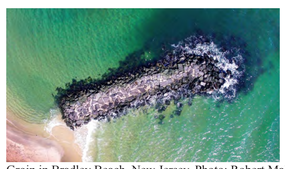
Groins and the 'Erosion Hotspot' Problem: a coupled Geo-economic Model for Community-Scale Response



Groin in Bradley Beach, New Jersey. Photo: Robert Mallack

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Fourth Ave aerial, Bradley Beach, NJ. Photo: Robert Mallack

Introduction

-US east coast is highly developed

-Managers have used hard and soft engineering to protect communities

-Groins, hard structures, change alongshore sediment distribution

-Deposition updrift

-Enhanced erosion downdrift

-Negative externality for downdrift communities (Market failure)

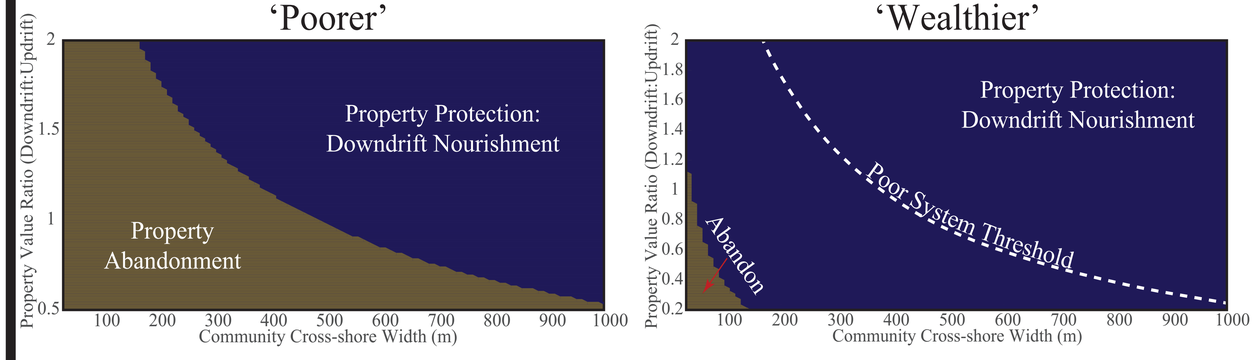
-Higher risk, greater damage, more costly (should we rebuild or retreat?)

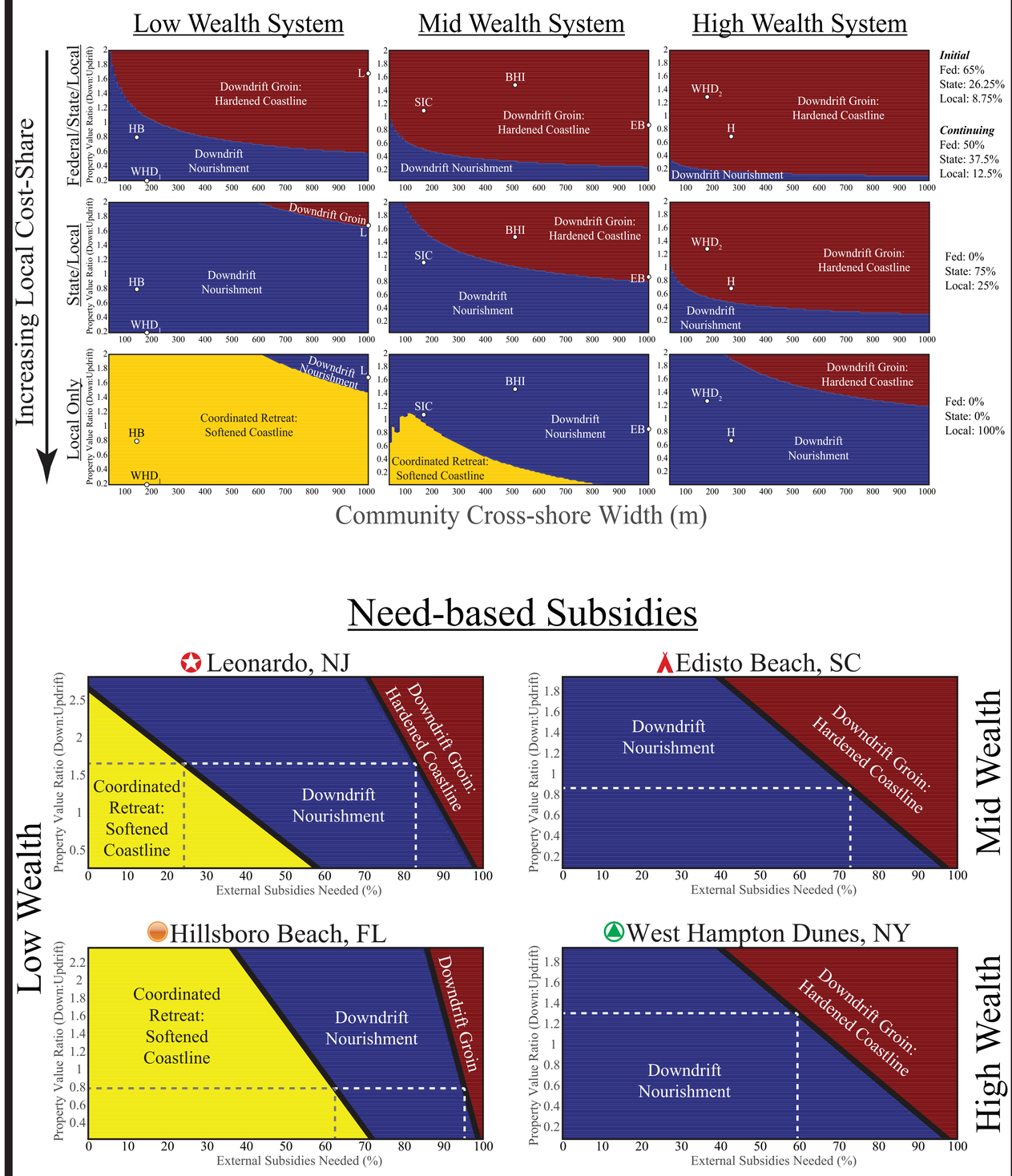
Motivation

Community	Community Width (m)	Down:Updrift PV Ratio	Strategy Taken
Holgate, NJ **(H)**	280	0.73	Groin
Sea Isle City, NJ **(SIC)**	165	1.15	Groin
Bald Head Island, NC **(BHI)**	500	1.51	Groin
Oakwood Beach, NY **(OB)**	540	0.68	Downdrift Retreat
Leonardo, NJ **(L)**	1000	1.64	Elevate Structures
Edisto Beach, SC **(EB)**	1000	0.88	Nourishment
Hillsboro Beach, FL **(HB)**	125	0.80	Nourishment
West Hampton Dunes, NY **($WHD_{1,2}$)**	175	0.10	Nourishment
		1.31	??

Model Exploration

Protect or Abandon?





Need-based Subsidies

Methods

Geomorphic Equations

$$\frac{dw}{dt} = \frac{1}{s \cdot D}[Q_{in} - Q_{out}] - \mathrm{E}$$

$$Q_{out} = \frac{w}{L} Q_{in}$$

Economic Equations

$$\int_0^T (B - C) e^{-\rho \cdot t} dt + \sum_{j=1}^{m} \frac{B_{buyout}}{(1+\rho)^{t_j}}$$

Costs

$$C_G = c_l \cdot \phi_G \cdot L$$

$$C_N = c_l \cdot \phi_N \cdot N \cdot s \cdot D$$

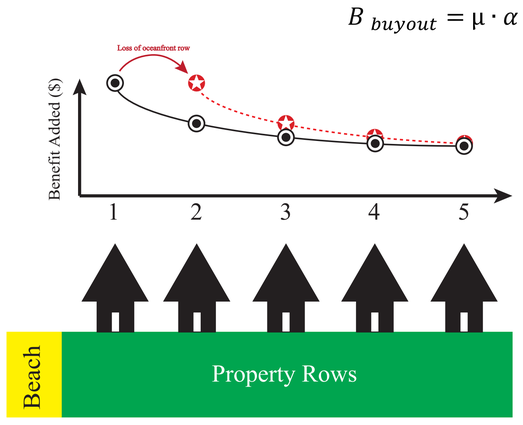
$$C_m = c_l \cdot \phi_M \cdot \phi_G \cdot L$$

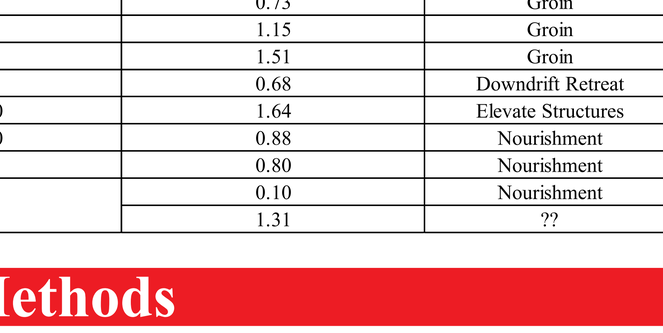
Benefits

$$A = \alpha \cdot \rho$$

$$B = A \cdot \left(\frac{w}{w_\alpha}\right)^{\beta} \cdot n^{\psi}$$

$$B_{buyout} = \mu \cdot \alpha$$





Further Discussion

-Future local cost-share increase (community-scale approach)

-Hard structures become less feasible

-Retreat becomes more feasible

-Poorer and smaller two-community systems choose retreat

-Wealthier and larger systems choose nourishment

-Problem: Ensuant alongshore wealth inequality

-Pricing out owners of lower valued properties?

-Privatization of coastline? Loss of a public good?

-Solution: Need-based subsidies for protection projects

-Avoid adverse effects of property value appreciation

-Require communities match risk with magnitudes of wealth

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