

## Evolution & Behaviour

# How did wild cats turn into our beloved domestic animals?

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doi.org/10.25250/thescbr.brk568

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This Break was edited by Akira Ohkubo, Associate Editor - TheScienceBreaker

*Ancient wild cats likely decided to move to our house thousands of years ago, but how this unique evolutionary adaptation happened remains unknown. Our study suggests that the rise of agriculture in Neolithic times helped establish the intimate human-cat relationship.*



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How cats – one of our favorite domestic animals – historically turned to live with us remains mysterious. The relationships between humans and housecats' common ancestor, the Near Eastern wildcat, begun as early as a rise of farming over 9,000 years ago, but it took thousands of years until fully domesticated housecats appeared around 3,500 years ago. What actually happened between these periods and how the ancestral wildcat evolved into our beloved housecat remains unknown. It has been challenging to address this question because of the lack of archeological hints for how humans and cats interacted in ancient times. In a new study, we addressed this long-standing question by revealing the importance of agriculture in establishing the human-cat relationship.

Remnants of early cats dated to 6,000-4,000 years ago were recently found in Poland, only thousands of kilometers away from where their ancestors were present. The appearance of these early cats coincided with the flourish of the Neolithic culture – characterized by its agricultural revolution – in the region. This raises an exciting question – did agriculture somehow trigger the human-cat relationship?

To address this question, we set out to track the changes in cats' behavior, focusing on their dietary habits. Entering Europe, Neolithic farmers cut down forests to create crop fields and kept these fields fertile using animal feces. Chemically speaking, this resulted in a significant increase in heavy nitrogen isotope in soils. Isotopes are atoms of the same

element that differ by mass, so they undergo chemical and physical reactions in different ways. As a result, heavy nitrogen isotopes are concentrated in animals and their feces. The heavy nitrogen isotope is then transferred from fertilized soils into plants and animals, including cats, in the food chain flow. Such a dramatic change in the nitrogen isotope ratio (light versus heavy nitrogen) can be recorded in bones. This chemical information can be stored in fossils for thousands of years – and even until today.

Analyzing nitrogen isotopic signatures in archeological cat remnants, we found that early cats tended to prey in manured fields and thus have heavy nitrogen-rich diets. To obtain a more comprehensive picture, we extended the study to the entire ecosystem: from humans, domestic ungulates and dogs, to wild carnivores, rodents and birds. We statistically modeled variations in prey hunted by ancient cats, which allowed us to categorize cats' prey into three isotopically distinct groups. These groups included low-heavy nitrogen animals (wild rodents and forest birds living outside of agricultural landscape), high-heavy nitrogen animals (synanthropic animals: animals living close to humans and strongly relying on manured crops, such as mice), and others (small migratory birds such as thrushes and woodcocks), distinct from different groups in nitrogen isotope content.

The results showed that Neolithic cats majorly hunted the high-heavy nitrogen prey group

(synanthropic animals). This prey group built even over half of their diet, which means that the ancient cats from Neolithic Poland were synanthropic (they lived close to humans), while they also relied on other variable food resources. In contrast, the nitrogen isotope signature of ancient dogs was very similar to that of humans, which may explain why dogs are popularly thought of as more human-friendly domestic animals than cats. All these findings suggested that the appearance of Neolithic culture and its agricultural revolution led to the domestication of wildcats.

Our study also provokes other possible scenarios about the evolution of cat domestication. For example, Neolithic cats might have been domesticated but still quite independent, and they might have freely explored around their home, living somewhere between agricultural and forest landscapes. Alternatively, they could have been still wildlife during the Neolithic periods, hunting synanthropic animals near human settlements.

Our discovery puts a milestone towards understanding the history of human-cat interactions. But there is still much to do to get the answer. Future studies would need to collect more archaeological data to understand the social behaviors of cats over the past several millennia. So, our cat exploration has just begun!