appeared in 2003

Prime numbers are best for multiplying

Breeding cycles of some insects show mathematical features that involve prime numbers, says S.Ananthanarayanan.

The cycles seem to have evolved so that the insects could avoid systematic attack by predators.

Numbers and primes

Ordinary numbers, like 8, 45 or 63 can be expressed in terms of smaller numbers. Like $8 = 4 \times 2$, $45 = 5 \times 9$ and $63 = 7 \times 9$. But prime numbers, like 11 or 23 or 59, have no factors (other than themselves and the number 1). Hence they cannot be expressed in terms of smaller numbers.

If a species of insect appeared in force, to breed, every 8 years, then it would be at risk to predator species that appeared every 8,4 and 2 two years. A species that bred every 6 years would be prey to another species that appeared every 6 yrs, 3 years or 2 years. But if the species bred every 7 years, then, because 7 is a prime number, it would be attacked only by a species that appeared every 7 years. This would lower the risk.

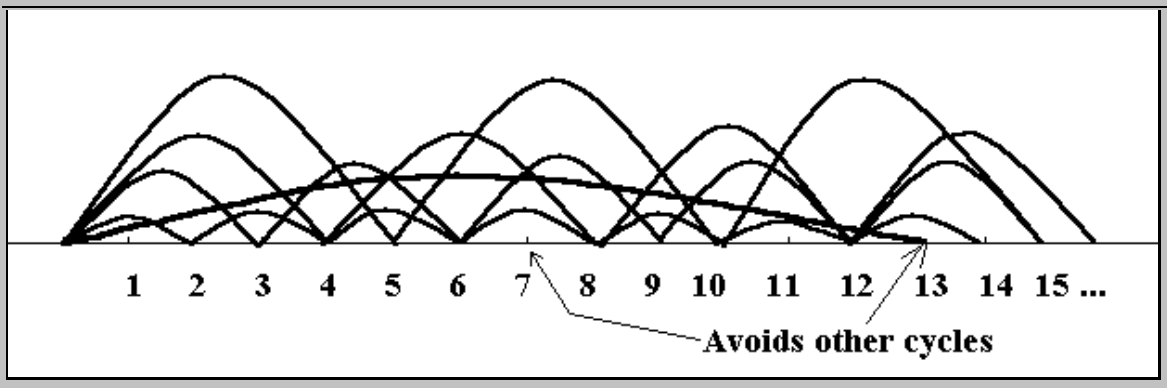
Breeding cycles

All species would, of course, be prey to enemies that appeared every year. But these would be 'public' enemies and would not target a particular species. Most species, moreover, do breed every year, and are in sufficient numbers or have strategies that allow them to survive. But annual breeding, while it is the most efficient way, is not the only one and some species stay in hiding till they emerge, every few years, to breed. This is not as efficient as annual breeding and the species also needs to expose itself completely, when it emerges to breed. But, on the credit side, the species is safe from attacks every year.

Now, during these breeding years, if they had a special enemy that was also there, then the species is not likely to survive and grow. Hence, the strain of the species that survives is the one that has a cycle that avoids the cycle of specific enemies. The enemy, for the efficiency of its own breeding, would generally have shorter cycles, with the hope of finding prey during its own seasons in the field.

Safe cycles

The strains that survived seem to have taken to cycle periodicities in prime numbers, that avoid 'factors', during which predator species could also be there. Varieties of ***Magicada***, a celebrated, 'periodic' species of cicada, or a kind of grasshopper, have cycles of either 13 or 17 years. Magicada live underground but every 13 or 17 years, they emerge for six weeks in huge numbers of carnival cacophony, to feed, mate, lay eggs and die. The cycle of 13 or 17 years seem to be the secret of the species' survival.



Mario Marcus and associates at the Max Plank Institute of Molecular Physiology, Dortmund, Germany have prepared a mathematical model of competing species, with differing levels of population, reproductive efficiency and cyclicity. Computers can then simulate thousands of generations of different species, predators and prey, with all possible cycles of reproductive and predatory activity. The trials consistently show that it is the cycles in *prime* numbers that survive, and should hence evolve

The computer programs, incidentally, have proved to be useful as generators of prime numbers, not by methods of mathematics, but by the test of the ability to survive. The computer feeds in vast ranges of cyclicity. The numbers, including very large ones, that remain are the primes. It is not a particularly efficient way to generate primes, but there, it is nature's way!