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Invasive alien slug could spread further with climate change

A recent study sheds light on why some alien species are more likely to become invasive than others. The research in Switzerland found that the alien Spanish slug is better able to survive under changing environmental conditions than the native Black slug, thanks to its robust 'Jack-of-all-trades' nature.

Invasive alien species are animals and plants that are introduced accidently or deliberately into a natural environment where they are not normally found and become dominant in the local ecosystem. They are a potential threat to biodiversity, especially if they compete with or negatively affect native species. There is concern that climate change will encourage more invasive alien species to become established and, as such, a better understanding is needed of why and how some introduced species become successful invaders.

The study compared the 'phenotypic plasticity' of a native and a non-native slug species in Europe. Phenotypic plasticity is the ability of an organism to alter its characteristics or traits (including behaviour) in response to changing environmental conditions.

According to a framework used to understand invasive plants, invaders can benefit from phenotypic plasticity in three ways. Firstly, they are robust and can maintain fitness in varied, stressful situations, and are described as 'Jack-of-all-trades'. Secondly, they are opportunistic and can increase fitness in specific, favourable conditions, termed 'Masters of some', and, lastly, they are able to use both strategies ('Jack and Masters').

The study was the first to apply this framework to an animal species. Conducted in the Swiss Alps, it compared an invasive alien slug species (*Arion lusitanicus,* or 'Spanish slug') with a native slug of the same family (*Arion fuscus* or 'Black slug') on two fitness traits: survival and egg production. The researchers varied nutrition and temperature for the slugs by placing them at five different altitudes, between 700 and 2400 metres high.

The results show that the sites at the lowest and highest sites were most stressful to both slug species. The native Black slug was able to survive comparatively better at higher altitudes and colder winter conditions, but, overall, the alien slug had a significantly higher survival rate as it was better able to survive at lower altitudes. This indicates that the slug is robust at lower sites and can maintain fitness in changing conditions of increasing temperature.

Both species had a significantly lower level of egg production at higher altitude sites, particularly when there was less food. However, the slug could maintain egg production when no food was supplemented, whereas the native slug species could not produce any eggs in this condition. Again, this indicates that the slug is a robust or 'Jack-of-all-trades' under stressful conditions when food supply is short.

With the predicted temperature increase during winter, the slug, if moved across ecological barriers by long distance transport, such as cars and lorries, might become a successful invader in many parts of the EU.

The approach used in the study provides a valuable way to understand invasions of alien species and assess their phenotypic plasticity in order to predict their spread and to develop means of controlling them.