

Driftwood

Self-Regulating Access to Natural Resources

Modeling and Simulation of Complex Systems

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Problem Statement

- Resource competition for driftwood collection on coastal shores
- Ownership marked by stone placement
- Theft possible when unobserved
- Need for effective self-regulation

Key Research Question

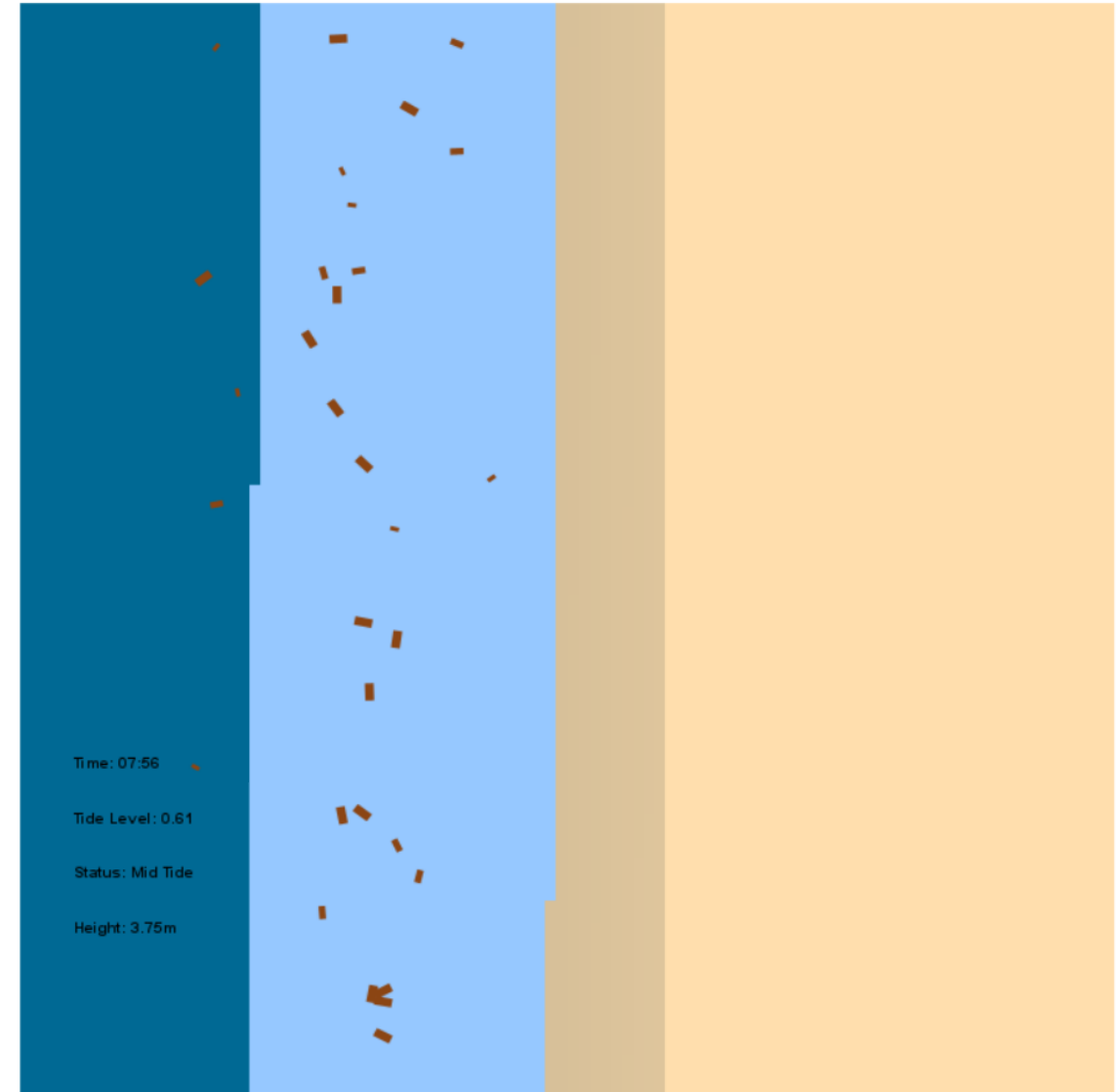
- Is it possible to achieve a stable resource management system through:
 - Peer pressure regulation
 - External enforcement
 - Group dynamics

Spatial Organization

- Deep Sea Zone (20% width)
- Tidal Zone (20-65%)
- Sandy Beach Zone (65-100%)

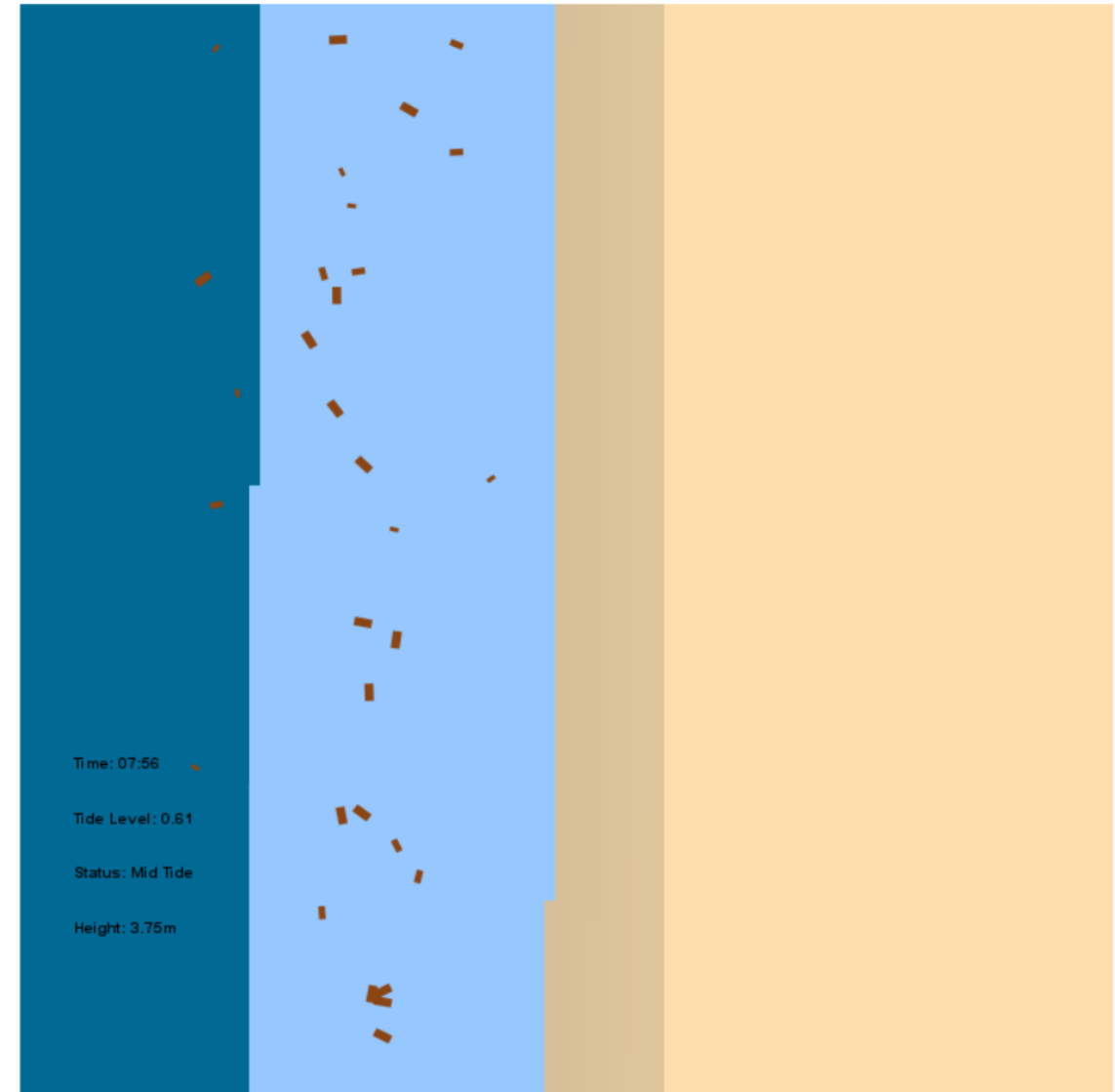
Dynamic Systems

- 24-hour day/night cycle
- Synchronized tidal system
 - Rising: 0:00–6:00 and 12:00–18:00
 - Falling: 6:00–12:00 and 18:00–24:00
- Wave dynamics with parametric control
- Water depth calculations and beach topography



Driftwood

- 3 sizes:
 - Large: 5
 - Medium: 3
 - Small: 1
- Tide influenced movement
- Wave influenced movement



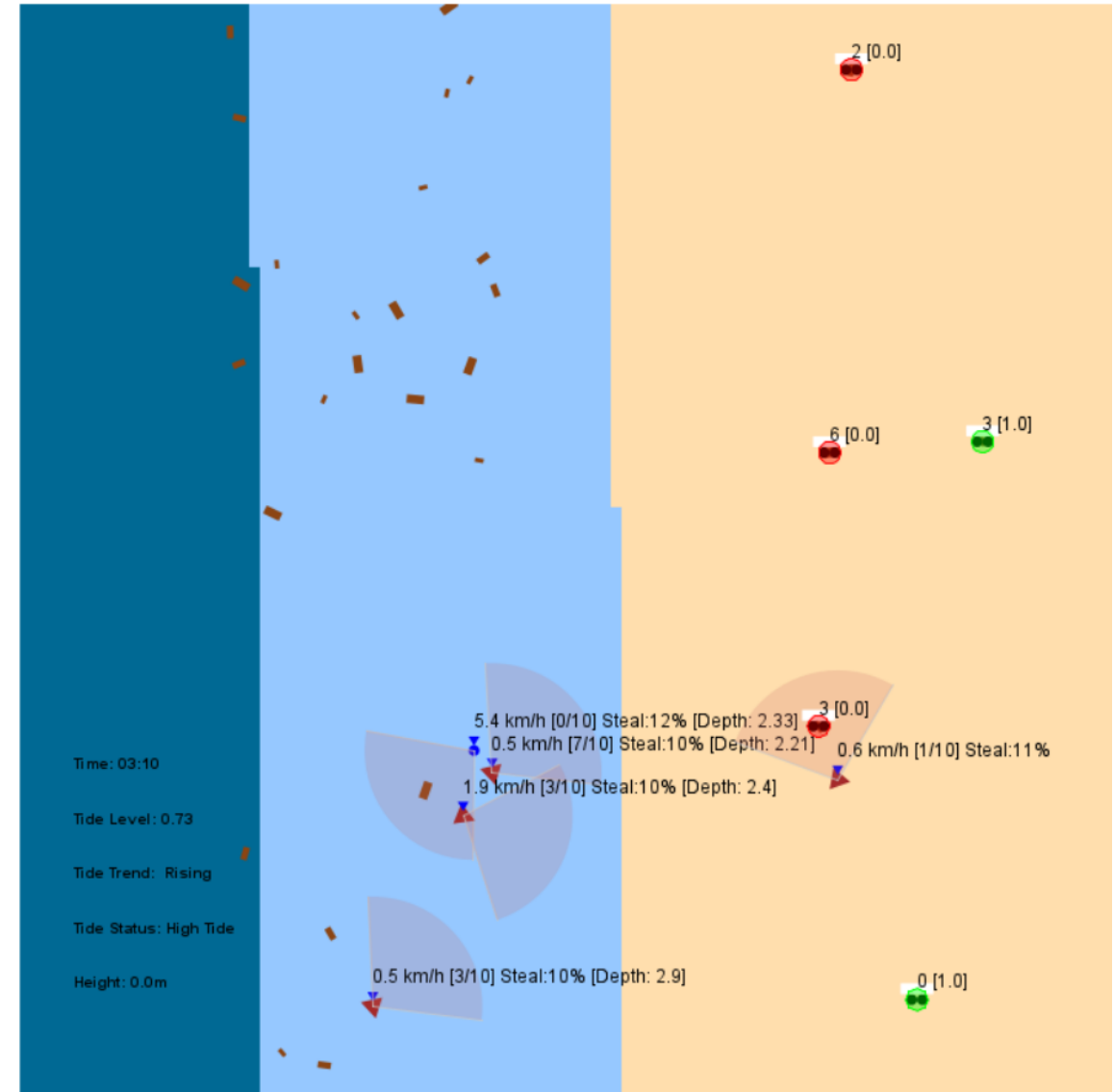
Extension 1: Self-Regulation and Pile Ownership

Collector Behavior

- Speed: 0-8 km/h
- Carrying capacity: 10 units
- Field of view: 100 degrees, 10m range
- Greediness factor: 0.3-0.8

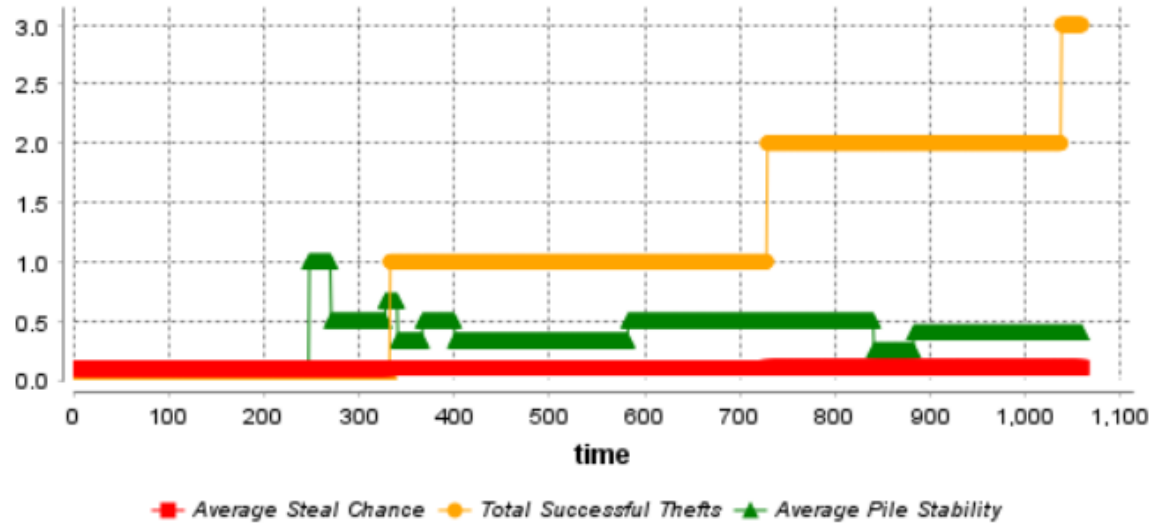
Theft Mechanics

- Initial steal chance: 10%
- Maximum: 20%
- Success-based increase: 1%

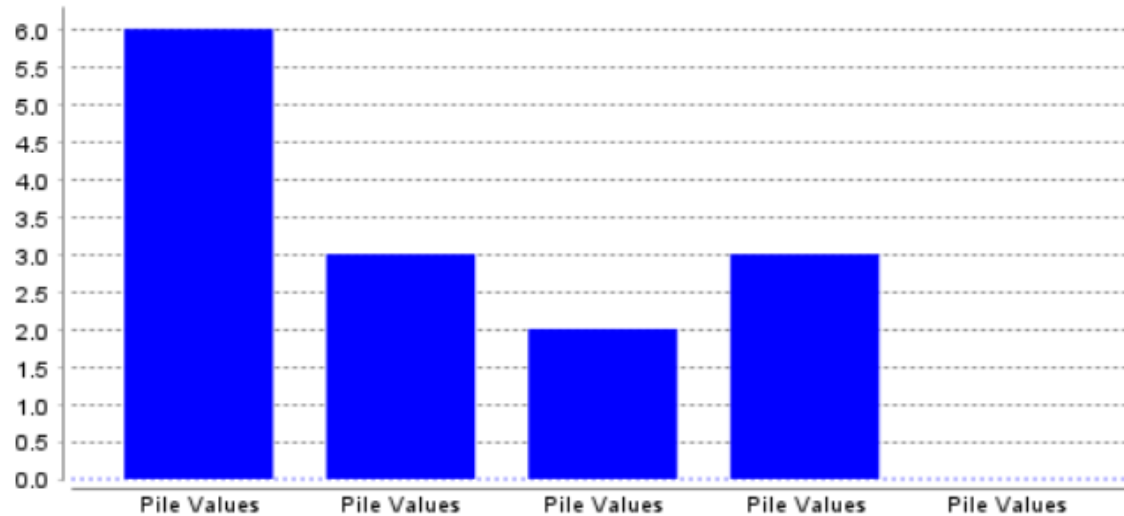


Ext1: Self-Regulation and Pile Ownership – Analysis

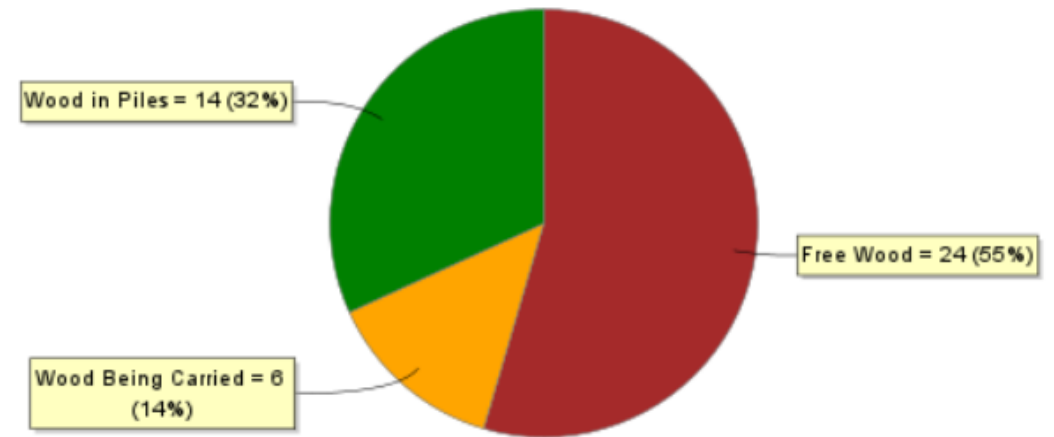
Theft and Pile Security



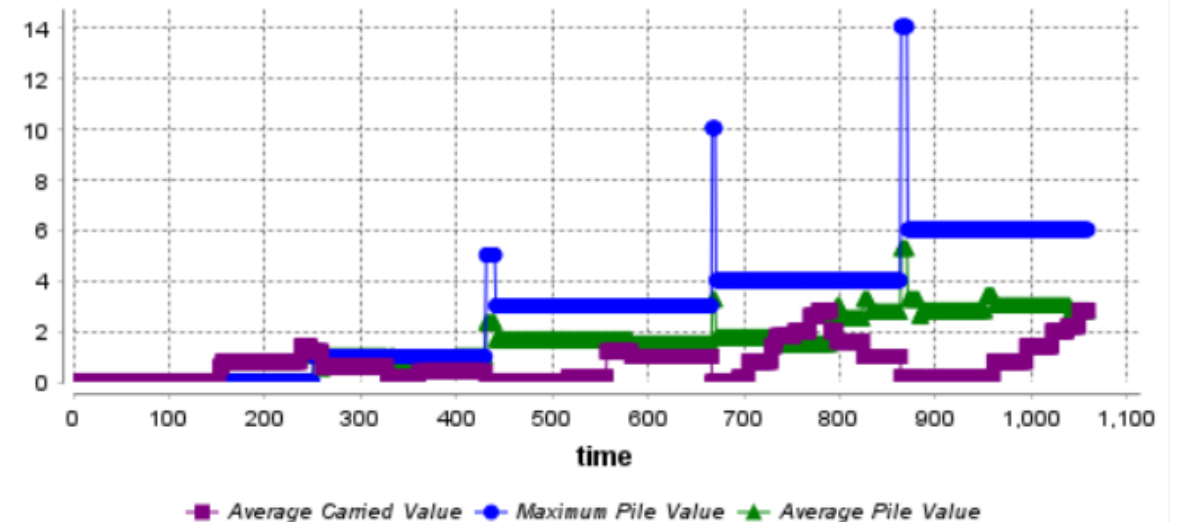
Pile Value Distribution



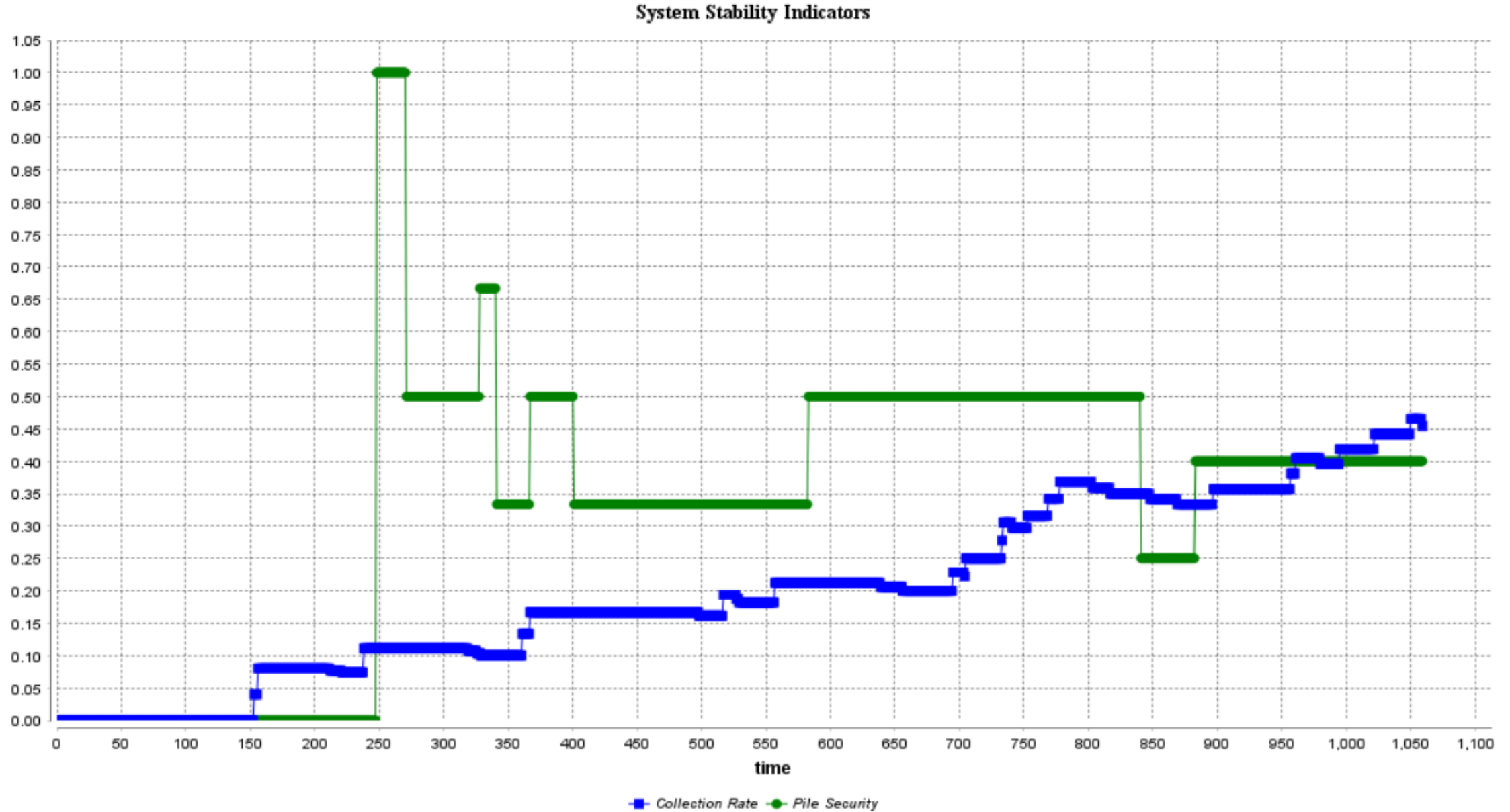
Wood Distribution



Collection Metrics



Ext1: Self-Regulation and Pile Ownership – Analysis



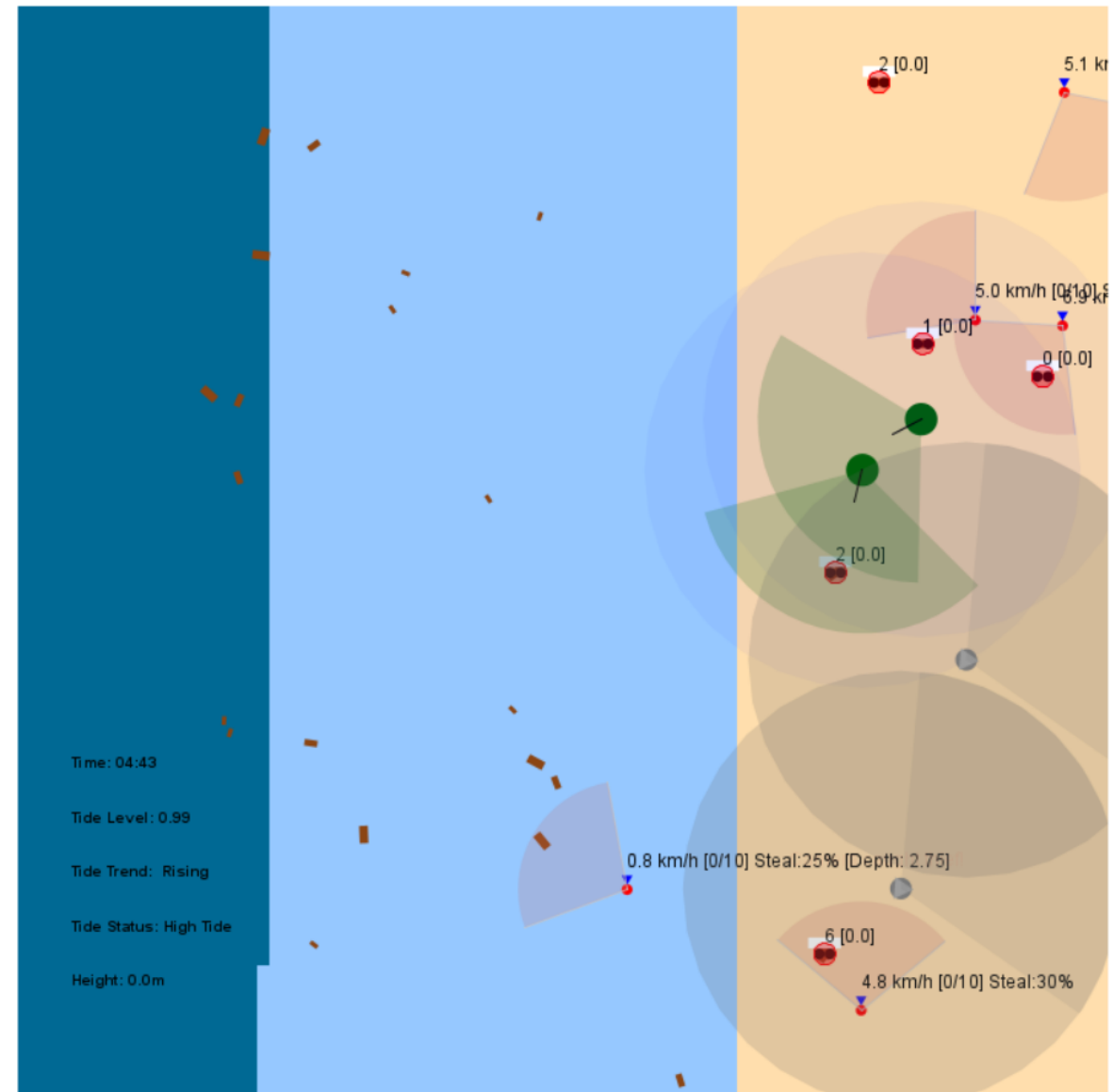
Extension 2: External Enforcement

Enforcement Mechanisms

- Authority agents with enhanced FOV
- Security cameras
- Active pursuit system
- Punishment mechanics

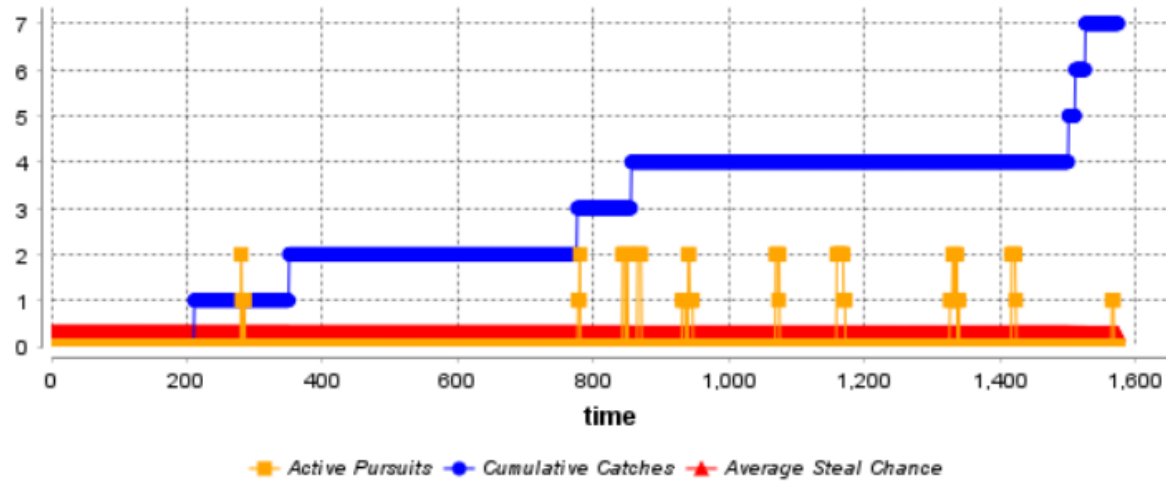
Impact Analysis

- Catch rates
- System stability
- Resource security
- Theft deterrence

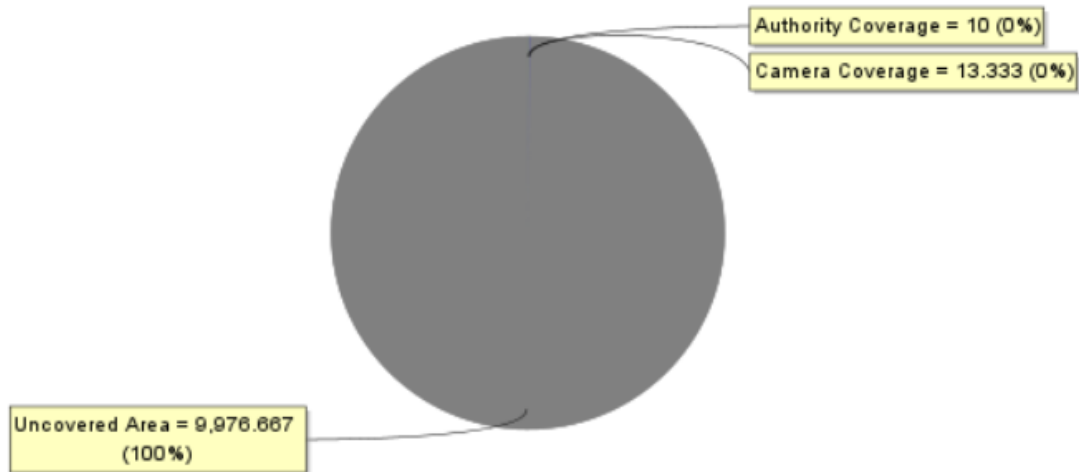


Ext2: External Enforcement – Analysis

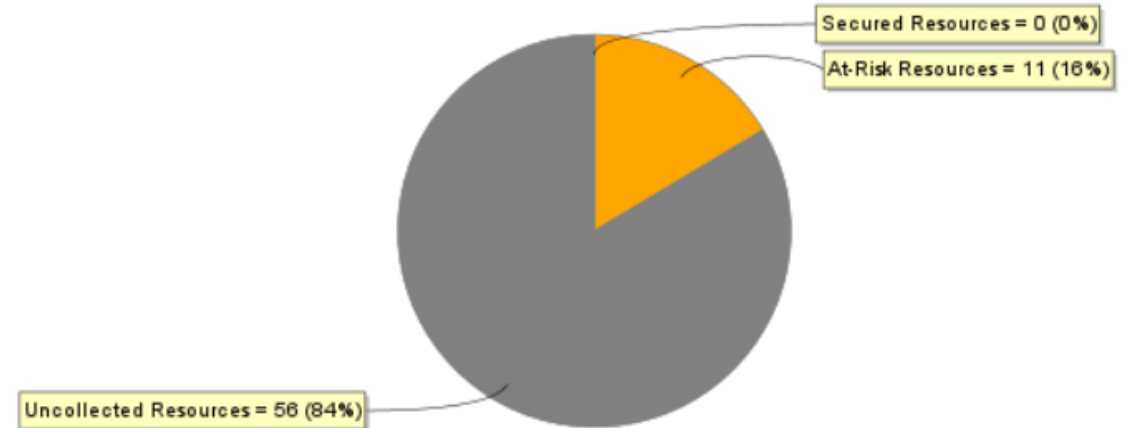
Authority Effectiveness



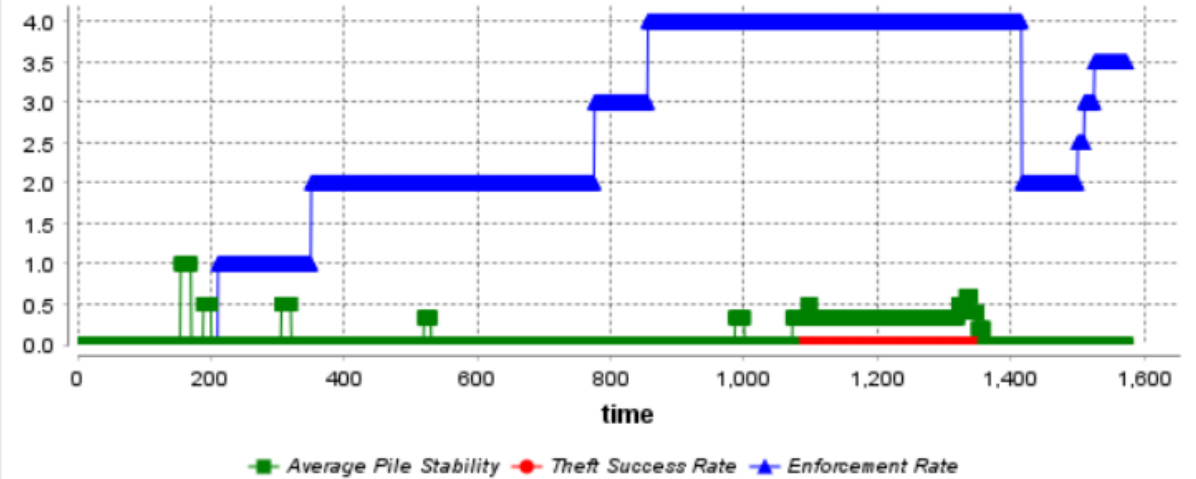
Security Coverage



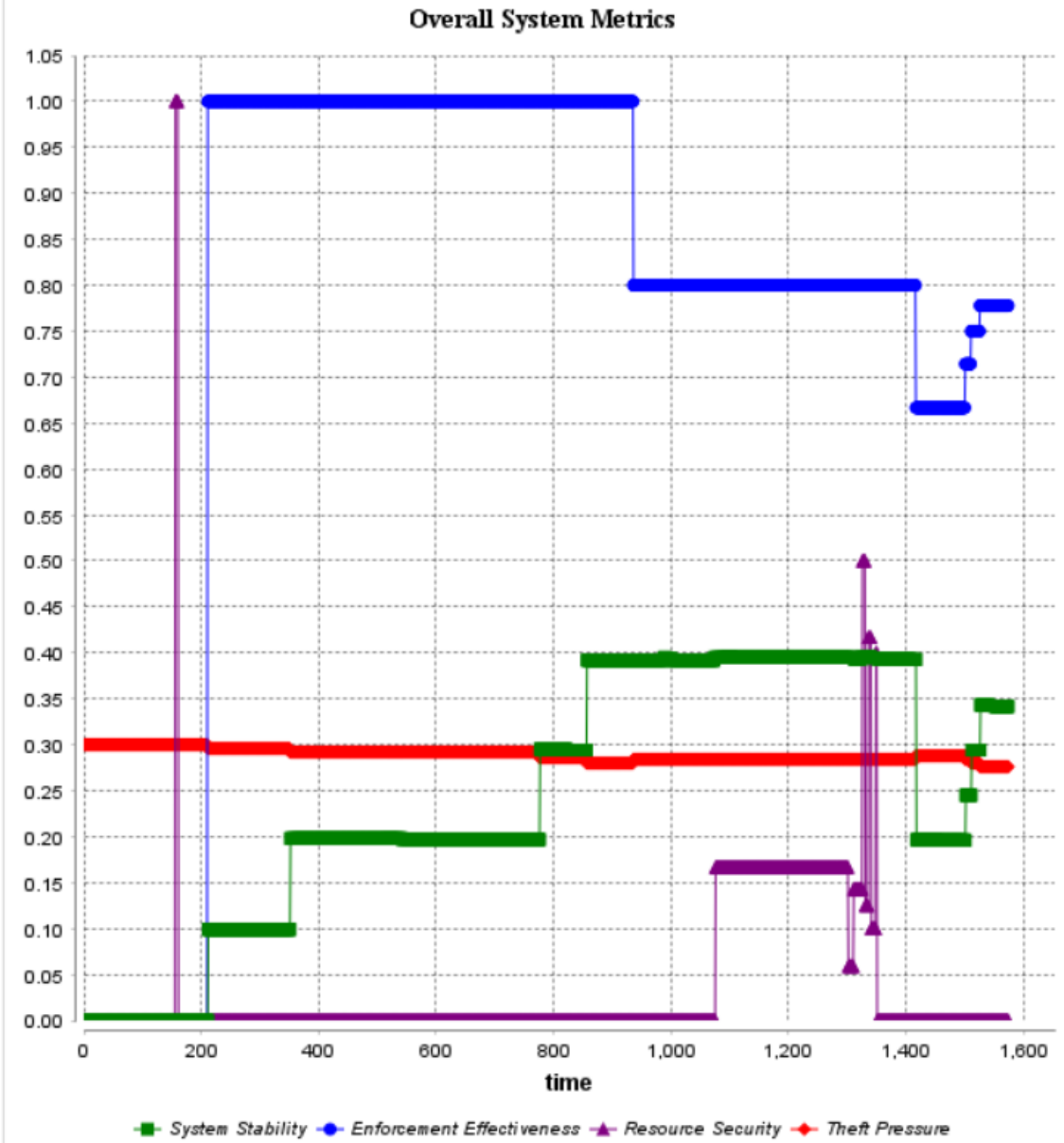
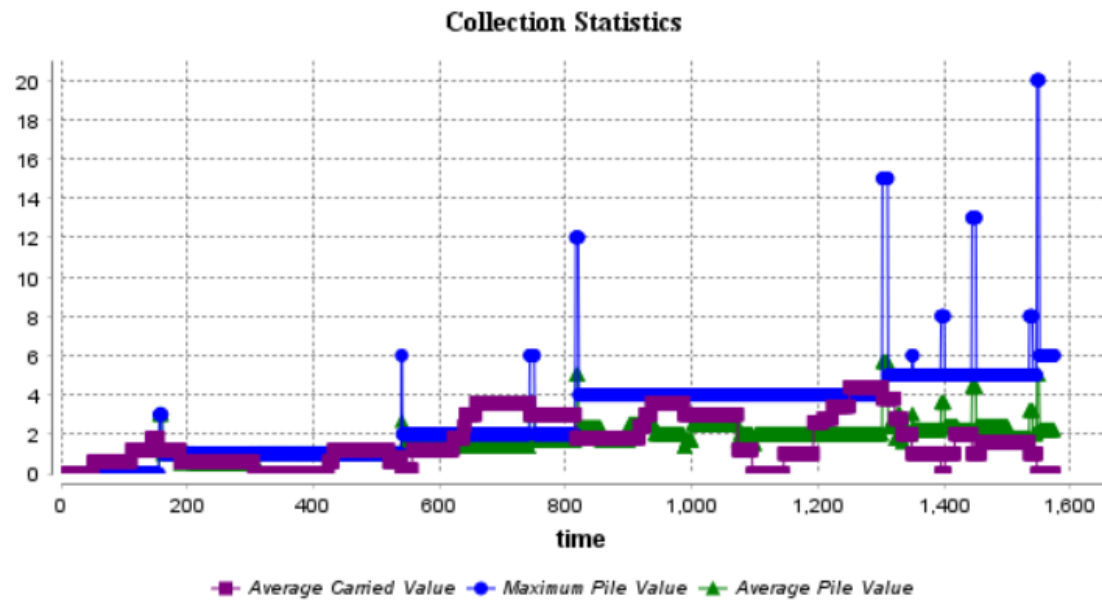
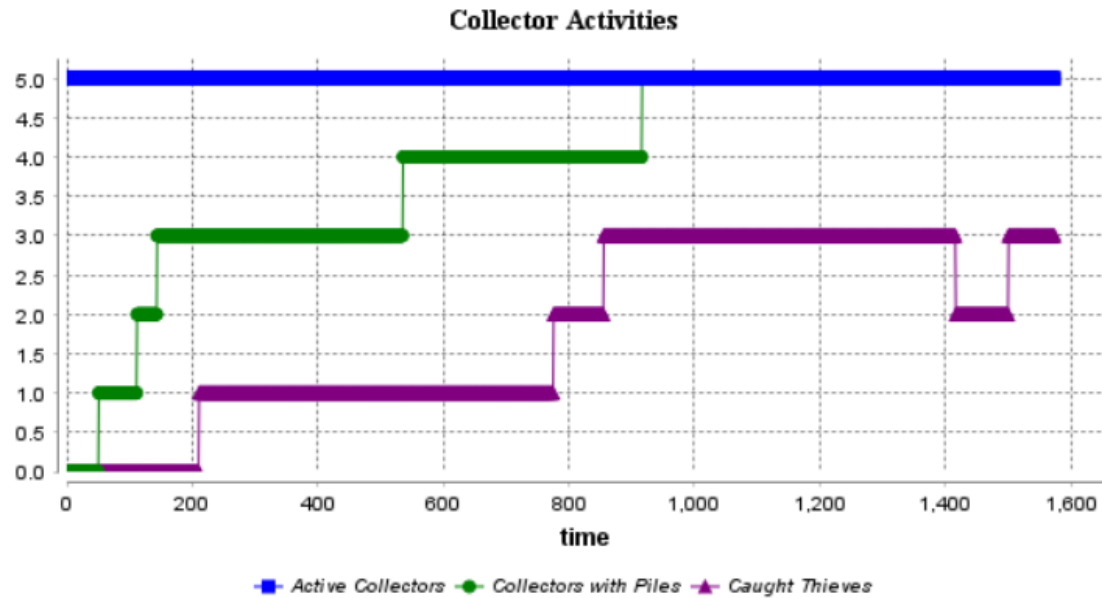
Resource Distribution



Security Metrics



Ext2: External Enforcement – Analysis



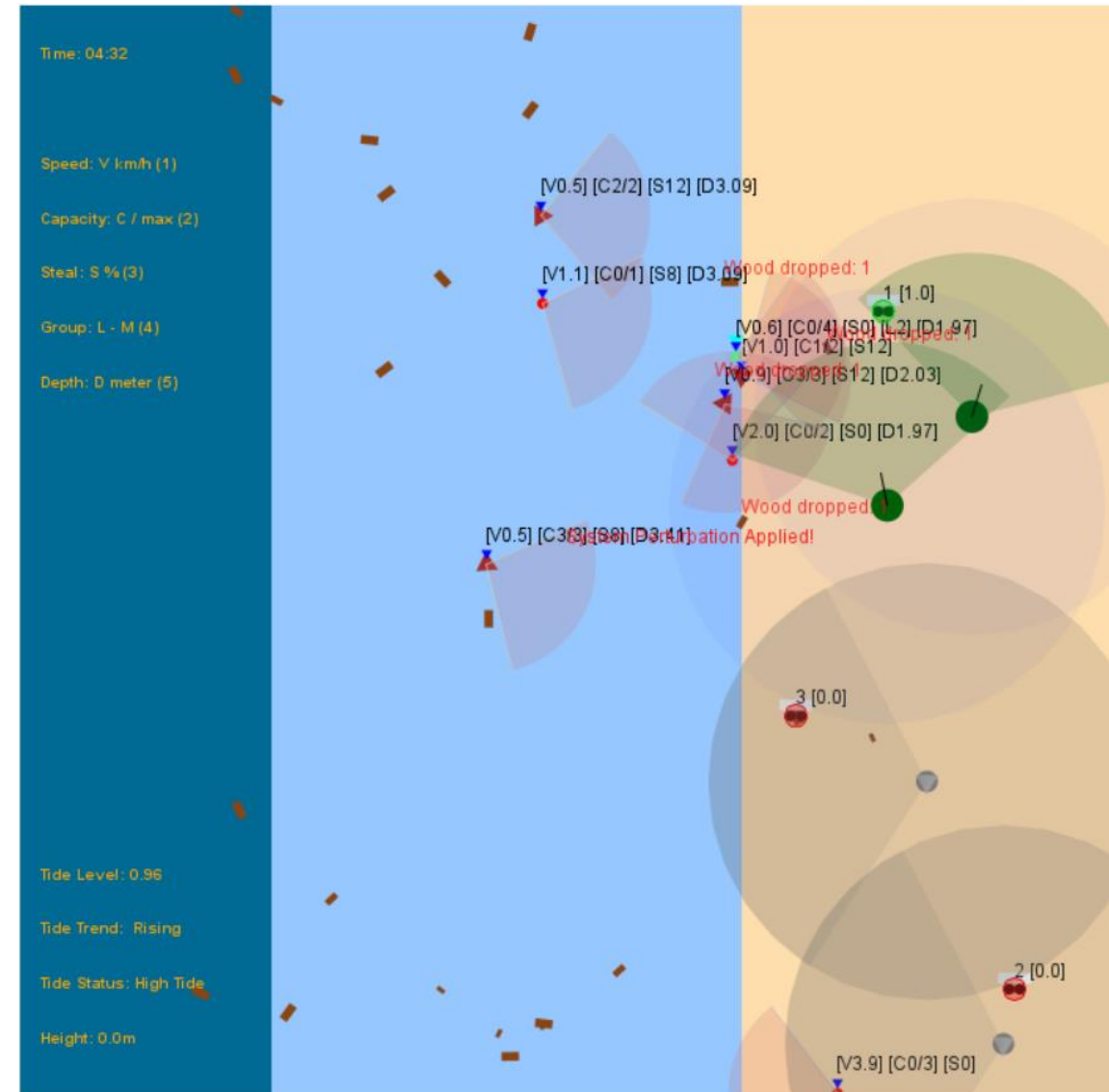
Extension 3: Group Dynamics

Group Formation

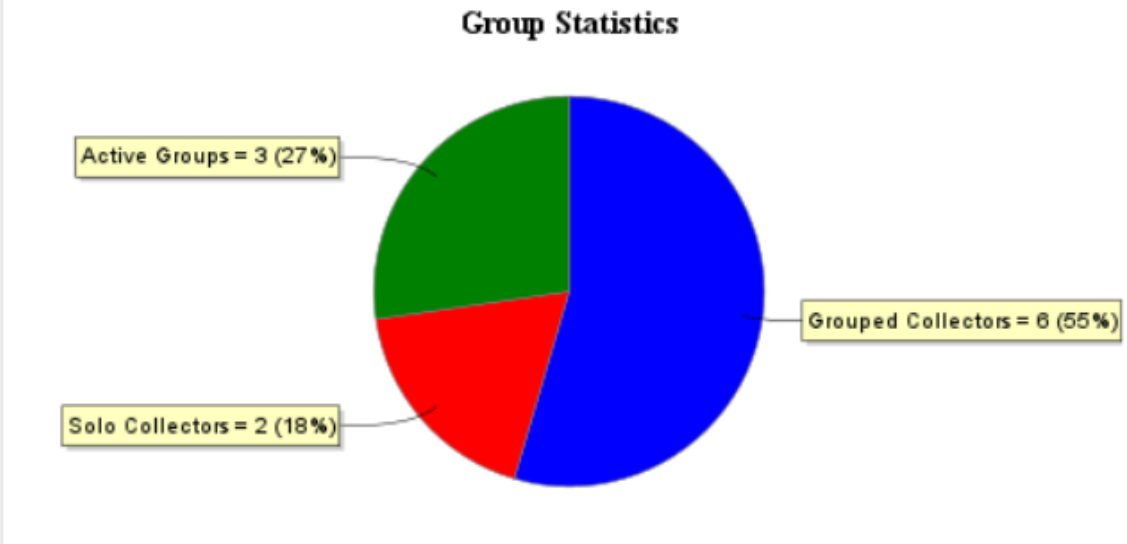
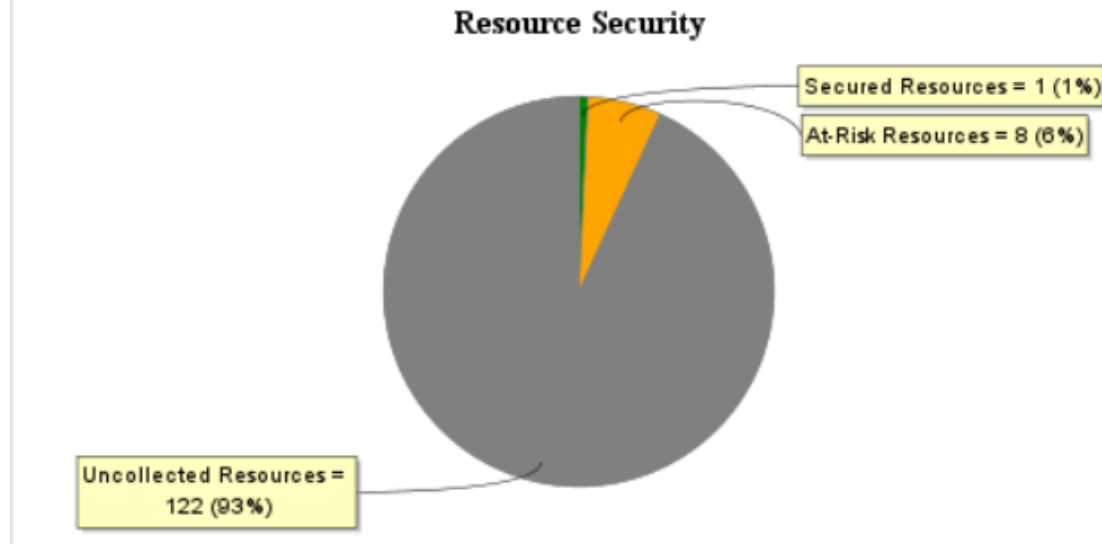
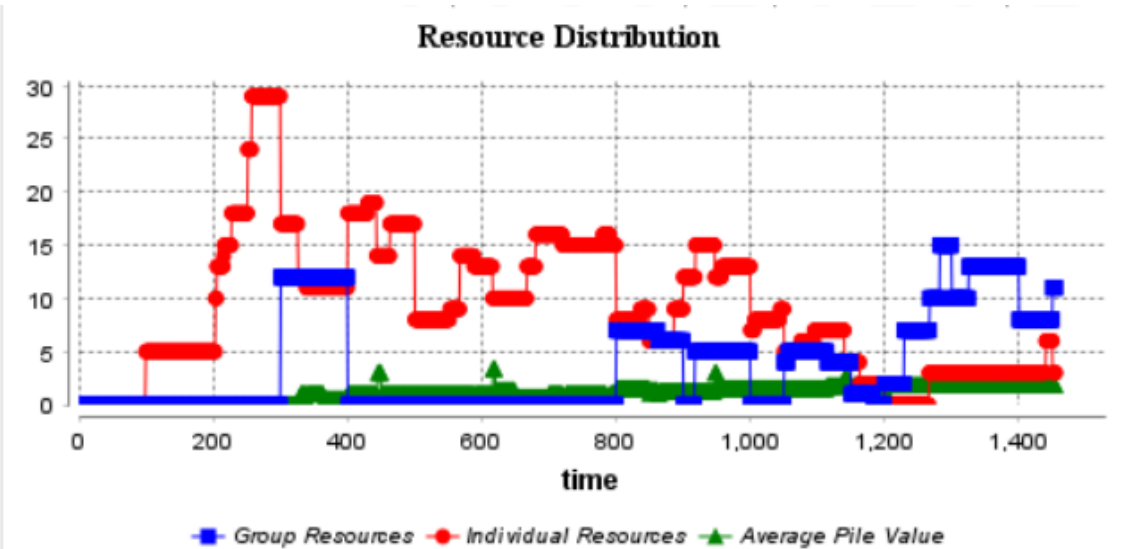
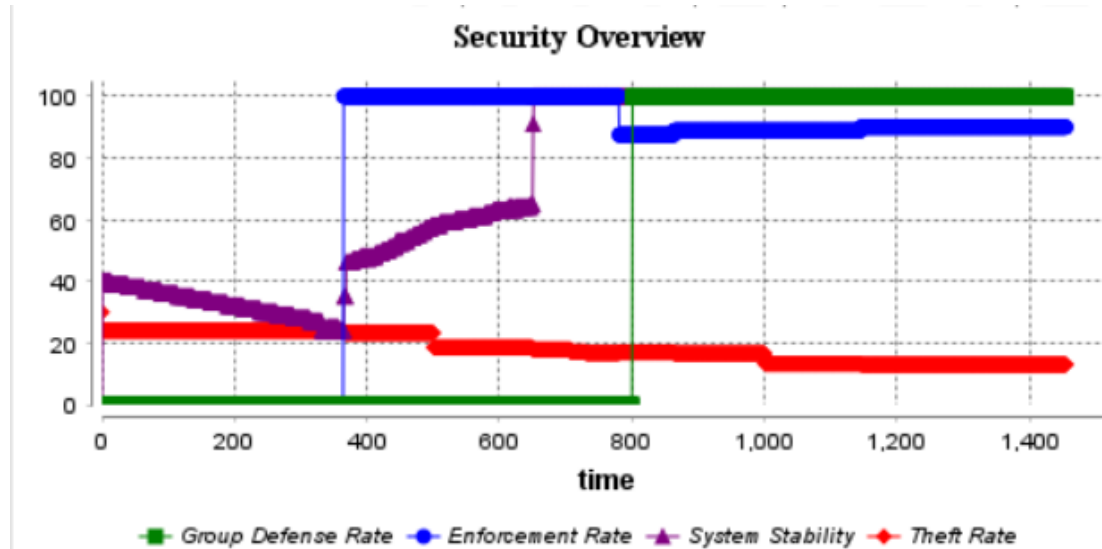
- Size: 2-4 members
- Formation chance: 30%
- Breakup chance: 10%
- Cooperation bonus: 20%

System Resilience

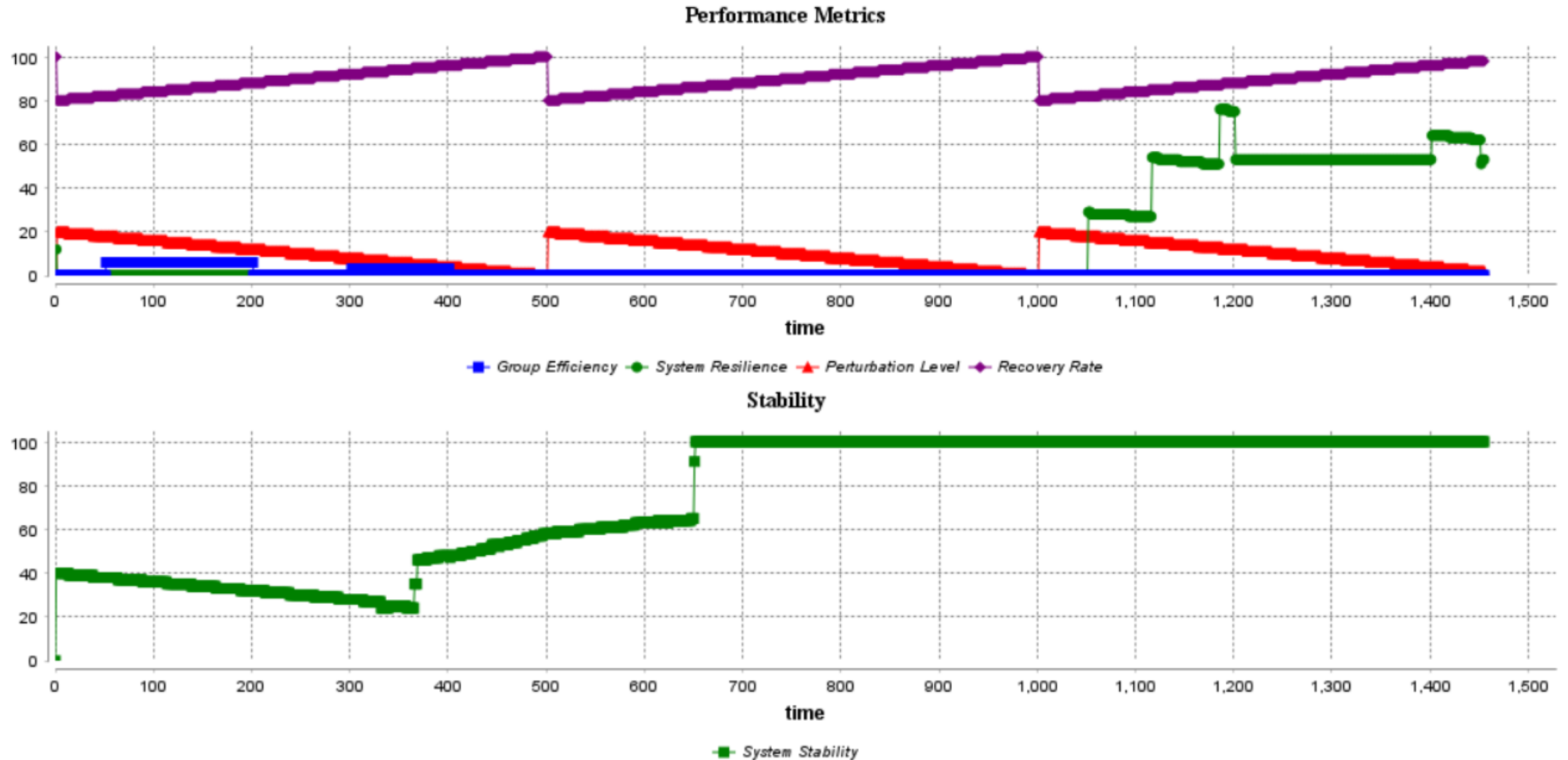
- Perturbation testing
- Recovery analysis
- Group vs. individual performance
- Stability metrics



Ext3: Group Dynamics – Analysis



Ext3: Group Dynamics – Analysis



Conclusion

System Stability Achieved Through:

- Peer pressure mechanisms
- External enforcement
- Group cooperation

Key Contributions

- Demonstrated emergence of stable resource management
- Identified optimal enforcement strategies
- Validated group-based resilience

Thank you!