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[生物科技] 中研院提出新理論 解釋生物多形現象及同域物種形成
[生物科技] 中研院研究員提出新理論 解釋生物多形現象及同域物種形成

世界上的生物擁有變化萬千的多樣性面貌，即使同種生物外形上也有多樣變化，如同人類血型有O型、A型、B型和AB型，小樹林蝸牛(Grove snail，學名 Cepaea Nemoralist)也有褐、黃、粉紅等不同顏色。對生物學家來說，這種多形現象（polymorphism）不僅有趣，更具有生物演化的重要學術意涵。因為這些呈現多形的生物可能有相同基因體(如雌雄鱷魚基因體相同)；也可能有不同的基因體(如雌雄哺乳類動物基因體不同)。這些都與物種為求適應環境，試圖存活下去，息息相關。

生物學家同時也發現，環境是促使同一物種(species)發展多形(morph)的非常重要因素。例如，在春天時與環境顏色相近的褐、粉紅色小樹林蝸牛，不易被獵食，容易存活，而夏、秋天，黃色小樹林蝸牛則存活較多。時序與環境的變化，如何影響多形現象是非常吸引人的學術問題。

中研院物理所胡進錕教授與亞美尼亞葉里溫物理研究所的 Armen Allahvendyan
教授，2人共同於2009年2月6日在頂尖物理學專業期刊《物理評論通訊(Physical Review Letters 102，058102)》發表一篇論文，指出隨時間精細週期變化的環境(fine-grained time-periodic environment)有可能讓原來居於劣勢的物種型態(morph)存活下來，而造成多形現象，這有利於該物種的繁衍。本理論與一項微生物族群的實驗結果相符。

胡進錕研究員解釋，隨時間精細週期變化的環境是指在一生物體的生命期中，環境已有數個週期的變化。例如，小樹林蝸牛生命期約7至8年，它在生命期中經歷7
至8次四季的變化，因此它可感受到精細週期變化的環境。胡進錕研究員與 Armen Allahvendyan
教授應用演化博弈理論（evolutionary game theory）和 Kapiza 法(P.L. Kapiza
1894~1984，得1978年諾貝爾物理獎) 研究各種形態生物總數隨時間變化的現象而獲得先前所說的結論。

他們同時也應用此理論，來探討學術界目前仍熱烈爭辯的「同域物種形成」(sympatric speciation)
機制。所謂「同域物種形成」，係指在單一族群(a single
population)中引發的物種(species)形成，是一種較新具挑戰性的看法；而另一種「異域物種形成」（allopatric speciation）則較為學術界普遍接受。所以，胡進錕研究團隊認為，隨時間精細週期變化的環境，可能是「同域物種形成」的先決條件。隨時間精細週期變化的環境，使得同一物種(species)先形成不同的多樣型態(morph)，這些多樣型態(morph)再演化為不同的物種(species)。

論文參考網站：
http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=PRLTAO000102000005058102000001&idtype=cvips&gifs=yes

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[Biology] Researchers from Taiwan Academica Sinica and Armenia Propose New Theory of Polymorphism and Sympatric Speciation

On 6 February, 2009, Dr. Armen Allahverdyan of the Yerevan Physics Institute, Yerevan, Armenia and Dr. Chin-Kun Hu of the Institute of Physics published a new theory of polymorphism and sympatric speciation in a leading international physics journal, Physical Review Letters. The article explored a new mechanism of polymorphism related to the influence of a fast, time-dependent (fine-grained) environment.

Polymorphism is the term used for two or more clearly different types of phenotype (morphs) that exist in one interbreeding population. One of the most well-known and vivid examples of polymorphism are the human ABO blood groups. Humans with four different blood groups – A, B, AB and O live in one population. The origin of this environmentally-driven polymorphism is related to periodically appearing epidemics of cholera. In normal (cholera-free) periods the O group has a physiological advantage over all other groups, but the other three groups, especially the AB group, are more resistant to cholera.

In the context of the current theory 'fast' means that the environment can change many times during an individual's life-time. For example a Grove snail (Cepaea Nemoralist) which lives 7-8 years can experience many seasonal changes. Up until now such a fine-grained environment was not viewed as a potential source of polymorphism, as according to generally accepted common-sense among biologists, individuals exist in an average, static environment, and thus adapt to it. Up until now time-dependence was not considered. However, Allahverdyan and Hu discovered that under certain conditions, weak morphs (i.e., certain groups within the population) can compete and survive in the struggle with strong morphs, since they adjust more flexibly to their time-varying environment, thereby creating a polymorphic state. Moreover, the researchers show that overall fitness during the establishment of this polymorphism can decrease. Paradoxical as it seems, this result agrees with recent experiments on microbial populations subject to a fine-grained environment.

The researchers applied their results to sympatric speciation, a well known – but until recently controversial – mechanism of species formation, where in contrast to the allopatric scenario the speciation is induced inside one interbreeding population of a species. They argue that a fine-grained environment can be a prerequisite for the phenomenon of sympatric speciation.

The research was published in Physical Review Letters 102, 058102 (2009) available at:
http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=PRLTAO000102000005058102000001&idtype=cvips&gifs=yes

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