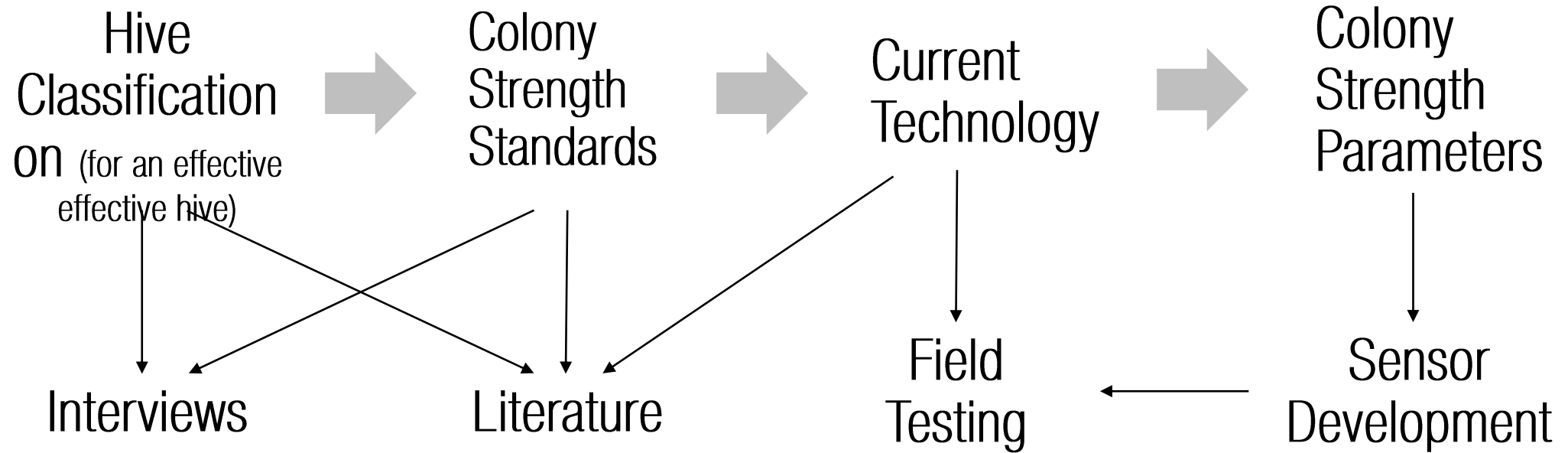


# Development of non-invasive and systems for assessment of health.

# PROJECT OVERVIEW

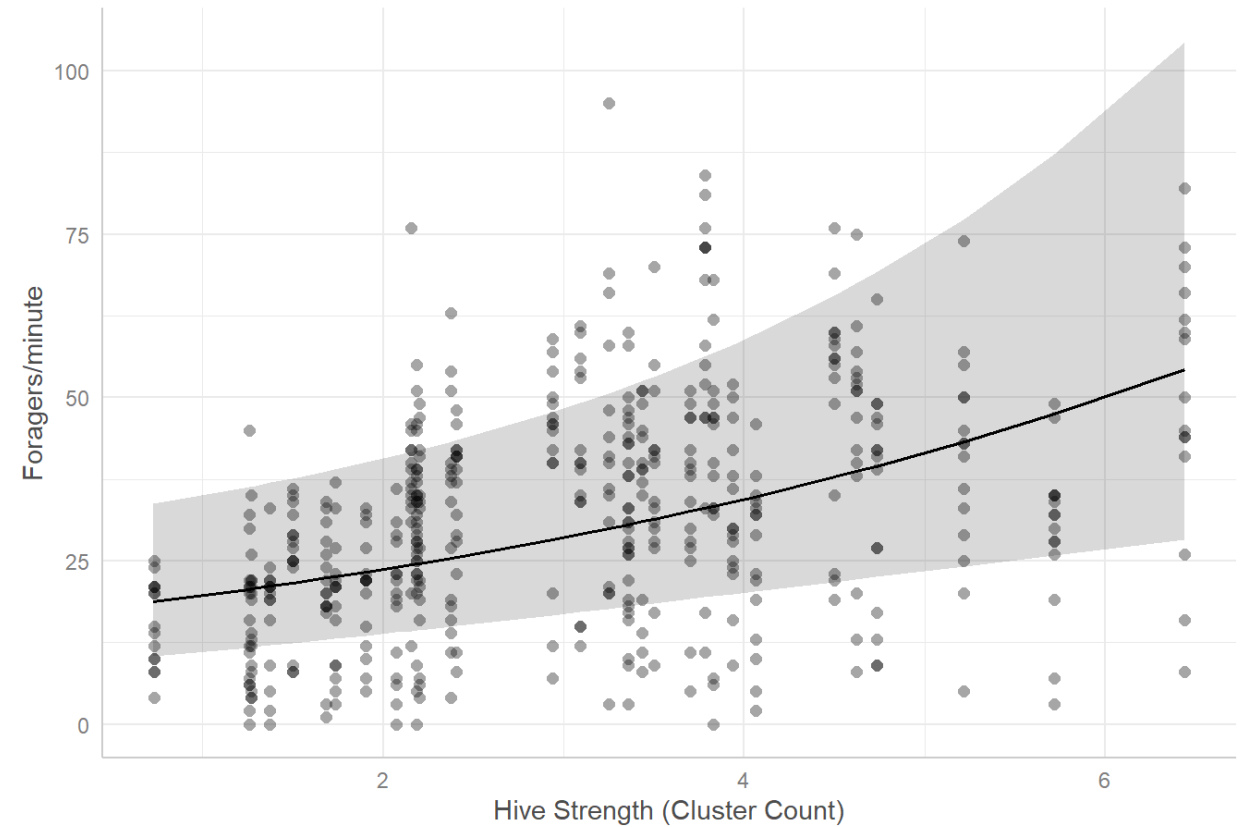


# HIVE CLASSIFICATION

- What makes an “effective” pollination hive?
- Large mobile foraging force
- Nectar or pollen driven foragers?
- Queen-right not important short-term
- Brood important for pollen driven crops

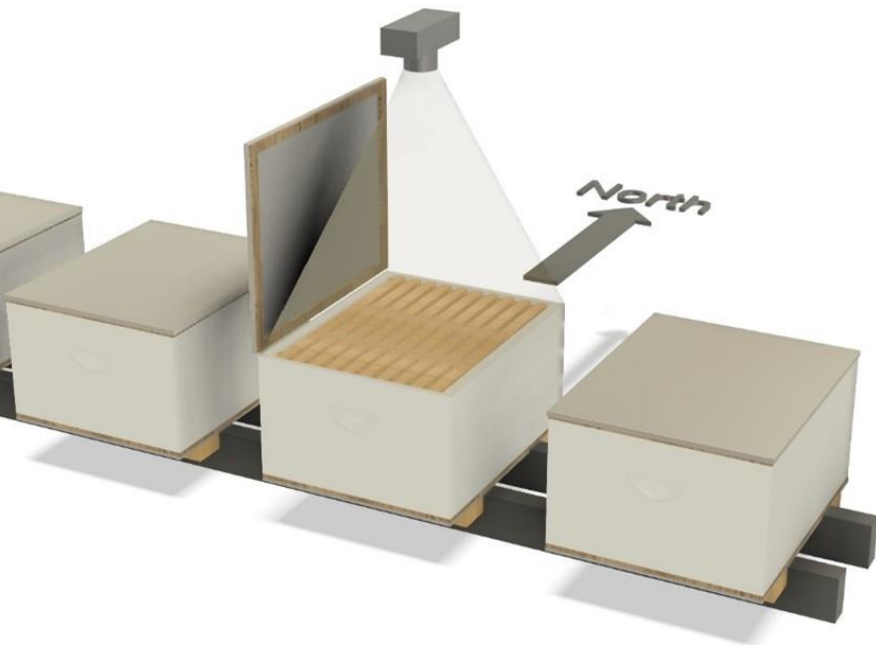
# COLONY STRENGTH STANDARDS

- 8 Frame standard
  - Sheesly & Poduska (1970) confirmed
  - No real reason for 8 frames.
- Three problems with “standards”



# PROBLEM 1

- Audits are subjective: rely on apiarist experiential knowledge.



Cluster Counter V1.0

Save to CSV Load CSV Help tips

Autoscroll Autoprogess Quit

-- Box Config --

Langstroth

9 Frame

Full Depth

Set Hive Type

-- Drawing --

Set Frame Length

Density % 100

Cluster Oval (NOF)


Cluster Rectangle (NOF)

Cluster Frames (NOF)

Inter-Frames (IFB)

-- Manual --

Manual audit



Set Image Folder

#	File	?	Type	Score	Hv#	Dens	Brood
7	1_1_202	N	?	0	-1	-1	0
8	1_1_202	N	?	0	-1	-1	0
9	1_1_202	N	?	0	-1	-1	0
10	1_1_202	N	?	0	-1	-1	0
11	1_1_202	N	?	0	-1	-1	0
12	1_1_202	N	?	0	-1	-1	0
13	1_1_202	N	?	0	-1	-1	0
14	1_1_202	N	?	0	-1	-1	0
15	1_1_202	N	?	0	-1	-1	0
16	1_1_202	N	?	0	-1	-1	0
17	1_1_202	N	?	0	-1	-1	0
18	1_1_202	N	?	0	-1	-1	0
19	1_1_202	N	?	0	-1	-1	0
20	1_1_202	N	?	0	-1	-1	0
21	1_1_202	N	?	0	-1	-1	0

Hive#: -1

Audit type: ?

Frames score: 0

Density %: -1

Hive Configuration: Langstroth -1 full

Image Navigation: << First <Prev(b) Image 14 of 94 Next(n)> Last >>|

Hive Number -1 -1 +1 Set Repeat

Image:1\_1\_20210413\_06-25-02.jpg of size(pixels) (4624, 2084)

# PROBLEM 2

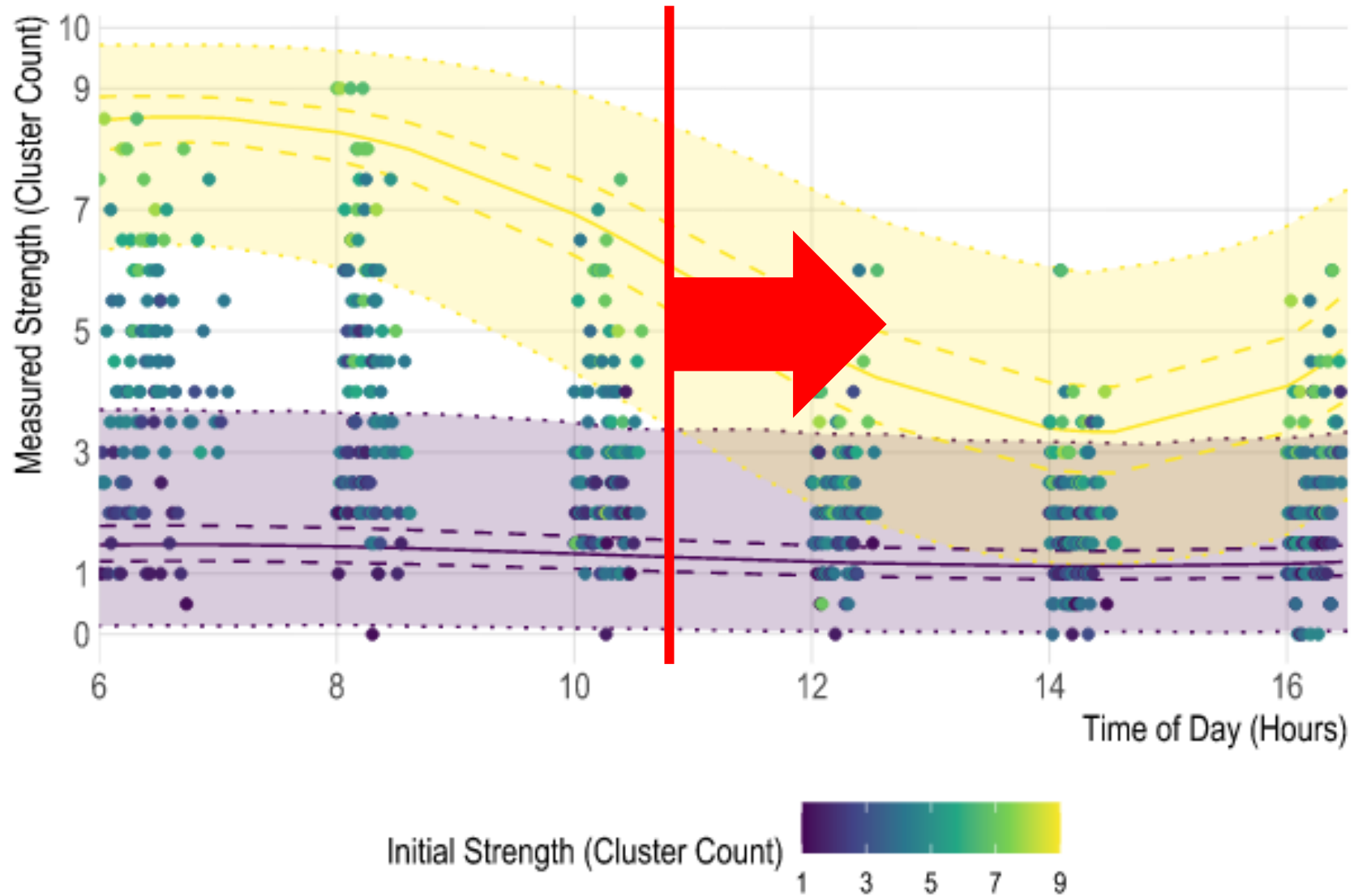
- Orchard specification is “Frames of Bees”
  - 1 Frame = Full depth, 75% bee coverage both sides
  - Sheesly & Poduska (1970)
- Almond audits use Nasr’s (1990) “Cluster Count” method

$$\textit{Frames of Bees} = 2.114 + (0.637 \cdot \textit{Cluster Count Score})$$

Nasr (1990)

- Cluster count of 9 = Frame count of 7.8

# PROBLEM 3



# APIARISTS ON SENSORS

- High cost of systems: small subset of hives monitored
- High reported failure rates
- Low trust of technology by apiarists
- Most systems give you data, not information...

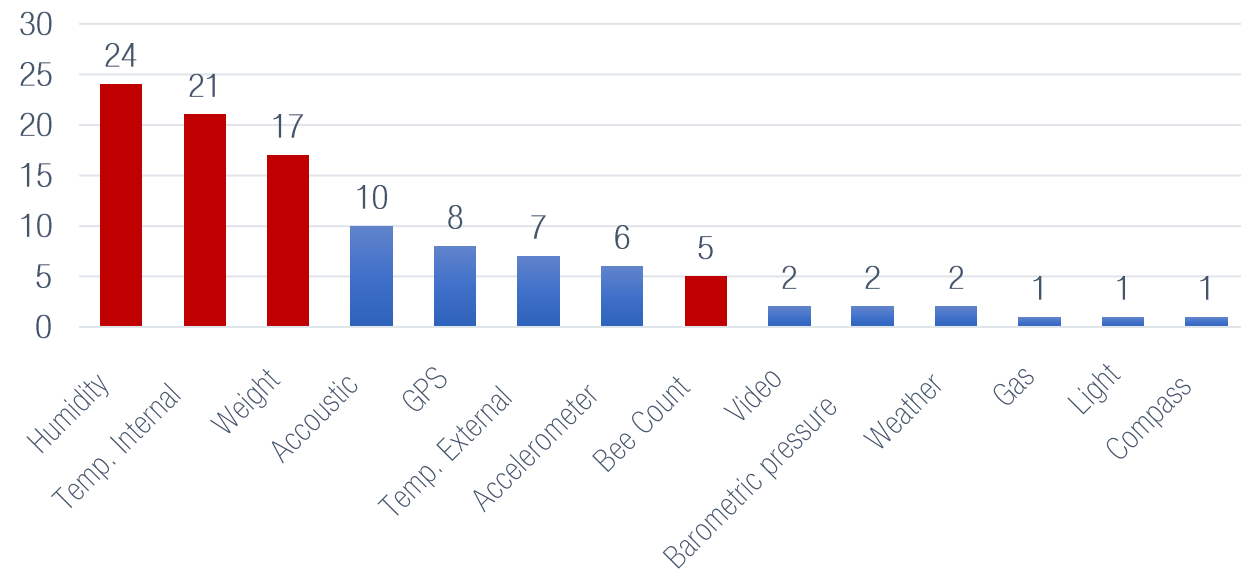


# COLONY PARAMETERS

- Linking colony parameters to strength

- Temperature
- Humidity
- Weight
- Bee Transit
- FLIR (thermal camera)

Sensor use in current hive technology



# COLONY PARAMETERS

- Colony parameters linked to strength

- Temperature
- Humidity
- Weight
- Bee Transit
- FLIR (thermal camera)

- Temperature correlates to strength
- Determined optimum sensor position
- For each frame of bees, 0.36°C increase
- Working on a prediction model
- Cook, D., Tarlinton, B., McGree, J. M., Blackler, A., & Hauxwell, C. (2022). Temperature Sensing and Honey Bee Colony Strength. *Journal of Economic Entomology*.  
<https://doi.org/10.1093/jee/toac034>

# COLONY PARAMETERS

- Colony parameters linked to strength
  - Temperature
  - Humidity
  - Weight
  - Bee Transit
  - FLIR (thermal camera)
- Likely links to strength
- Complex relationship
- Research in progress

# COLONY PARAMETERS

- Colony parameters linked to strength
  - Temperature
  - Humidity
  - **Weight**
  - Bee Transit
  - FLIR (thermal camera)
- Good indicator of historical foraging
- Does not indicate colony health or strength
- Analysis ongoing

# COLONY PARAMETERS

- Colony parameters linked to strength
  - Temperature
  - Humidity
  - Weight
  - Bee Transit
  - FLIR (thermal camera)
- Good indicator of foraging capability
- Does not indicate colony health
- Analysis ongoing

# COLONY PARAMETERS

- Colony parameters linked to strength
  - Temperature
  - Humidity
  - Weight
  - Bee Transit
  - FLIR (thermal camera)
- Tested Verifli (USA) System
- Mixed results
  - $\pm$  2-3 frame error margin
  - Hive material issues
- Technology may be too young for accuracy

# THE SOLUTION?

- Longitudinal Quality Assurance Systems
- Measure the apiarist, not the hive. (i.e. BQUAL)
- Breeding, feeding, disease management, transport, sustainability
- Better processes = better bees = better pollination

**THANK YOU.**