

## Establishment of an Invasive Species in a New Habitat

A species entering an environment or habitat in which it did not evolve has few if any checks on its population size. Once the species becomes established, it is very difficult or impossible to remove it. Establishment of the invading species often results in the destruction of native habitat and the reduction or extirpation of populations of native species. Accidentally or intentionally, humans have introduced many exotic species into new habitats—for example, European starlings into North America; mongooses into Jamaica, Hawaii, and other tropical islands where sugar cane is a cash crop; and rabbits into Australia—resulting in the displacement or the extirpation of the native ecologically equivalent species, predation on native species that have no defense against the invader, and habitat alteration or destruction.

Successful establishment of the invading species is affected by propagule pressure. Propagule pressure has two components:

- **Propagule size:** The number of individuals released into the environment at one time (“per release event”)
- **Propagule number:** The number of release events occurring over time

A single individual entering an unfamiliar environment usually has little chance of survival. For example, the house mouse caught in the kitchen with a no-kill trap and transplanted to a field is unfamiliar with the new habitat and usually falls prey to predators before it can find safety or is unable to locate food sources and succumbs to starvation. Another possible outcome is death by diseases or parasites to which the transplanted individual has no immunity or other defenses.

Successful invading species exhibit high propagule pressure (either many individuals invading simultaneously or many repeated invasions by a few individuals at a time) and might be better able to avoid diseases and predators in the new environment or predators might not recognize the invader as potential prey. Thus, the invading population has no checks on population size and can increase exponentially.

As with any exponential growth, there is an initial lag period—a time during which the population does not seem to be increasing. For example, in bacterial reproduction, an initial population size of one cell increases slowly at first (1 cell → 2 cells → 4 cells → 8 cells → etc.), with the population doubling at each reproduction. But by the 8th generation, the single bacterium has produced 128 offspring; by the 12th generation, it has produced 4,096 offspring.

The population increase of an invading species is affected by its intrinsic rate of natural increase ( $r$ ), which is determined by the number of offspring per reproductive event and the frequency of reproductive events (the generation time or length of time between reproductive events). A single feral female domestic cat can produce an average of four young per litter and two litters per year (in some places, four litters per



year), yielding 64 offspring (or more) in just four years. Compound this growth with the high survival rate of the offspring (which will also be reproducing), and the invading population quickly becomes enormous and destructive: Introduced mongooses decimated native ground-nesting bird populations in Hawaii and introduced rabbits in Australia produced “dust bowl” conditions by depleting the native vegetation. In most cases, the invading population persists in the new environment indefinitely—often despite human attempts to eradicate it.

