How introductions become invasions

An invasive species is nonnative to the ecosystem and causes, or is likely to cause, environmental, economic or human-health harm. Location and impact both matter.

1. DISTINGUISH ARRIVAL, ESTABLISHMENT AND HARM

INTRODUCED

Moved beyond its natural range.

→

ESTABLISHED

Maintains a reproducing population.

→

INVASIVE

Spreads and threatens native species or causes other harm.

Not every introduction proceeds through every stage. A nonnative crop is not automatically invasive; a species can be native in one region and invasive in another.

2. HUMAN ACTIVITIES CROSS NATURAL BARRIERS

Organisms travel in ship ballast water, on equipment and in transported wood. Ornamental plants may escape cultivation; released pets may survive in the wild. These pathways can move species much farther than their usual dispersal would allow.

3. WHY SOME SPECIES SPREAD QUICKLY

Many invaders are generalists: they use varied resources or tolerate a wide range of conditions. Many also have r-selected traits, such as early reproduction and numerous offspring. Where natural enemies exert less control, population growth and competition with native species can increase.

These are common advantages, not a checklist every invader must satisfy. Suitable habitat and resources still limit establishment; no population grows exponentially forever.

Definition and introduction pathways: USDA, National Invasive Species Information Center.
Generalists, r-selection and competition: College Board, EIN-4.A.2.

Scope: College Board APES CED, Topic 9.8, EIN-4.A.1-3, p. 190.

Trace the mechanism of ecosystem harm

A useful explanation connects a species interaction to a change in native populations. Competition, predation and habitat change can alter food webs and reduce biodiversity.

1. CONNECT THE INTERACTION TO ITS CONSEQUENCE

COMPETITION	Shared food, light or space becomes harder for native organisms to obtain; their growth or reproduction can fall.
PREDATION	An introduced predator consumes native prey, potentially reducing populations and changing food-web relationships.
HABITAT CHANGE	An invader changes vegetation or other habitat conditions, so some native species lose suitable living or breeding sites.

A population decline is not automatically extinction. Outcomes depend on the species, habitat, invasion size and other pressures.

2. ZEBRA MUSSELS: FOOD COMPETITION AND FOULING

Native to Eurasian fresh waters, zebra mussels are invasive in many North American waters. They filter algae needed by native consumers and attach to native mussels, impairing them. Dense growth on water-intake structures also creates maintenance costs. Clearer water alone does not prove a healthier ecosystem.

3. LIONFISH: A NEW PREDATOR ON ATLANTIC REEFS

Lionfish are native to the Indo-Pacific but invasive in the Atlantic. They consume native fish and crustaceans and have few natural predators in the invaded region. Reduced prey populations can affect other consumers and reef food webs. The same species is not invasive everywhere it occurs.

Biodiversity and habitat impacts: USDA, What Are Invasive Species?
Zebra mussel feeding and infrastructure effects: U.S. Geological Survey.
Lionfish range, predation and ecological effects: NOAA, What Is a Lionfish?

Scope: College Board APES CED, Topic 9.8, EIN-4.A.1-3, p. 190.

Prevent, detect and manage the damage

Choose a response that matches the species and stage of invasion. Removing a small new population is often more feasible than eliminating a widespread, established one.

1. PREVENT ENTRY AND RESPOND EARLY

Target the pathway: clean equipment, inspect transported materials and avoid releasing pets. Surveys and public reports can reveal new arrivals. Confirm identification, then act rapidly while the population is small. Early detection improves the chance of eradication but does not guarantee success.

2. COMPARE CONTROL METHODS AND TRADE-OFFS

PHYSICAL	Pull, trap or remove organisms. Can target a small patch, but requires labor and may need repeated treatment.
CHEMICAL	Apply an appropriate pesticide or herbicide. Can suppress an infestation, but may harm nontarget organisms.
BIOLOGICAL	Use a tested natural enemy. May provide lasting suppression, but the agent could harm nontarget species; careful screening is essential.

Combine compatible methods when appropriate; no single method fits every invader.

3. MEASURE RECOVERY, NOT JUST REMOVAL

Eradication eliminates the population from a defined area; control reduces abundance or harm. After treatment, check for regrowth, reinvasion and nontarget damage. Track native-species recovery as well as invader abundance, and adjust the plan. Restoring native habitat may be needed after removal.

Early detection and eradication: National Park Service, EDRR.
Control methods and trade-offs: USDA, Control Mechanisms.
Monitoring, treatment evaluation and restoration: NPS, Yosemite invasive plant management.

Scope: College Board APES CED, Topic 9.8, EIN-4.A.1-3, p. 190.