ECOLOGY

Precarious preferences

MICHAEL C. SINGER & CAMILLE PARMESAN

In 1993, three ecologists reported[1] that an isolated population of the butterfly *Euphydryas editha* that inhabited a meadow in Nevada was starting to evolve a preference for laying its eggs on *Plantago lanceolata* — a non-native plant introduced to the region by cattle ranchers. On page 238, two of these researchers now show[2] that the butterflies became completely dependent on the exotic plant, with adverse consequences.

Originally, *E. editha* laid its eggs on the native plant *Collinsia parviflora*, but the longer life span of *Plantago* enabled larvae to feed on it for longer, increasing larval survival. In the current study, Singer and Parmesan report that all the female butterflies they examined in 2005 preferred to lay their eggs on *Plantago* (pictured, *E. editha* resting on *Plantago*). And by 2007, all the larvae they found in the field were feeding on this non-native plant.

But cattle ranching ceased in 2005, leading to a rapid build-up of grassy vegetation and a decline in the dominance of *Plantago*. This, in turn, led to the extinction of the isolated *E. editha* population between 2007 and 2008, probably because the long grasses blocked out sunlight, cooling the warmth-loving larvae. The growth of the grasses quickly abated, but the butterfly population remained extinct until between 2013 and 2014, when *E. editha* recolonized the field, laying its eggs on *Collinsia*, and so setting the stage for the process to begin again.

These findings demonstrate how the adaptation of insect populations to human-induced environmental change can render those populations dependent on the continuation of specific human practices — a potentially precarious position, given the rapidity with which such things can change. **Anna Armstrong**

1. Singer, M. C., Thomas, C. D. & Parmesan, C. *Nature* **366**, 681–683 (1993).
2. Singer, M. C. & Parmesan, C. *Nature* **557**, 238–241 (2018).

PARTICLE PHYSICS

Weak charge of the proton measured

The proton's weak charge defines the strength of certain interactions between protons and other particles. A precise determination of this quantity provides a stringent test of the standard model of particle physics. SEE LETTER P.207

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Subatomic particles interact through four fundamental forces. However, only two of these forces have effects on macroscopic scales: gravity keeps us grounded on Earth, and electromagnetism causes lightning on stormy days. We are not directly influenced by the other two forces — the weak and strong forces. Similarly, it is generally known that mass is at the root of gravitational interactions and that electric charges and magnetic moments are central to electromagnetism. But the physical properties that describe the strength of weak and strong interactions, known as weak and colour charges, respectively, are less familiar. On page 207, the Jefferson Lab Q_{weak} Collaboration[1] reports the first high-precision measurement of the weak charge of the proton, which sets tight constraints on physics that cannot be described by current theories.

The strong force is so overwhelming that the particles that interact through it, known as quarks and gluons, are tightly bound to one other and exist only as composite objects, such as protons and neutrons. By contrast, the weak force is so feeble that its interactions are almost completely masked by those of electromagnetism. One might therefore wonder how the weak charge of a particle can be measured if it is as small as the name implies. Fortunately, nature provides a convenient yardstick that is associated with a principle known as parity symmetry.

A process conserves parity symmetry if it occurs with the same probability as its exact mirror image. It is straightforward to see that parity symmetry is broken in the macroscopic world, particularly in biological systems. For example, most humans are right-handed. If parity symmetry were conserved for the handedness of humans, half of the population would be right-handed and half would be left-handed.

Particles also have a handedness. A right-handed particle spins in the direction defined by the curl of your four fingers when you point your right thumb along the direction of the particle's velocity. Conversely, a particle is left-handed if you must use your left hand to relate its spinning and velocity directions. Remarkably, all subatomic particles violate parity symmetry when they interact with one