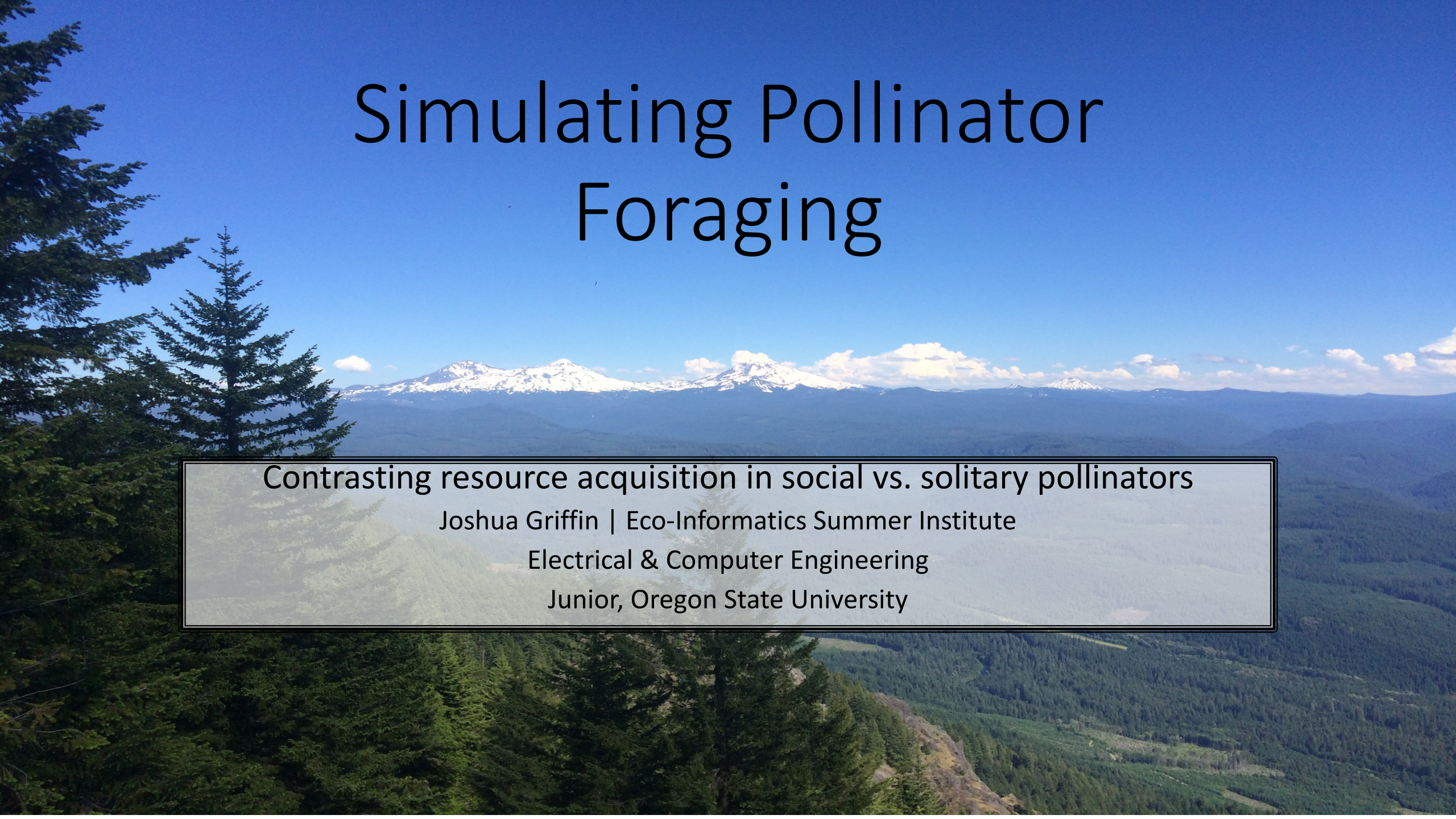


Simulating Pollinator Foraging

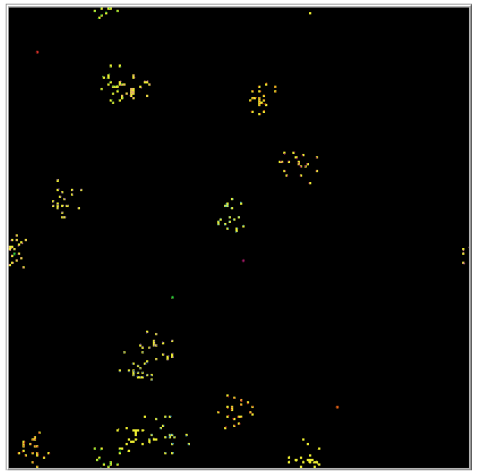
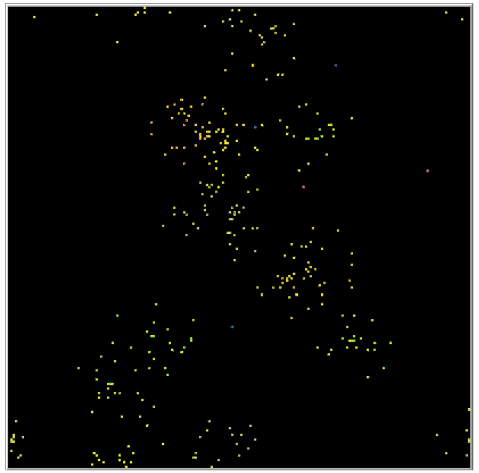
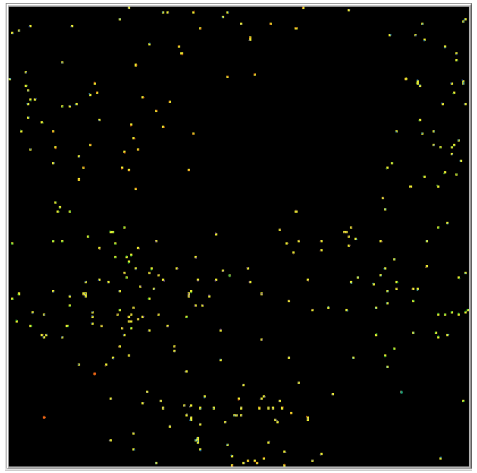
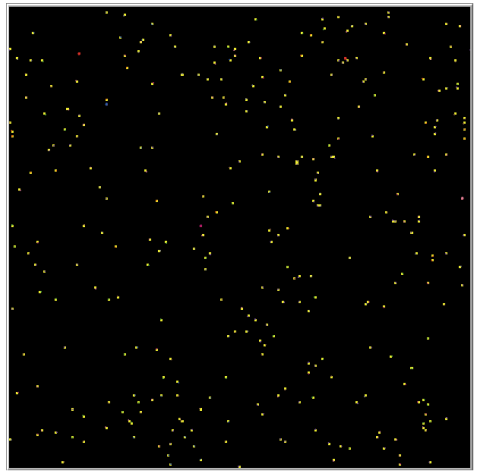
Contrasting resource acquisition in social vs. solitary pollinators

Joshua Griffin | Eco-Informatics Summer Institute

Electrical & Computer Engineering

Junior, Oregon State University

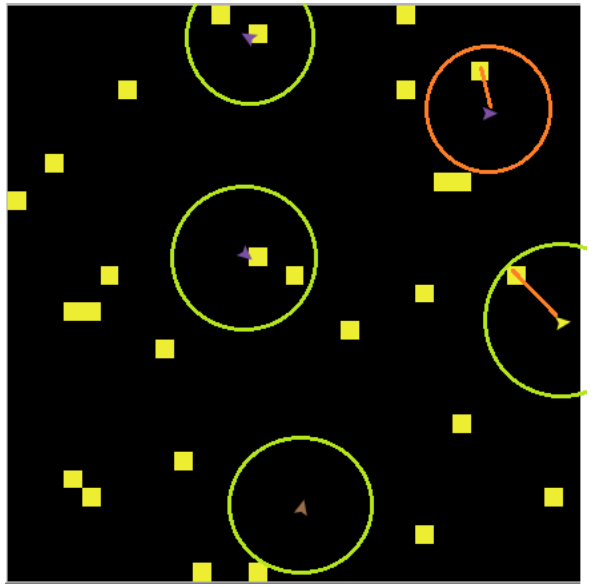
Resource Clustering

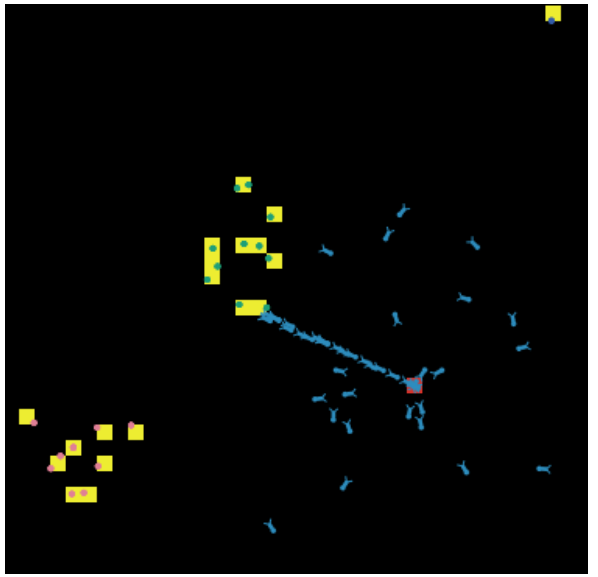







Pollinator Behavior types

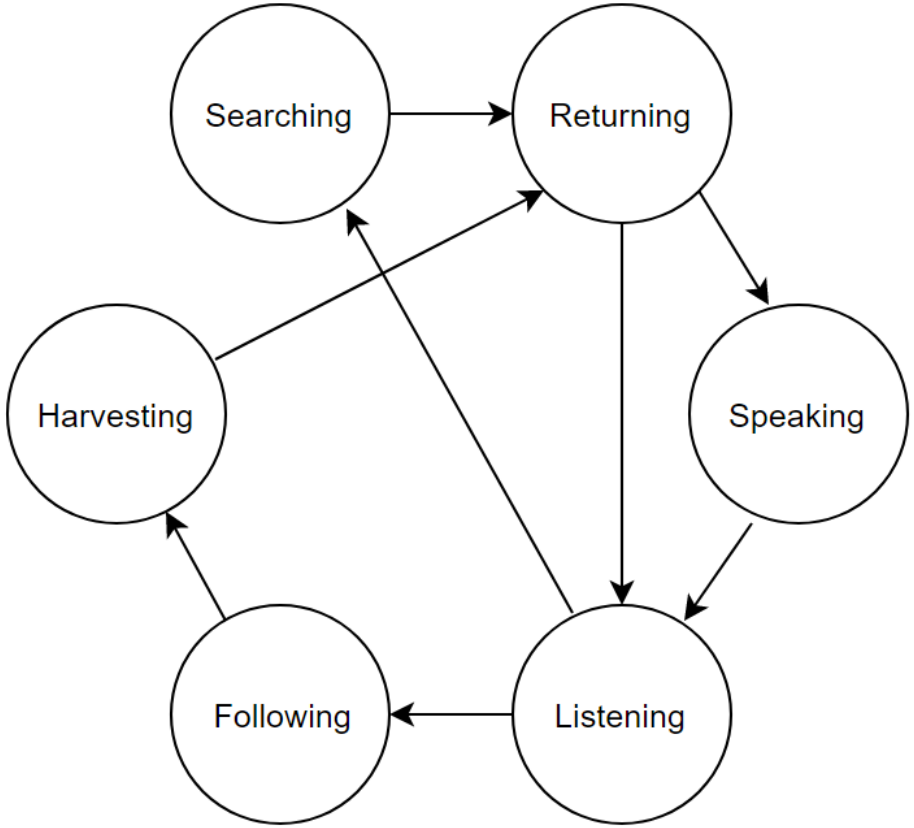
- Solitary
  - Movement is independent of other pollinators
- Social
  - Communicate location of flowers to other pollinators
  - Communication occurs at a central “hive”
- Random
  - This is used as a control
  - Movement is random within a forward moving range.





Traits of Social Agents

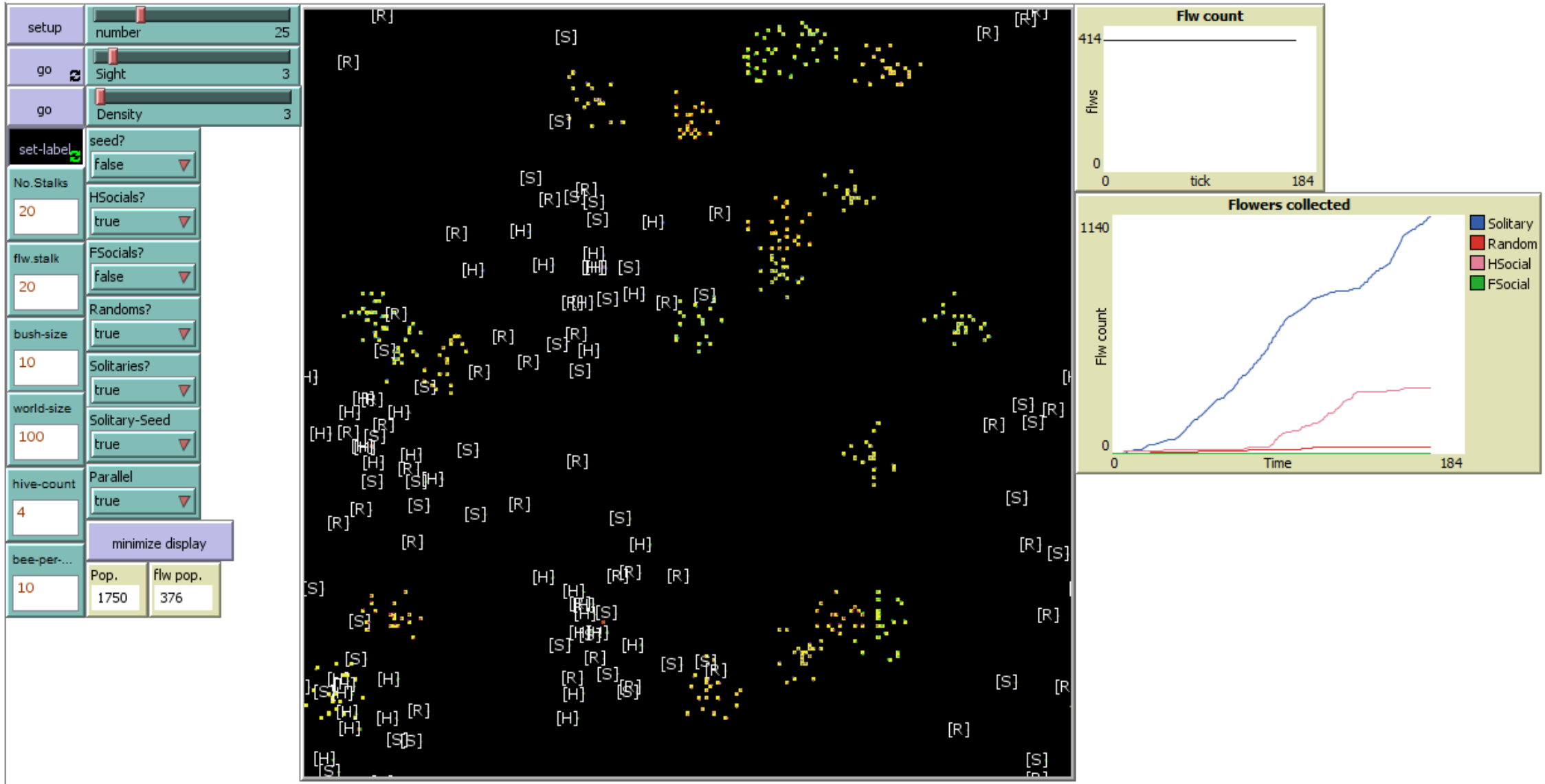
- All agents have a small sensory range. Agents will travel directly to flowers within that range
- Modelled as a state machine; each state is governed by a different motive

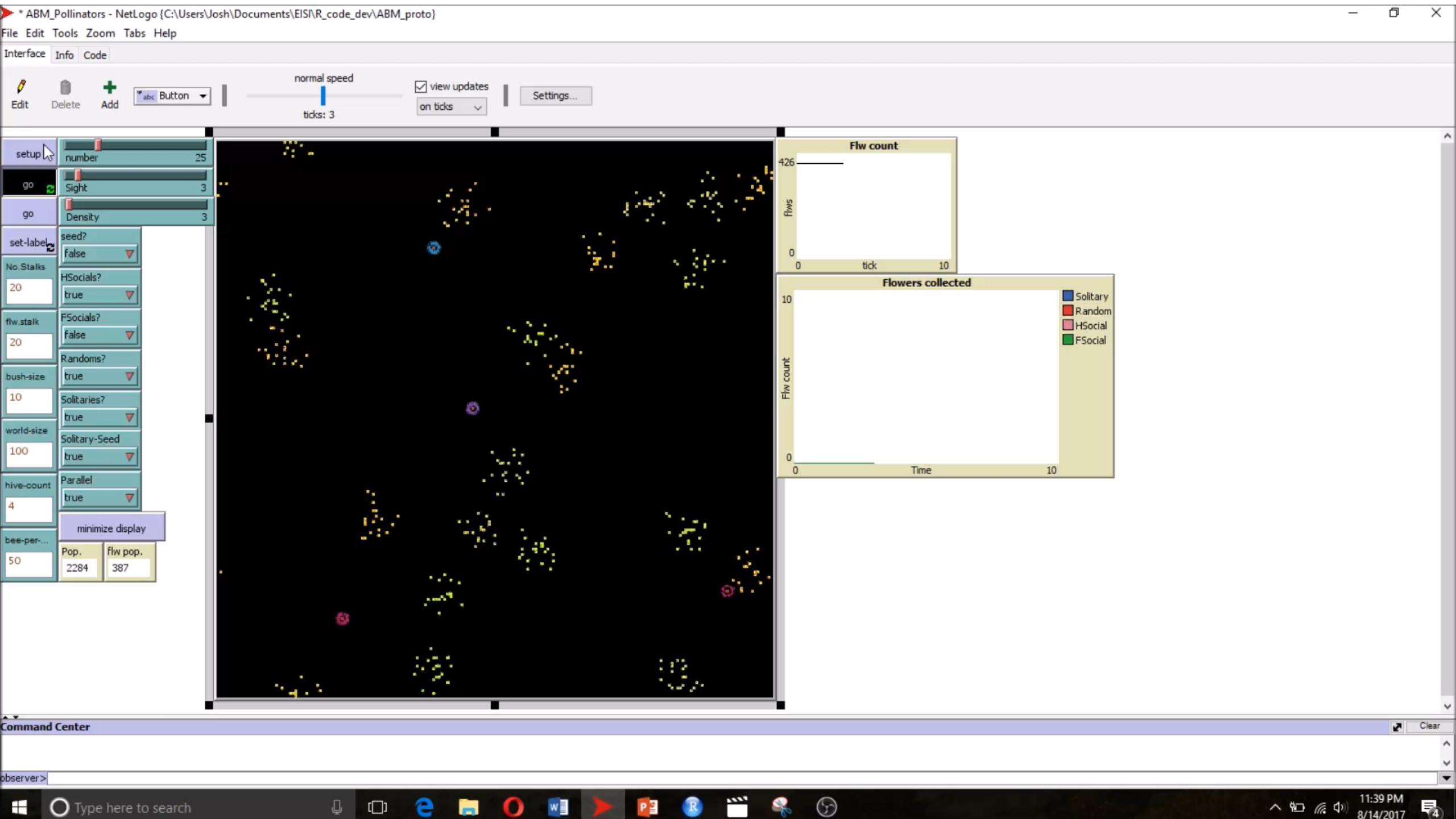


Methods/Predictions

- Plot: Harvested Flowers vs. Time
- Social:
  - Expected: Faster resource acquisition when resources are in tight clusters.
- Solitary:
  - Expected: Faster resource acquisition when resources are dispersed.
- Simulation method:
  - 10 cluster radius settings
  - 100 trials per cluster radius
  - 1000 time-steps
- Use Simulation to design better experiments

Graphic User Interface




* ABM_Pollinators - NetLogo {C:\Users\Josh\Documents\EISI\R_code_dev\ABM_proto}
File Edit Tools Zoom Tabs Help
Interface Info Code
Edit
Delete
Add
Button
normal speed
ticks: 3
view updates
on ticks
Settings...
setup
go
go
set-label
number 25
Sight 3
Density 3
seed? false
HSocials? true
FSocials? false
Randoms? true
Solitaries? true
Solitary-Seed true
Parallel true
No.Stalks 20
flw.stalk 20
bush-size 10
world-size 100
hive-count 4
bee-per-... 50
minimize display
Pop. 2284
flw pop. 387
Flw count
426
flws
0
0
tick
10
Flowers collected
10
Flw count
0
0
Time
10
Solitary
Random
HSocial
FSocial
Command Center
Clear
observer>
Type here to search
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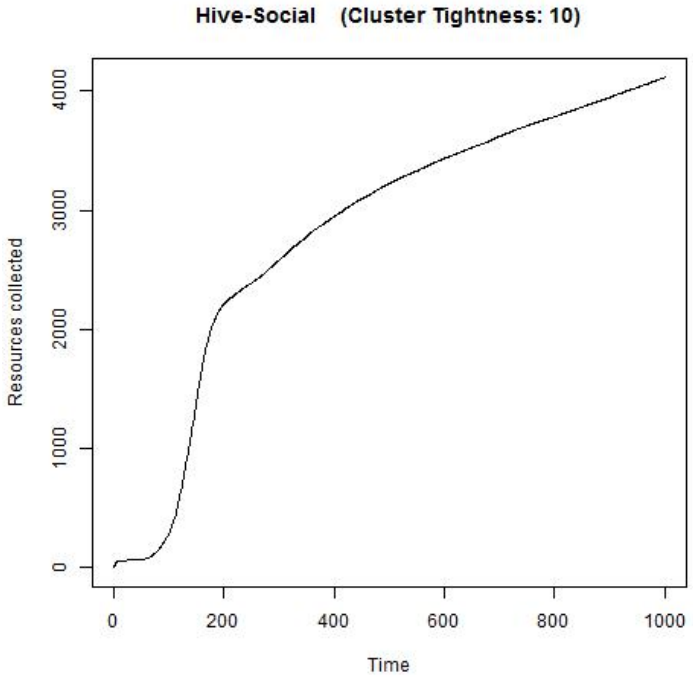
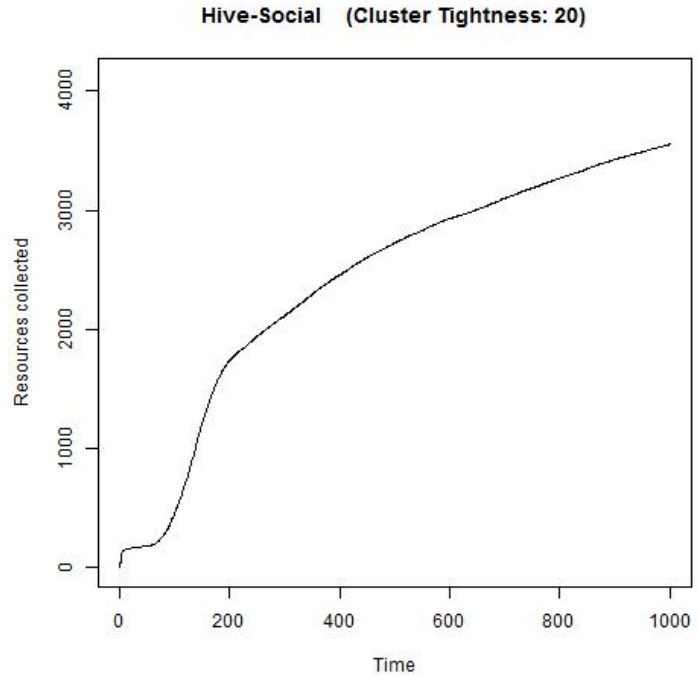
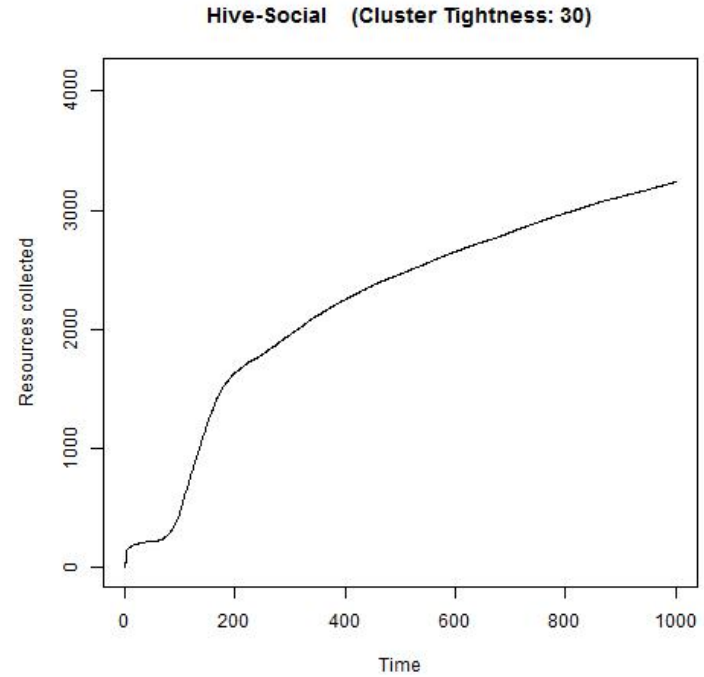
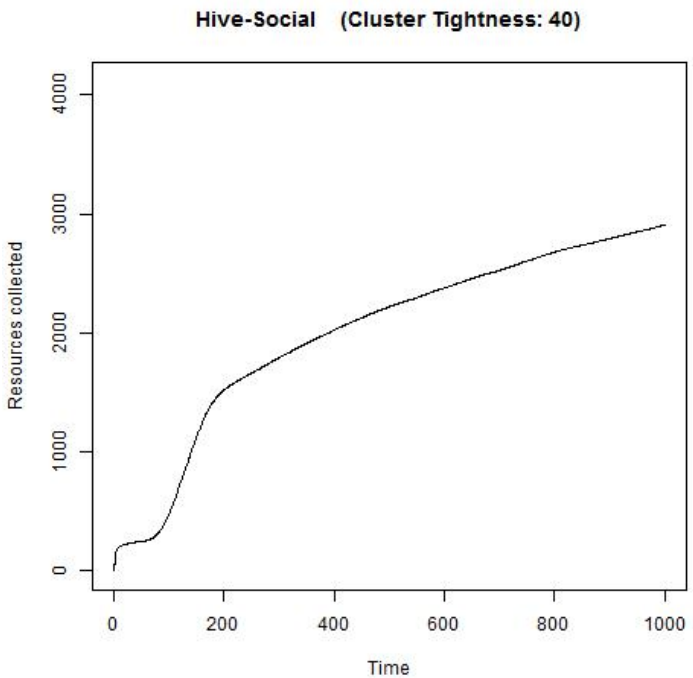
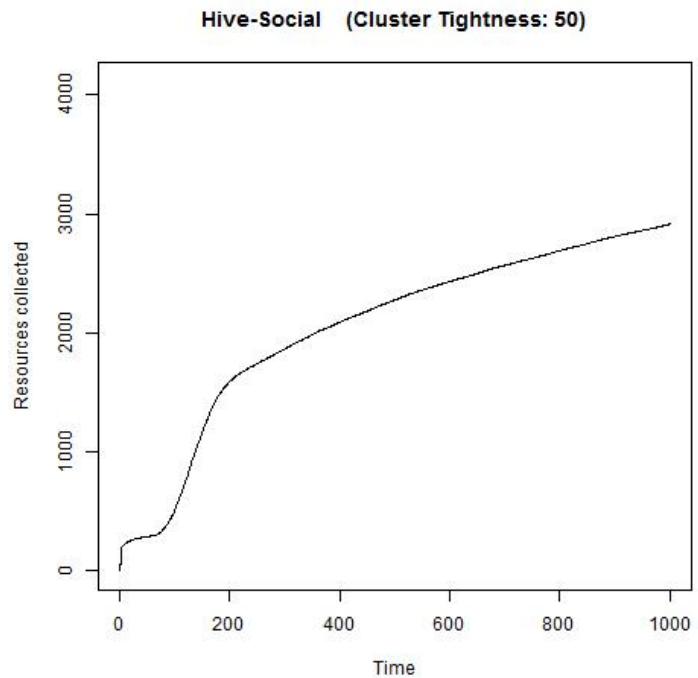
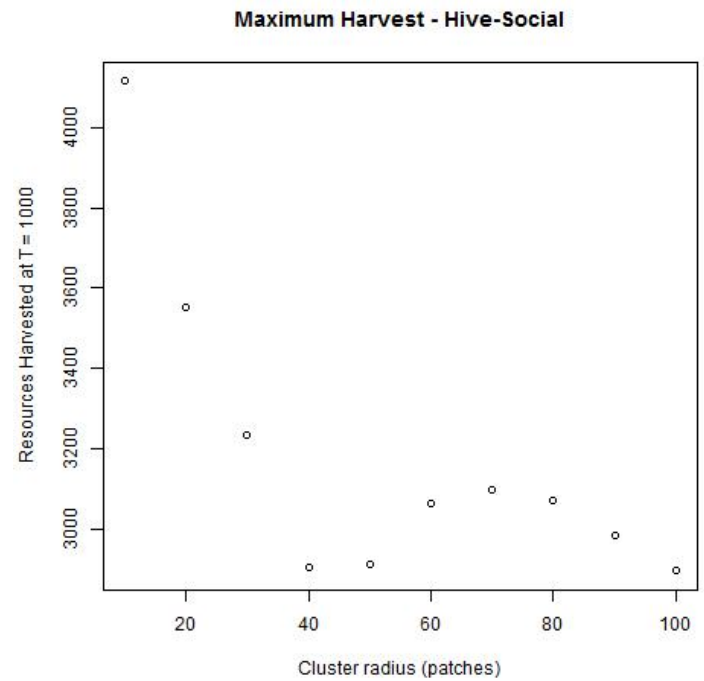

Hive-Social (Cluster Tightness: 10)
Resources collected
Time
0
1000
2000
3000
4000
0
200
400
600
800
1000

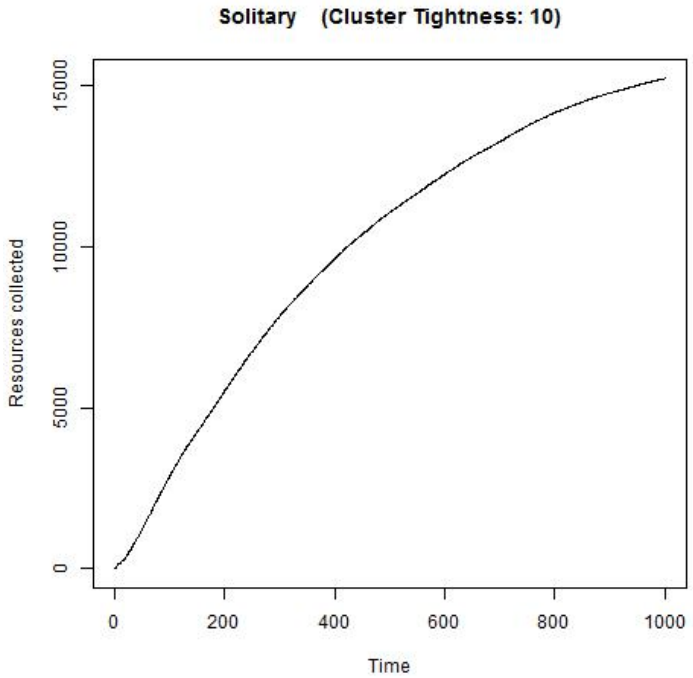

Hive-Social (Cluster Tightness: 20)
Resources collected
Time
0
1000
2000
3000
4000
0
200
400
600
800
1000

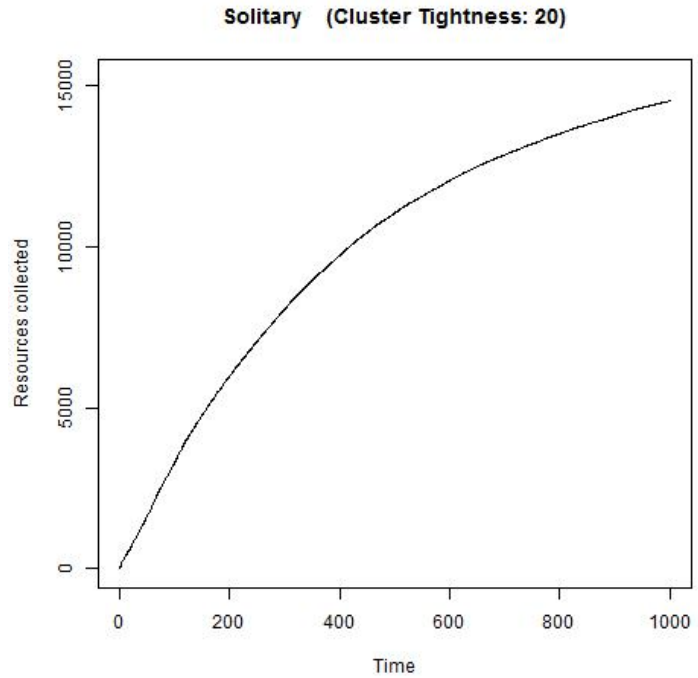

Hive-Social (Cluster Tightness: 30)
Resources collected
Time
0
1000
2000
3000
4000
0
200
400
600
800
1000

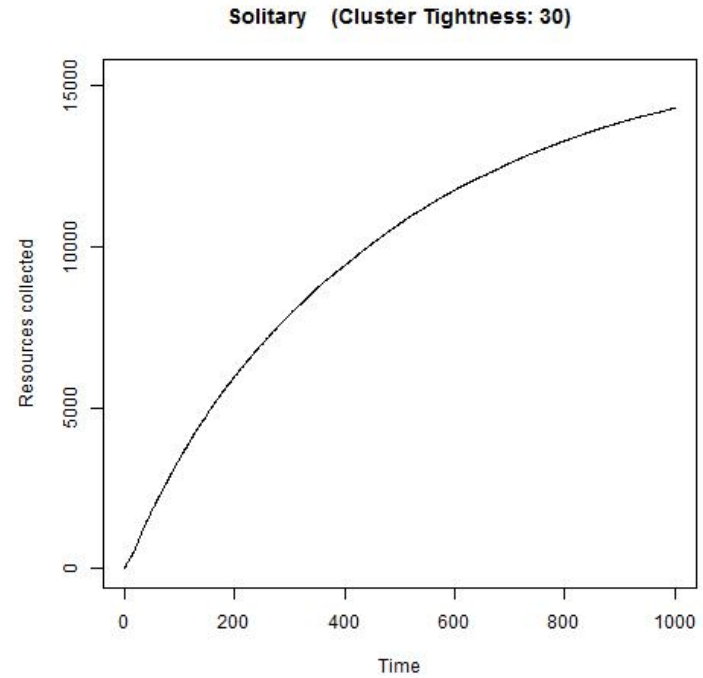

Hive-Social (Cluster Tightness: 40)
Resources collected
Time
0
1000
2000
3000
4000
0
200
400
600
800
1000

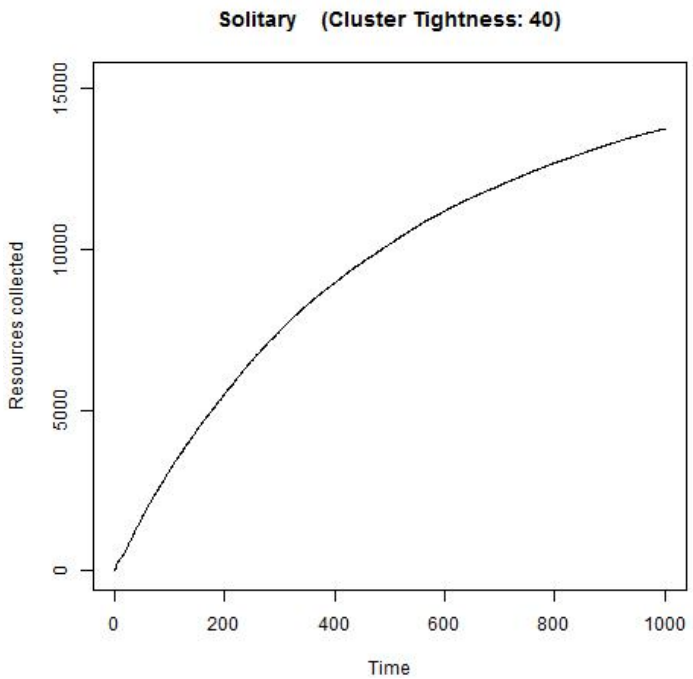

Hive-Social (Cluster Tightness: 50)
Resources collected
Time
0
1000
2000
3000
4000
0
200
400
600
800
1000

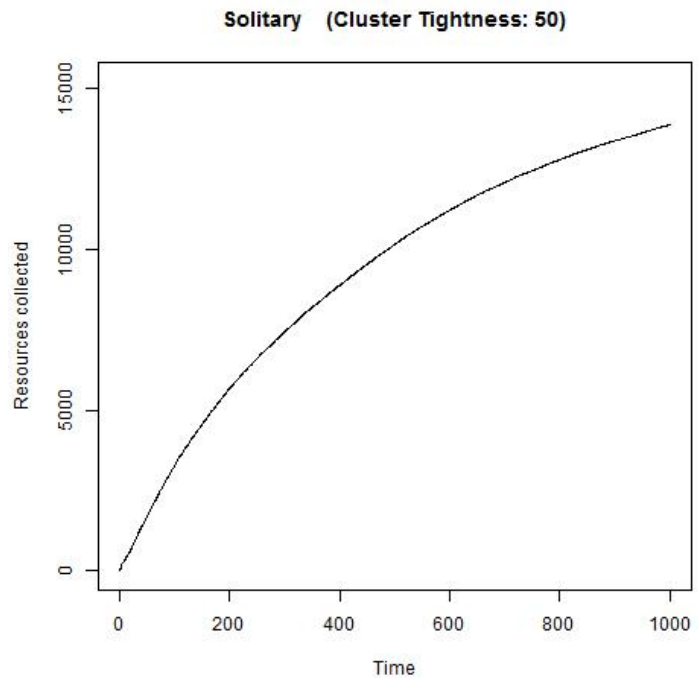

Maximum Harvest - Hive-Social
Resources Harvested at T = 1000
Cluster radius (patches)
3000
3200
3400
3600
3800
4000
20
40
60
80
100

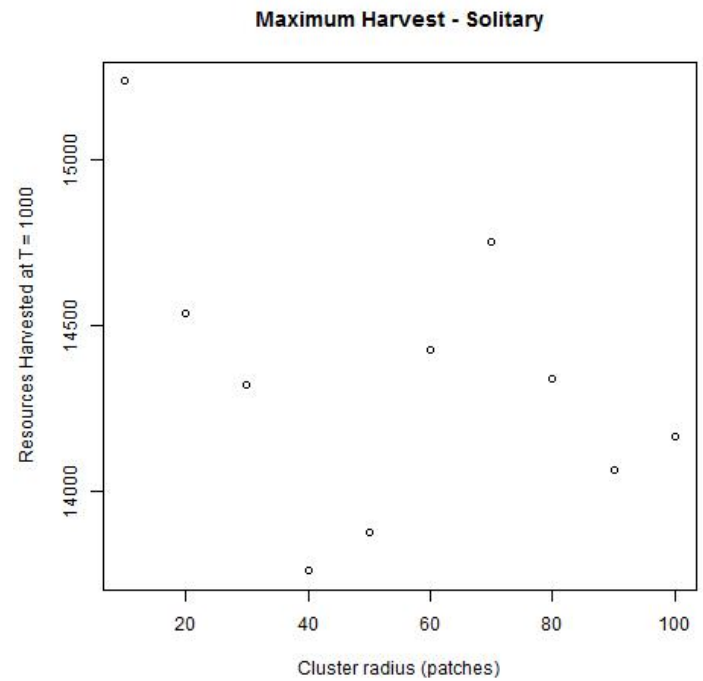

Solitary (Cluster Tightness: 10)
Resources collected
0
5000
10000
15000
0
200
400
600
800
1000
Time


Solitary (Cluster Tightness: 20)
Resources collected
0
5000
10000
15000
0
200
400
600
800
1000
Time


Solitary (Cluster Tightness: 30)
Resources collected
0
5000
10000
15000
0
200
400
600
800
1000
Time


Solitary (Cluster Tightness: 40)
Resources collected
0
5000
10000
15000
0
200
400
600
800
1000
Time


Solitary (Cluster Tightness: 50)
Resources collected
0
5000
10000
15000
0
200
400
600
800
1000
Time


Maximum Harvest - Solitary
Resources Harvested at T = 1000
14000
14500
15000
20
40
60
80
100
Cluster radius (patches)

Conclusion

- Partial validation of my hypothesis
  - Social bees gather more resources when flowers are clustered
  - Solitary bees do not respond to changes in clustering

Thank you to Oregon State, H.J Andrews, and the advisors that made this possible!