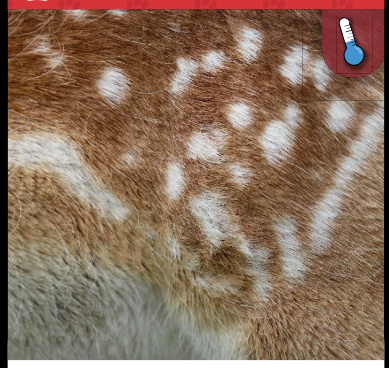
Fur

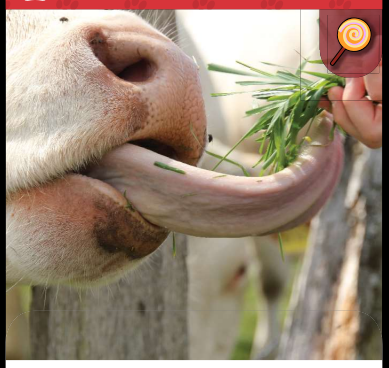


This Trait cannot be played on Aquatic Species.

One of the greatest insulators available to a species is immobile air. To trap air many species have hair or fur. It has been reported that fur is up to 6 times more effective than blubber.

E3

Ruminant Digestive System



This card can only be played on Trophic Level 2 Species.

Many species can live off fibrous plant matter. However, most of the fixed carbon in these plants is in cellulose. Therefore to digest it, some herbivores have symbiotic bacteria which contain cellulase.

E3

Specific Alarm Calls

The adjacent 2 Species in this Trophic Level are Resilient to Predation.

African Vervet Monkeys can encode the presence of different kinds of predators in their alarm calls so that specific (hence more effective) responses are carried out.

E3

Dishonest Communication

Dishonest communication can aid animals in many ways. Angler fish use a light lure to attract prey in the depths of the ocean. Wolves raise their hackles when scared to make themselves appear larger.

E3

Beneficial Mutation

+ **Look through the discard pile. Take the first 3 Trait cards you find and add them to your hand.**

The peppered moth colour change from mottled grey to black was a beneficial mutation in industrial areas, where a black moth on a sooty tree trunk was less likely to be predated. This mutation spread rapidly during the 19th century.

E3

Carnivore Introduced into Ecosystem

1

Affects Animal Species only.

− **Your opponent chooses 1 of your Vulnerable Species. It loses 2 Trait cards.**

+ **If all your Species are Resilient, draw 3 cards.**

Predator populations increase when prey are abundant. If predators reduce their food supply too much, it can no longer sustain them and both populations dwindle. Reduced predation then allows prey populations to increase again.

E3

Habitat Fragmentation

1

− **Choose 1 of your Vulnerable Species. It goes Extinct.**

+ **Draw 1 card for each Resilient Species.**

Fragmentation has serious ecological impacts including population loss and reduced biodiversity.

E3

Herbivore Introduced into Ecosystem

1

Affects Plant Species only.

− **Your opponent chooses 2 of your Vulnerable Species. Lose 1 Trait card from each.**

+ **If all your Species are Resilient, draw 3 cards.**

Herbivores have specific adaptations for eating plants. For example, they often have flat molars for crushing plant material and alkaline saliva so plant material can be pre-digested.

E3

Intensive Farming

1

Affects Plants only.

− **Choose 1 of your Vulnerable Species. It loses 2 Trait cards.**

+ **Draw 1 card for each Resilient Species.**

Negative effects of intensive farming include: natural habitat loss; loss of biodiversity; and soil erosion. Deforestation is a major example of clearing natural habitat to create room for agriculture.

E3

Intensive Farming

1

Affects Plants only.

Choose 1 of your Vulnerable Species. It loses 2 Trait cards.

Draw 1 card for each Resilient Species.

Extensive use of fertilisers, herbicides and insecticides in intensive farming contaminate water soils and water bodies which can cause eutrophication.

E3

Over-Exploitation

1

If at least 1 of your Species is Vulnerable, discard all Trait cards from your hand.

Draw 3 cards if all Species are Resilient.

When a species is exploited, for example through hunting as with the Northern Elephant Seal, this can result in a genetic bottleneck. A large population falls to a few individuals which decreases allele frequencies and genetic variation.

E3

Interaction Inhibitor

Negate the activation and/or effect of an Interaction card and place it in the discard pile.

E3

Cheating

Continuous

Place on an opponent's 'Pollination' Interaction card and negate its effects while this card is active. Their Resource Number at the end of their turn is reduced by 2. When either of the Species that 'Pollination' is attached to goes extinct, place this card in the discard pile.

Cheating describes relationships that were previously mutualistic but are now antagonistic. Bees that avoid picking up pollen by chewing through tubular flowers gain the nectar reward without helping the plant to reproduce.

E3

Scavenger

If an opponent's Species goes Extinct, add the Trait cards of their Extinct Species to your hand.

Species with a scavenger lifestyle eat carrion or dead plant matter. Vultures are a common example and often make use of meat left by predators such as lions.

E3

Cleaning Symbiosis

Continuous

Place this card between 2 Animal Species. Both of these Species are Resilient to Parasitism. If either Species goes extinct, discard this card.

In this mutualistic interaction, the cleaner species eats the parasites on the surface of the client species. Cattle egrets migrate alongside cattle herds and eat the flies and parasites that affect the cattle.

E3

Cleaning Symbiosis

Continuous

Place this card between 2 Animal Species. Both of these Species are Resilient to Parasitism. If either Species goes extinct, discard this card.

Some cleaner fish use dance-like movements to initiate a relationship with their host. However, some predatory fish, like the blenny, Aspidontus taeniatus, can imitate this dance to deceive the host and feed off its healthy tissue.

E3

Assessment Display

Continuous

Play on your Community. All your Animal Species cannot be affected by opponents' Interaction cards. Remove this card at the end of your next turn.

Assessment displays help to avoid intraspecific competition, which can be costly to both individuals. For example, Red Deer on the Isle of Rum use roaring and parallel walks to avoid rutting conflicts.

E3

Migration

Can only be played on your turn. Choose an opponent's Animal Species and move it to your Community.

The salmonids are a group of stenohaline fish that migrate each year, from hunting grounds in salt water oceans into fresh water rivers to spawn.

E3

Ritualisation

Can only be played on your turn. Go through the discard pile and add any 2 Interaction cards of your choice to your hand, apart from 'Ritualisation' or 'Commensalism'.

An important stage of ritualisation is about increasing the chance that the intended recipient of the communicative behaviour is likely to receive it. This may be strategic placement (as in scent marking).

E3

Predator Ecesis

Continuous

Can only be played on your turn. Choose an opponent's Species that is Vulnerable to Predation and place this card in their Community. You must have a Species that is 1 Trophic Level higher than the chosen Species. As long as this card is active, the chosen Species loses one Trait card at the end of each of your turns. Remove this card if that Species goes Extinct or it becomes Resilient to Predation.

When a predator enters a new habitat it can alter the existing food web causing significant reductions in prey population abundance. In some cases this can cause local species extinction.

E3

Predator Ecesis

Continuous

Can only be played on your turn. Choose an opponent's Species that is Vulnerable to Predation and place this card in their Community. You must have a Species that is 1 Trophic Level higher than the chosen Species. As long as this card is active, the chosen Species loses one Trait card at the end of each of your turns. Remove this card if that Species goes Extinct or it becomes Resilient to Predation.

Although the introduction of a predator to a new area can have many negative effects, it can be beneficial to some species. If the new predator hunts a species competitor or predator it can indirectly increase the population size of that species.

E3

Pollination

Continuous

Can only be played on your turn. Play this card in your Community between an Animal at Trophic Level 2 and a Plant with a 'Manipulates Pollinators' Trait Attribute. Increase your Resource Number by 2 for as long as this card is active. If either Species goes Extinct, remove this card.

One theory to explain the Abominable Mystery (why Angiosperms are so abundant) is that they co-evolved with their pollinators. Support for this can be seen in the evolutionary histories of insect pollinators, who diversified around the time Angiosperms appeared.

E3

Pollination

Continuous

Can only be played on your turn. Play this card in your Community between an Animal at Trophic Level 2 and a Plant with a 'Manipulates Pollinators' Trait Attribute. Increase your Resource Number by 2 for as long as this card is active. If either Species goes Extinct, remove this card.

Plants have developed ways to manipulate animal pollinators using flower colour, pattern, chemicals (including those for scent) and even electrical fields.

E3

Pollination

Continuous

Can only be played on your turn. Play this card in your Community between an Animal at Trophic Level 2 and a Plant with a 'Manipulates Pollinators' Trait Attribute. Increase your Resource Number by 2 for as long as this card is active. If either Species goes Extinct, remove this card.

Using pollinators doesn't guarantee a plant successful fertilisation but it does promote outbreeding. This is why many plant species choose to take the risk and spend energy on attracting pollinators.

E3

Pollination

Continuous

Can only be played on your turn. Play this card in your Community between an Animal at Trophic Level 2 and a Plant with a 'Manipulates Pollinators' Trait Attribute. Increase your Resource Number by 2 for as long as this card is active. If either Species goes Extinct, remove this card.

The 4 main orders of insect pollinators are Coleoptera (beetles), Diptera (flies), Hymenoptera (includes bees, wasps and ants) and Lepidoptera (butterflies and moths).

E3

Protective Mutualism

Continuous

Can only be played on your turn. Place this card between 2 Species. Both of these Species are Resilient to Predation. If either Species goes Extinct, remove this card.

Ants make their nests in the thorns of Acacia trees and eat its nectar. In return for food and shelter, the ants protect the tree from herbivory by stinging any herbivore that tries to eat the tree.

E3

Dispersers

Continuous

Can only be played on your turn. Play this card in your Community between an Animal at Trophic Level 2 and a Plant with a 'Manipulates Dispersers' Trait Attribute. Increase your Resource Number by 1 for as long as this card is active. If either Species goes Extinct, remove this card.

Seeds can be dispersed by animals when they get trapped in their fur or hair. The animal can then transport the seeds long distances away from the mother plant before they fall off and potentially germinate.

E3

Dispersers

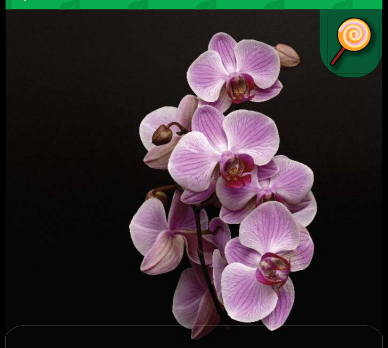
Continuous

Can only be played on your turn. Play this card in your Community between an Animal at Trophic Level 2 and a Plant with a 'Manipulates Dispersers' Trait Attribute. Increase your Resource Number by 1 for as long as this card is active. If either Species goes Extinct, remove this card.

Some animals ingest seeds and excrete them away from the mother plant. In some cases, the seeds need to be eaten by certain animal species as their digestive tract triggers the seed's germination process.

E3

Arbuscular Mycorrhizas

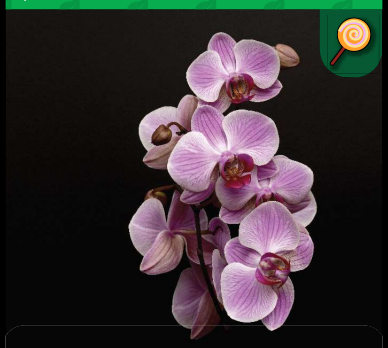


Invest 1.

In return for increased access to nutrients, plants may donate up to 20% of fixed carbon to the fungus. Approximately 70% of plant species use this form of symbiosis, including orchids.

E3

Arbuscular Mycorrhizas



Invest 1.

While there is a loss of fixed carbon to AM, these fungi increase a plant's rhizosphere without the cost of investing in the equivalent distance of root tissue.

E3

Low Stomatal Density

The lower the stomatal density the lower the surface area for the exchange of water vapour and respiratory gases. This prevents water loss but slows the diffusion of carbon dioxide into the plant.

E3

Low Stomatal Density

Stomatal density is a metric often used to study phenotypic plasticity. A single genome can give rise to several phenotypes of a plant species, each adapted to different carbon dioxide concentrations.

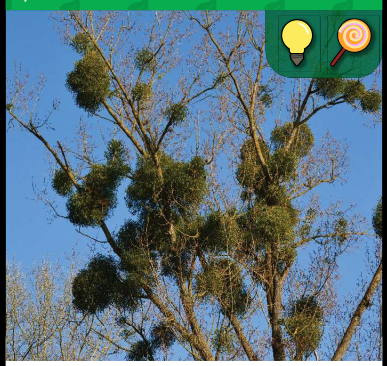
E3

Insectivory

Plants with this trait often inhabit areas with nutrient poor soils but high sunlight and water availability. They use the insects as a source of nitrogen, phosphorus and other nutrients so they can thrive in otherwise inhospitable terrain.

E3

Parasitic Plant



When you play this card, choose a Trait on an opponent's Plant Species that is Vulnerable to Parasitism. Place it in the Discard Pile.

Parasitism is thought to have evolved 12 times independently, all within the angiosperm group.

E3

Leguminous Plant

Invest 1.

This highly specialised association with rhizobia bacteria utilises the nitrogenase complex found only in prokaryotes to feed the plant with ammonium fixed from atmospheric nitrogen.

E3

Fruit Production

Manipulates Dispersers

By producing nutrient rich fruits many plants can ensure that their seeds are carried away from the mother plant by animals who eat the fruit.

E3

Fruit Production

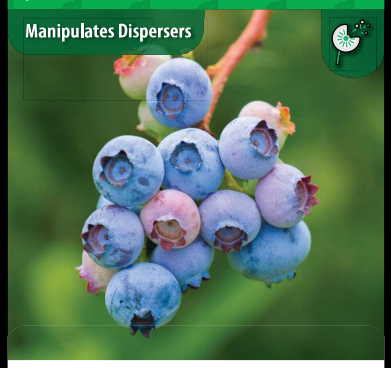
Manipulates Dispersers

Seed dispersal through fruit consumption reduces the chance of competition not only between the progeny but also between the progeny and the mother plant, providing a selective advantage.

E3

Fruit Production

Manipulates Dispersers



Animals who eat the fruit digest the nutritious pericarp (outer layer) and excrete the seed, which has the potential to germinate into a new plant.

E3

Phytoliths

Invest 1.

Some plants, such as grasses, take up silica from the soil and invest it into phytoliths within the plant tissue. These silicon dioxide based structures deter herbivores.

E3

Phytoliths

Invest 1.

Phytoliths are rigid and give the plant a grainy texture that makes it unpalatable to many herbivores as the plant is hard to digest.

E3