Endemic to a small island off the coast of China, the Shedao pit viper, *Gloydius shedaoensis*, is known for its 'accidental altruism.' Juvenile pit vipers often kill passerine birds too large to swallow. Large prey carcasses are scavenged by neighboring adults. In turn, adult pit vipers kill hawks that prey on juvenile pit-vipers, but are not a threat to the adults themselves. Using agent-based computer simulations, we quantified the lifetime fitness of pit viper breeders with one of three genotypes: selfish, altruistic or both selfish and altruistic. Our simulation was based on a four-dimensional (4D) model of social behavior which included interactions of pit viper offspring with predators and prey as well as conspecifics. Results showed that, over ten breeding seasons, pit viper breeders with flexible altruistic and selfish genotypes averaged seven times the number of surviving offspring relative to breeders with pure-selfish genotypes, and 23 times the number of surviving offspring as breeders with pure-altruistic genotypes. In summary, viewing animal behavior through the lens of the 4D model will extend our understanding of the evolutionary pathway to social behaviors through natural selection processes.