In this agent-based simulation, the ecological dynamics of a simple coral reef ecosystem are linked to the social dynamics of a recreational fisher community. Simulations capture the interaction and dynamic feedback between the two systems and how these affect fish stocks and fisher compliance under centralized and decentralized management approaches. The analysis reveals the complex nature of how system-level dynamics emerge from localized individual-level behaviors. The energetics and ecology of the reef’s three trophic levels are modeled: photosynthetic turf algae grows, herbivorous fish graze while schooling and avoiding predation, and roaming piscivores hunt herbivores and patrol the reef edge. With the functional reef system in place, the dynamics of recreational fishermen on the reef are modeled under various personal, environmental, regulatory and social constraints. Simple individual behaviors give rise to the more complex ecological phenomena of fish schooling, carrying capacity, and population cycles, and the sociological phenomena of resource depletion, diffusion of information and cooperation. In an open access fishery, the decline in fish populations creates negative feedback on fishing effort by damping enthusiasm and the number of fishing trips to the reef, thereby regulating fishing effort. In a recreational fishery with centralized management where enforcement agents arrest illegal fishers, the regulatory cost burden of enforcement can be leveraged by enhancing communication (and in turn compliance) among fishers, especially if news of enforcement actions is publicized. In a recreational fishery with community-based management where fishers have the choice to form self-organized coalitions to establish and enforce catch restrictions, the resource dilemma associated with overfishing can be overcome under certain conditions.