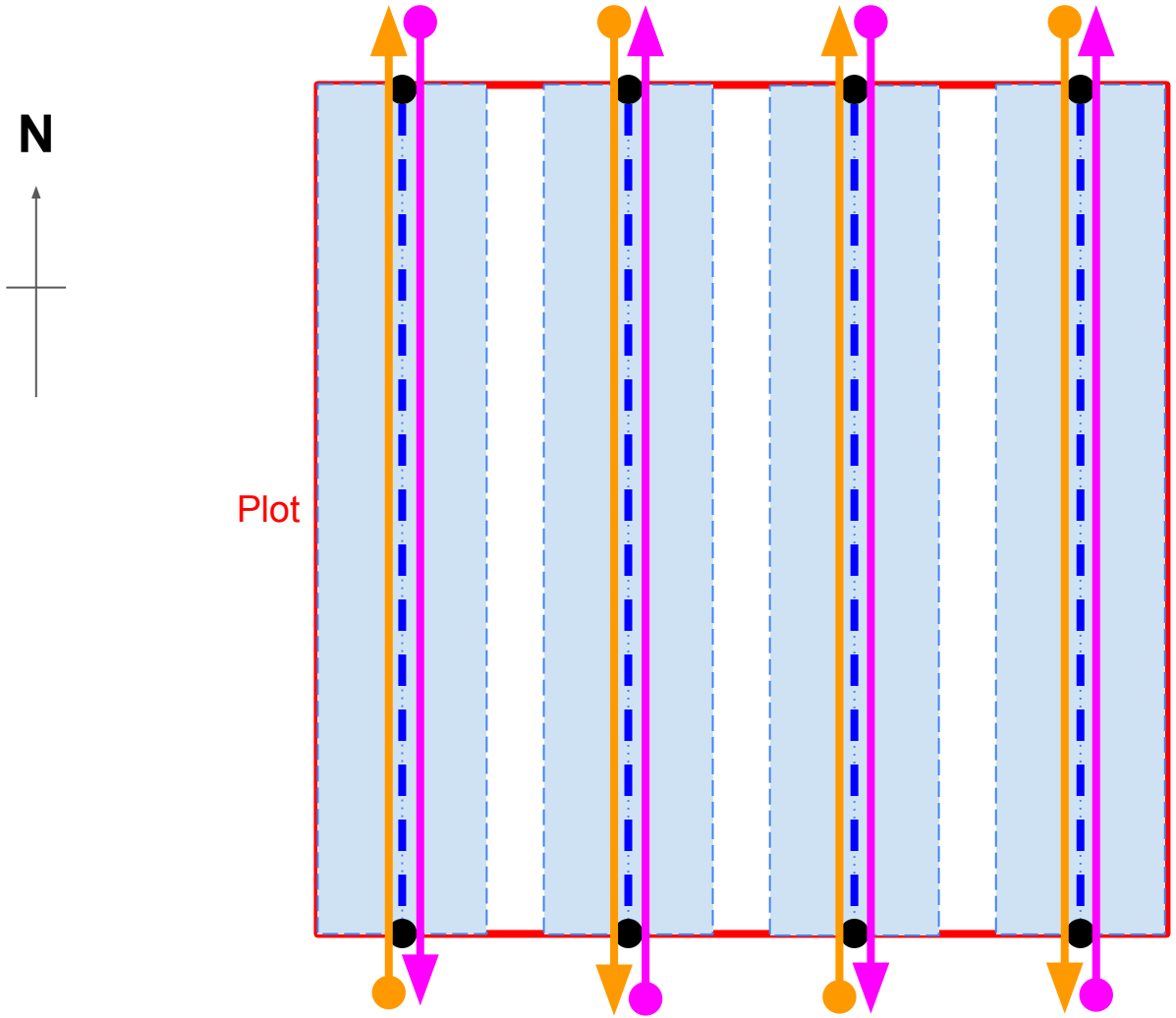
Summary

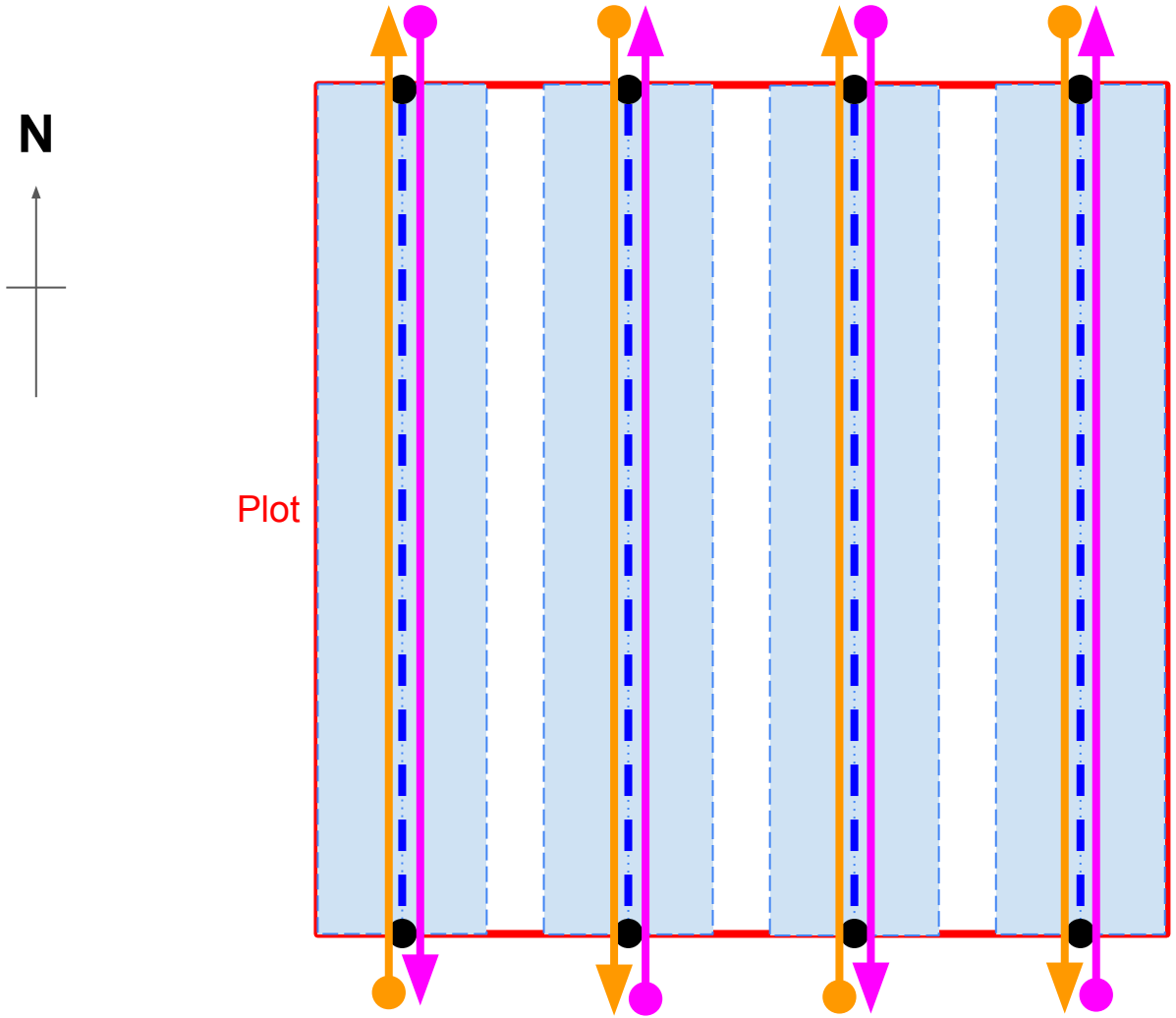
- MNC method measure the rate of nest accumulation between two points in time.
- Only nests that have been built recently (i.e., Stages A and B) are recorded during repeated surveys.
- Only one team can survey a transect at a time. Teams cannot share information or give clues to another team.
- Approximately 0.26% of the study area needed to be surveyed to achieve an accurate estimate of population size.

3. Field Practical


N
100m
N1
N2
N3
N4
50m
13.3m
26.6m
Plot
26.6m
13.3m
100m
50m
S1
S2
S3
S4

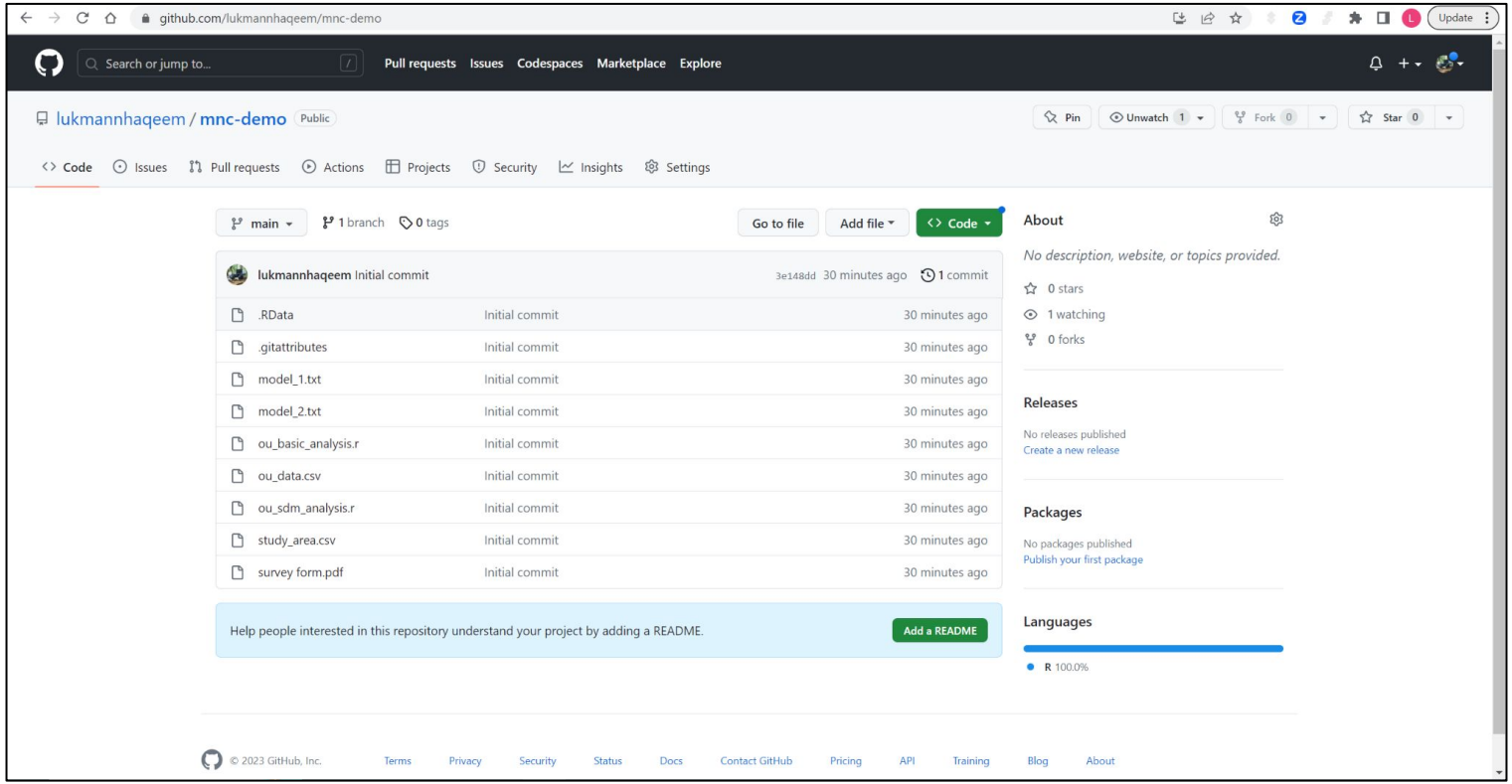

N
100m
50m
13.3m
26.6m
Plot
26.6m
13.3m
100m
50m

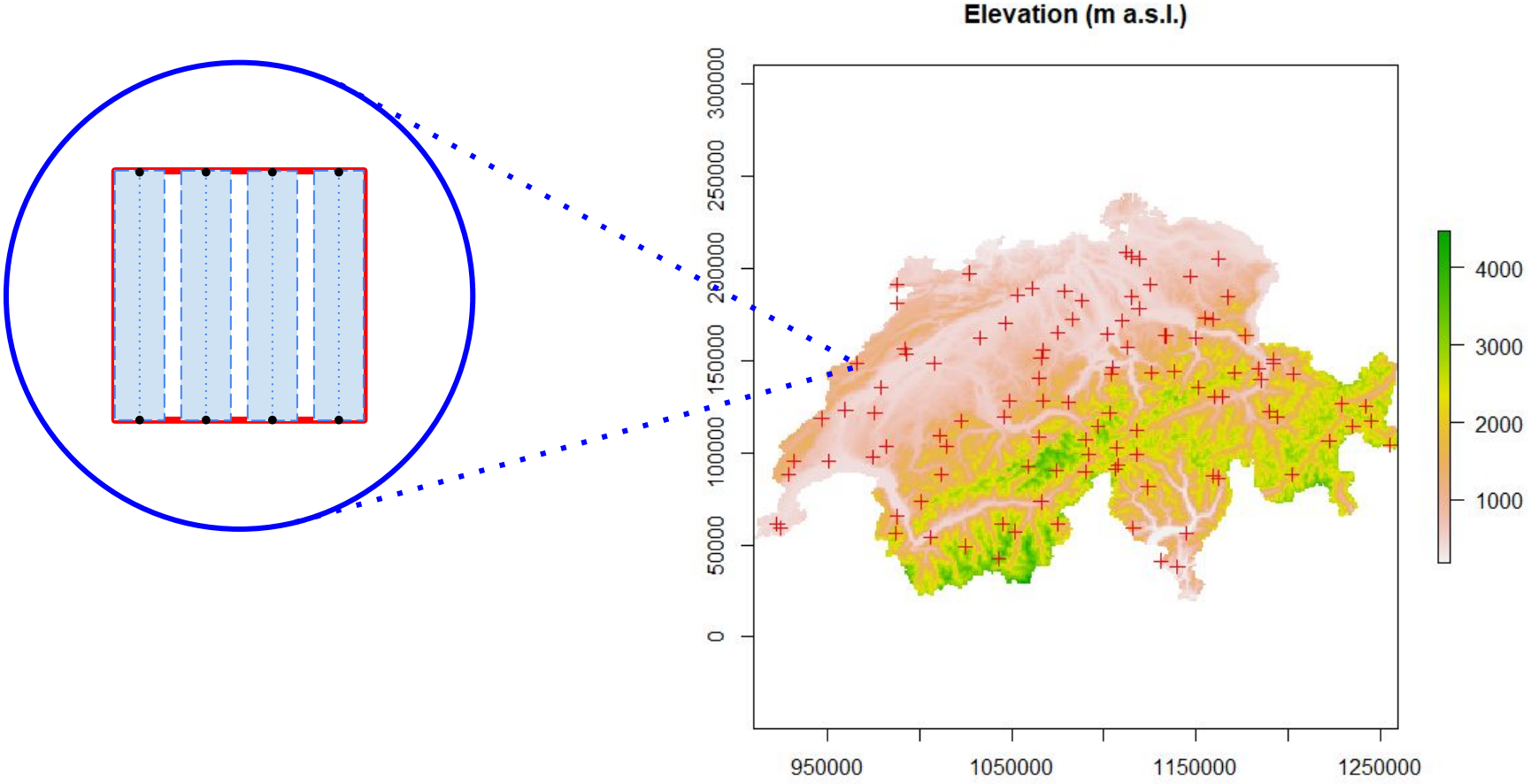

N
Plot


N
Plot

4.
Data management & analysis

github.com/lukmannhaqeem/mnc-demo




Elevation (m a.s.l.)
300000
250000
200000
150000
100000
50000
0
950000
1050000
1150000
1250000
4000
3000
2000
1000