A. Environment Module

AQUATIC	MAST	TERRESTRIAL	ECOTONE
Fish, waterfowl Peak: Summer	Nuts, acorns Peak: Fall	Deer, game Peak: Winter	Multi-zone access *(Poverty Point)*

Key Parameters:

σ = Environmental uncertainty (0-1)

ε = Ecotone advantage (0-0.5)

Zone covariance: Negative = buffering

Ecotone Effect:

$$\sigma_{eff} = \sigma(1-\varepsilon)$$

Reduces effective uncertainty

B. Agent Module

AGGREGATOR

- Travels to central site
- Invests in monuments
- Acquires exotic goods
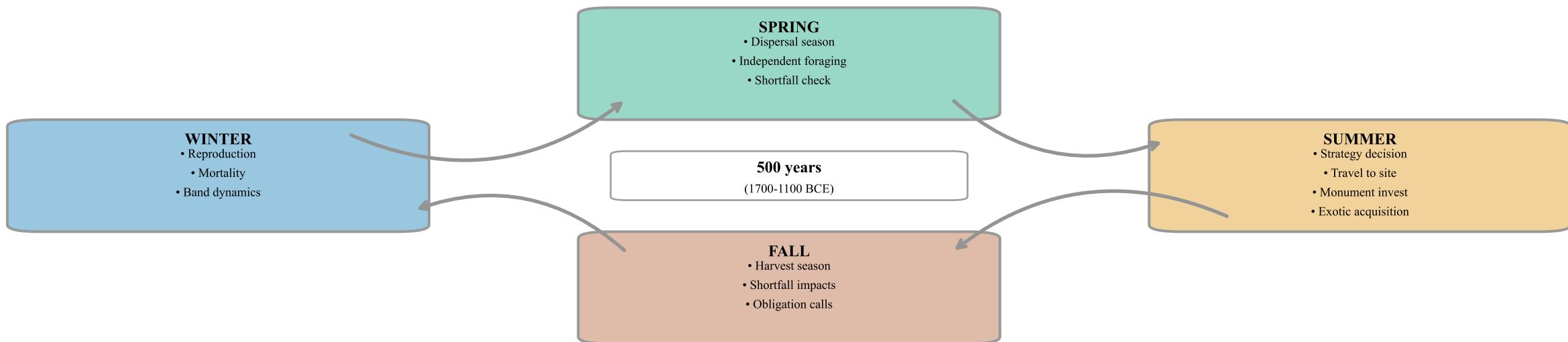- Forms obligations

  Cost: $C_{total} = 0.42$

INDEPENDENT

- Remains in home territory
- Full foraging time
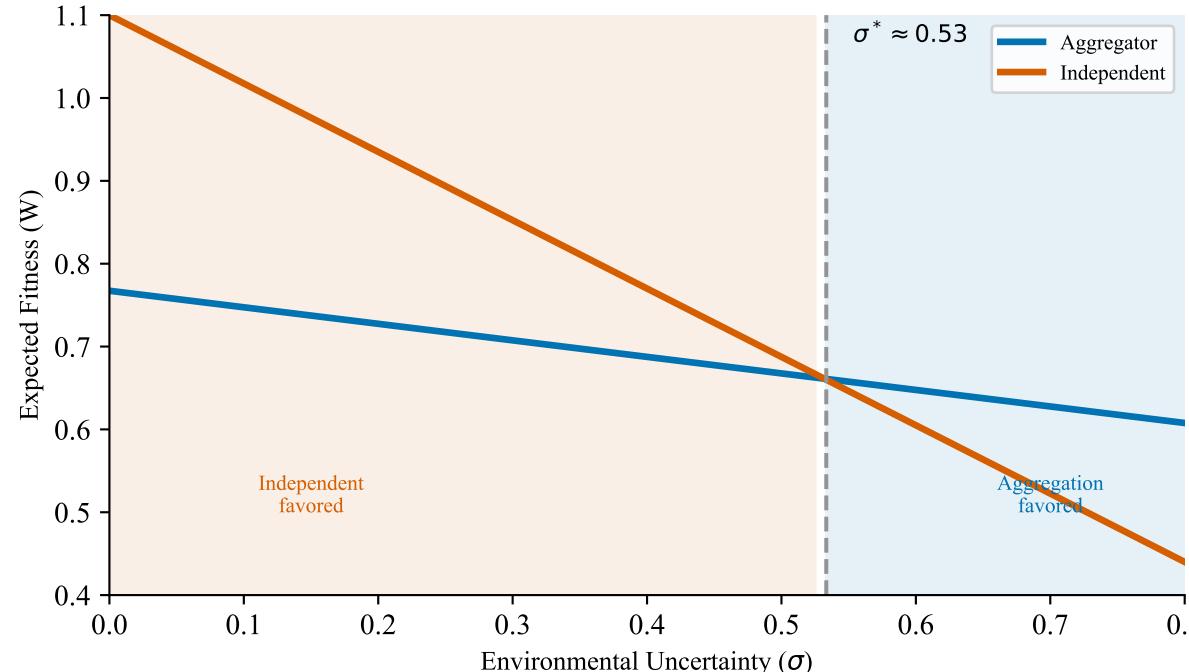- No aggregation costs
- Higher shortfall vulnerability

  Advantage: $R_{ind} = 1.10$

Band Attributes

- size: Population (10-50)
- resources: Holdings [0,1]
- prestige: Status level
- obligations: Social network

C. Annual Cycle

SPRING
- Dispersal season
- Independent foraging
- Shortfall check

WINTER
- Reproduction
- Mortality
- Band dynamics

500 years
(1700-1100 BCE)

SUMMER
- Strategy decision
- Travel to site
- Monument invest
- Exotic acquisition

FALL
- Harvest season
- Shortfall impacts
- Obligation calls

D. Fitness Functions

$\sigma^* \approx 0.53$

Independent favored

Aggregation favored

Legend: Aggregator, Independent

X-axis: Environmental Uncertainty (σ)
Y-axis: Expected Fitness (W)

E. Model Outputs & Predictions

Model Outputs

- Strategy dominance: (n_agg - n_ind) / n_total
- Monument accumulation: Cumulative investment
- Exotic goods: Total across bands
- Population dynamics: Size over time

Key Predictions

P1: Aggregation emerges when $\sigma > \sigma^*$

P2: Monument investment $\propto$ to σ

P3: Site primacy at maximum ecotone (ε)

P4: System collapse when σ drops below σ^*