Assisted migration can rescue populations but it is likely too difficult to do in the field.

10 Paragraph generic Nature outline:

1. Takeover vs. diffusion
2. Difficult telling them apart with only spatial or phylogenetic information, need both
3. Emergence of agriculture is a great trait to test these transmission modes
4. Ppl have attempted to answer this question with spatial methods and with phylogenetic methods, but never both.
5. We distinguished between the two using both spatial and phylogenetic processes
6. Run simulations
7. Calculate summary statistics and why it is hard to distinguish them with only these outputs
8. Random forest machine learning to help decide how to use those statistics
9. Diffusion wins
10. How the world is different now that we know this answer and have these methods.

Summary paragraph:

*One or two sentences providing a* ***basic introduction*** *to the field, comprehensible to a scientist in any discipline.*

*Two to three sentences of* ***more detailed background****, comprehensible to scientists in related disciplines.*

*One sentence clearly stating the* ***general problem*** *being addressed by this particular study.*

*One sentence summarising the main result (with the words “****here we show****” or their equivalent).*

*Two or three sentences explaining what the* ***main result*** *reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.*

*One or two sentences to put the results into a more* ***general context****.*

*Two or three sentences to provide a* ***broader perspective****, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (The above example is 190 words without the final section, and 250 words with it).*

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Paragraph #1

Purpose: Takeover vs. diffusion intro

Argument: Two major hypotheses have been suggested as potential mechanisms for the global spread of plant and animal domestication (farming) among human societies. The diffusion hypothesis suggests that farming technology was passively shared between neighboring groups, while the takeover hypothesis suggests that farming spread through the forceful eviction and replacement of non-farming competitors.

Number of citations: 1

Citations and purpose: Bellwood (1996) Phylogeny and reticulation in prehistory. – lays out the debate between two opposing camps, phylogeny vs. network interaction.

Figure: NA

Table: NA

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Paragraph #2

Purpose: Difficult telling them apart with only spatial or phylogenetic information, need both

Argument:

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

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Paragraph #3

Purpose: Emergence of agriculture is a great trait to test these transmission modes

Argument:

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

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Paragraph #4

Purpose: Ppl have attempted to answer this question with spatial methods and with phylogenetic methods, but never both.

Argument: Investigating the role and relative importance of these two processes based on historical texts, local archeological surveys, and genetic analyses alone has proven both difficult and uninformative. Here we use the tools of spatial ecology, phylogenetic methods, niche reconstruction, and machine learning to develop a rigorous quantitative framework to better distinguish between these alternatives.

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

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Paragraph #5

Purpose: We distinguished between the two using both spatial and phylogenetic processes

Argument: We modeled the spatial and phylogenetic distribution of farming under four different modes of transmission: inheritance, inheritance plus diffusion, inheritance plus takeover, and inheritance plus diffusion and takeover. These models were replicated extensively (ca. 100k replicates per mode) and the resulting phylogenetic and spatial patterns were collectively used to train a random forest machine-learning algorithm to identify the most likely mode of transmission of any given simulation output. Once trained, this algorithm was then used to determine which transmission mode most likely led to current phylogenetic and spatial distribution of farming among human cultures.

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

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Paragraph #6

Purpose: Run simulations

Argument:

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

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Paragraph #7

Purpose: Calculate summary statistics and why it is hard to distinguish them with only these outputs

Argument:

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

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Paragraph #8

Purpose: Random forest machine learning to help decide how to use those statistic

Argument:

Number of citations: 2

Citations and purpose: Breiman (2001) – Random forest method, Liaw and Wiener (2002) for randomForest R package

Figure: NA

Table: NA

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Paragraph #9

Purpose: Diffusion wins

Argument: When applied to the current spatial and phylogenetic distribution of farming across human societies, our random forest algorithm unambiguously suggests that the most likely mechanism behind the spread of farming was strict cultural diffusion. The trained random forest algorithm was able to properly classify the transmission mode of any provided simulation with 59% accuracy, but demonstrated a particularly strong ability to distinguish between the diffusion and takeover models. The instances where the algorithm misclassified transmission modes, it most frequently confused the diffusion or takeover model with the model including both diffusion and takeover or the baseline model including only inheritance.

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

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Paragraph #10

Purpose: How the world is different now that we know this answer and have these methods

Argument: These results suggest that the speed at which a trait spreads through human societies conveys information about the mechanisms regulating that spread. Domestication can spread more quickly through diffusion than through takeover because copying ideas from a neighbor takes less time and effort than spatially displacing those neighbors. On a local scale, there is evidence for both diffusion and takeover, but on a global scale (including all known human society) diffusion seems to be the dominant driver of farming expansion while takeover only occasionally contributed to the spread of this trait.

Number of citations: 0

Citations and purpose:

Figure: NA

Table: NA

Supplemental information:

Figures:

1. Spatial network
2. Simulation video
3. Stats through time
4. Stats frequency distributions
5. Parameter distributions for extant vs. extinct
6. Random forest outputs through time