Biological Inspired Resource Allocation for Distributed Multi Agent System with Limited Knowledge

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Abstract

Resource allocation in scenarios involving uncertainty, limited information, and potential threats can pose significant challenges and difficulties. This study examines a new biologically inspired distributed resource allocation algorithm, drawing inspiration from the snapping shrimp colonies. Operating within environments with uncertainty and resource limitations, snapping shrimp colonies exhibit distributed resource allocation when they allocate a limited number of defenders to protect the nest. The hypothesis of the paper is if inspiration is drawn from the snapping shrimp colonies, then the distributed resource allocation can be improved. The result is a new Snapping Shrimp Resource Allocation Algorithm (SSRAA), which is developed and applied to an Agent-Based Model of a wildfire scenario.

Research Question

Whether applying the Snapping Shrimp Resource Allocation Algorithm (SSRAA) can lead to improved performance, even with less sophisticated agents (less situational knowledge)?
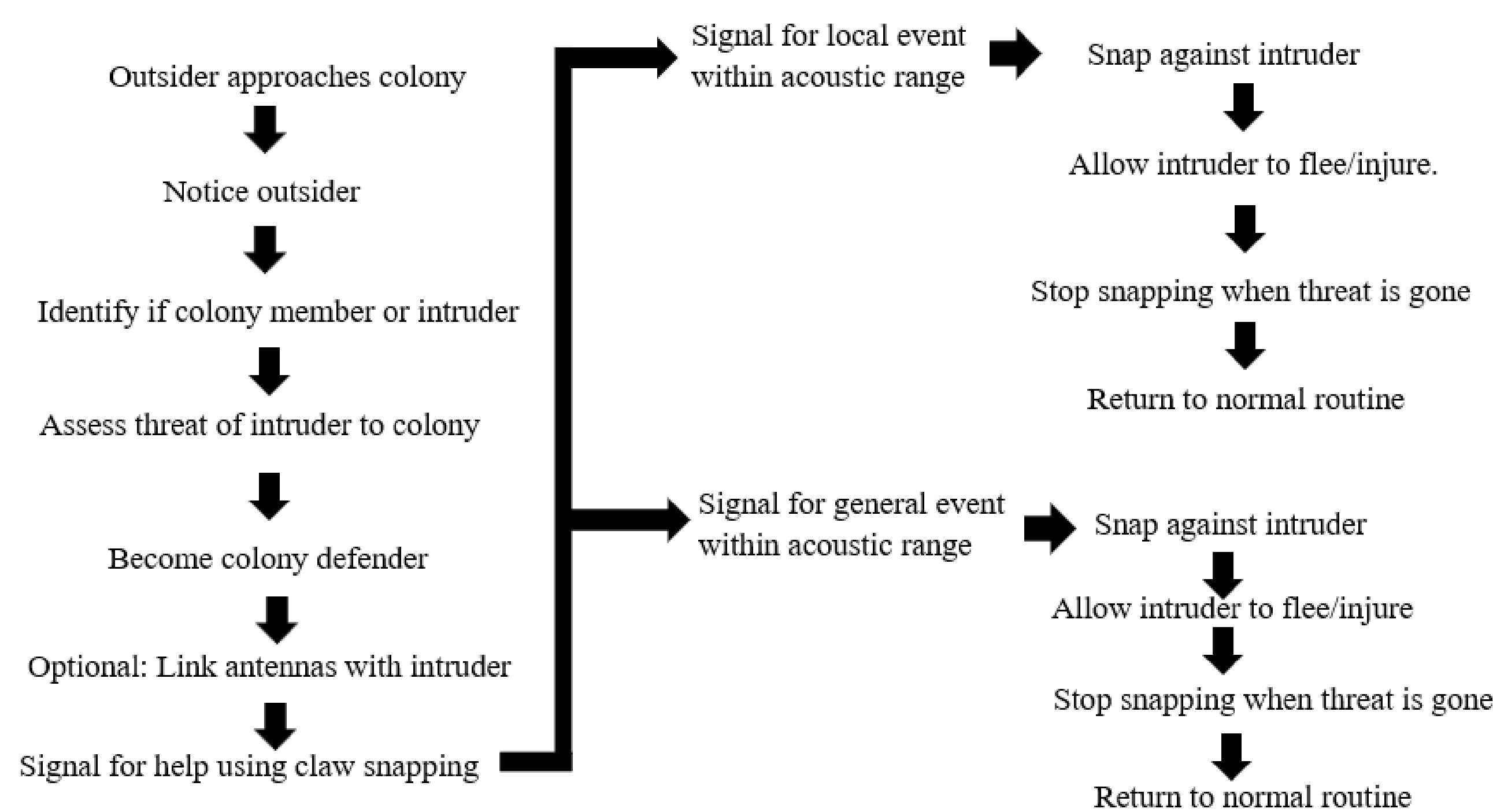
Bio Inspiration : Snapping Shrimp

Snapping Shrimp
Family *Alpheidae*
Genus *Synalpheus*

- Eusocial Species
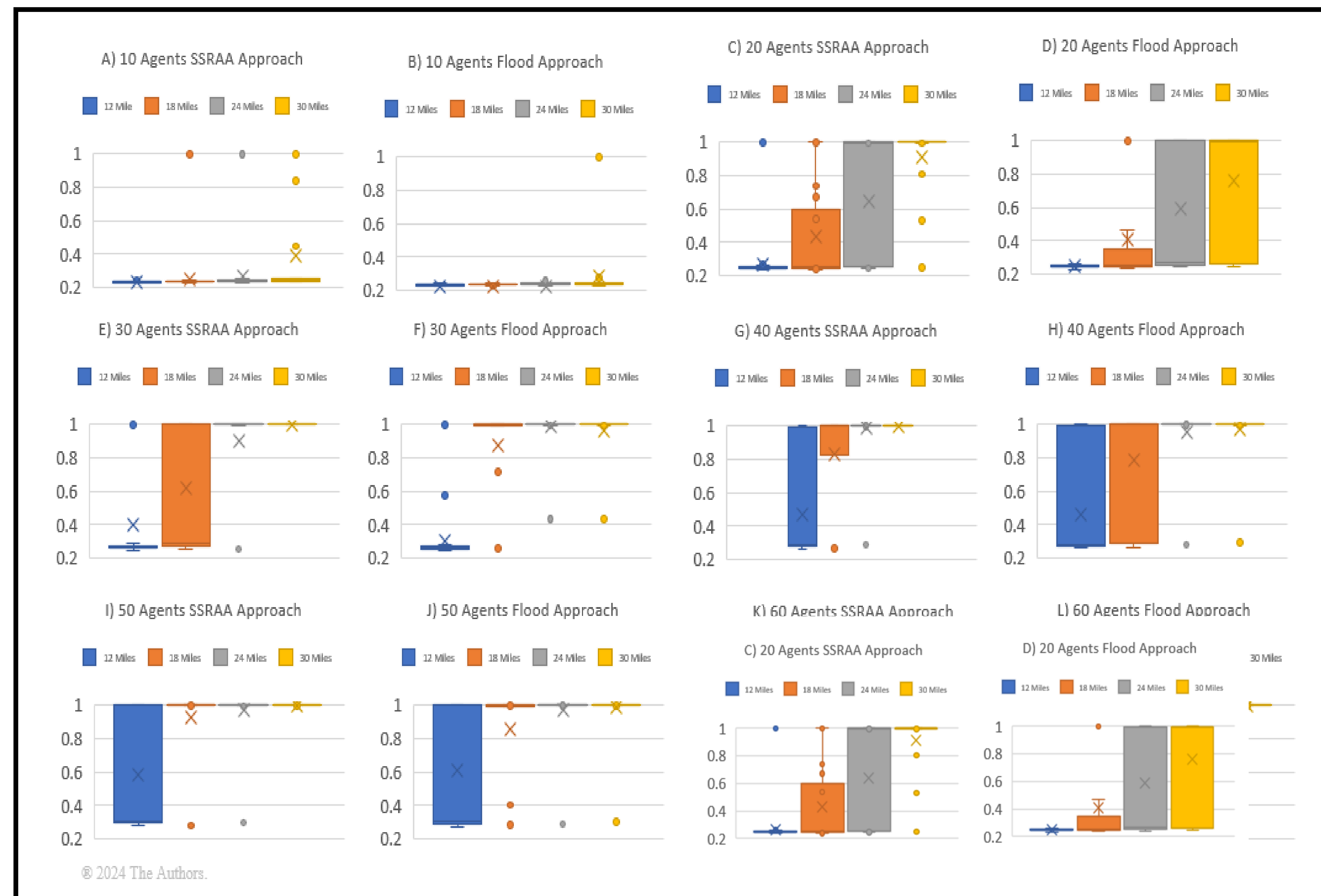- Colony Intruder Response
- High Powered Snapping Claw

**Colony Intruder Response Algorithm with Local and General Events**

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Biologically Inspired Design-for-Resilience Lab

Results : SSRAA Algorithm VS Flood Algorithm in Wildfire Study

A) 10 Agents SSRAA Approach   B) 10 Agents Flood Approach   C) 20 Agents SSRAA Approach   D) 20 Agents Flood Approach
E) 30 Agents SSRAA Approach   F) 30 Agents Flood Approach   G) 40 Agents SSRAA Approach   H) 40 Agents Flood Approach
I) 50 Agents SSRAA Approach   J) 50 Agents Flood Approach   K) 60 Agents SSRAA Approach   L) 60 Agents Flood Approach
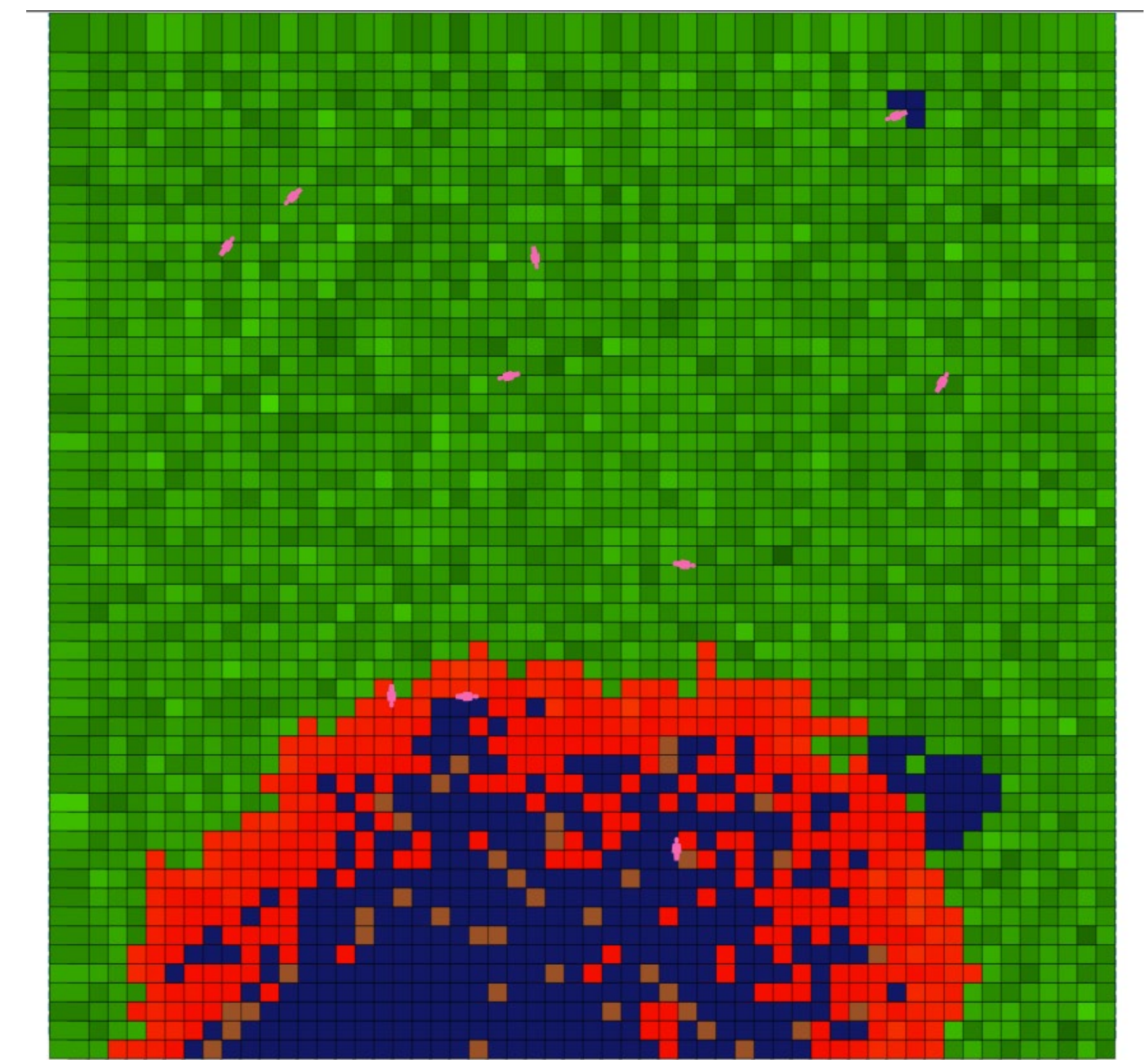
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Plots show how the flood vs SSRAA approach by the model. The SSRAA approach shows improve the performance with less advanced agents.

Biological Inspired Algorithm VS Flood Algorithm
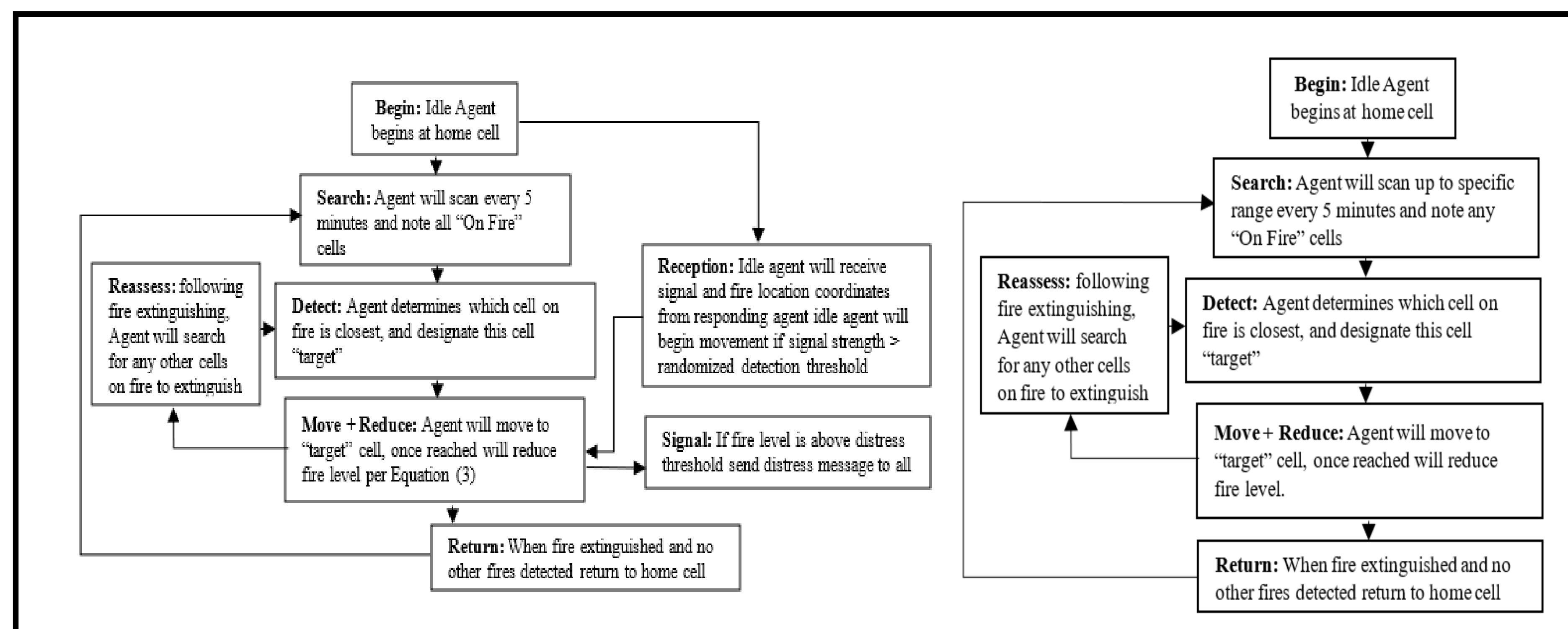
Biological Intruder Response Snapping Shrimp Algorithm vs Snapping Shrimp Resource Allocation Algorithm (SSRAA)

Application Case Study: Wildfire

Anylogic Model depicting the simulated resource allocation with wildfire expansion and firefighter agents. This model compares both algorithms together.

**The SSRAA saved 73.5% of the forest
The Flood saved 70.6% of the forest**

SSRAA outperformed Flood in 86% of the scenarios examined

The peak advantage - 20 agents, where SSRAA saved 5.95% more of the forest on average than the Flood Approach.

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Full Conference Paper