Land-use change is a major driver of habitat fragmentation, often resulting from urban expansion, agricultural practices, and deforestation. Urbanization leads to the conversion of natural landscapes into urban areas, creating isolated habitat patches. Deforestation, particularly in tropical regions, is a significant cause of habitat fragmentation, reducing habitat availability for many species. Additionally, climate change exacerbates these effects by altering habitat conditions and further fragmenting ecosystems (Teixido et al., 2021; Becker et al., 2023).

### 2.2 Ecological consequences of fragmentation

Fragmentation creates edge effects, where the conditions at the boundary of habitat patches differ from the interior, often resulting in altered microclimates. These changes can affect temperature, humidity, and light levels, impacting species that are sensitive to such variations. Fragmentation also disrupts predator-prey dynamics by altering the availability and distribution of both predators and prey, potentially leading to imbalances in local ecosystems (May et al., 2019).

Habitat fragmentation is a leading cause of biodiversity loss, as it reduces habitat size and connectivity, making it difficult for species to maintain viable populations. However, fragmentation can also create opportunities for invasive species, which may thrive in disturbed environments and outcompete native species. This dual impact highlights the complexity of fragmentation's ecological consequences, where it simultaneously threatens native biodiversity and facilitates invasions (Neely et al., 2024).

## 3 Amphibian Invasions: Patterns and Drivers

### 3.1 Common invasive amphibian species

Two prominent examples of widely distributed invasive amphibians are the American bullfrog (*Lithobates catesbeianus*) and the African clawed frog (*Xenopus laevis*). These species have been introduced to various regions outside their native ranges, often through human activities such as the pet trade and scientific research (Cushman, 2006). Their ability to thrive in diverse environments has facilitated their spread across multiple continents, impacting local ecosystems and native amphibian populations.

The invasive success of species like *Lithobates catesbeianus* and *Xenopus laevis* can be attributed to several key traits. These include high reproductive rates, broad dietary preferences, and adaptability to a wide range of environmental conditions (Belasen et al., 2019). Additionally, their ability to disperse over long distances and tolerate habitat fragmentation enhances their capacity to colonize new areas (Funk et al., 2005; Wright et al., 2020). These traits enable them to outcompete native species and establish stable populations in non-native habitats.

### 3.2 Key drivers of amphibian invasions

Human activities play a significant role in facilitating amphibian invasions. The pet trade and transportation networks are primary pathways for the introduction of invasive amphibians. These activities often result in the release or escape of non-native species into the wild, where they can establish invasive populations. The global movement of goods and people increases the likelihood of such introductions, making it a critical driver of amphibian invasions.

Climatic adaptability and reproductive strategies are crucial factors in the success of invasive amphibians. Species that can tolerate a wide range of climatic conditions are more likely to survive and reproduce in new environments. Additionally, amphibians with flexible reproductive strategies, such as prolonged breeding seasons and high fecundity, can rapidly increase their population size, enhancing their invasive potential (Teixido et al., 2021). These characteristics allow invasive amphibians to exploit new habitats and resources effectively, often at the expense of native species.

## 4 How Habitat Fragmentation Facilitates Amphibian Invasions

### 4.1 Creation of new habitats for invasive amphibians

Habitat fragmentation often results in the creation of isolated water bodies, which can serve as breeding sites for invasive amphibian species. These fragmented landscapes, particularly in agricultural and urban areas, provide new ecological niches that invasive species can exploit. For instance, studies have shown that amphibian