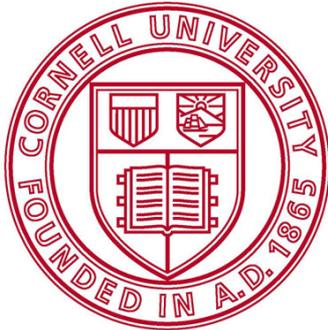


Prospects and limitations of modeling in the assessment of gene drive systems

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What do we expect to learn from a modeling analysis?

1. Qualitative predictions about the outcome of a drive release:

- Can a modification drive spread through the target population?
- Can a suppression drive eliminate the target population?
- Will resistance evolve and ultimately thwart a drive?
- Can a drive be confined to the target population?

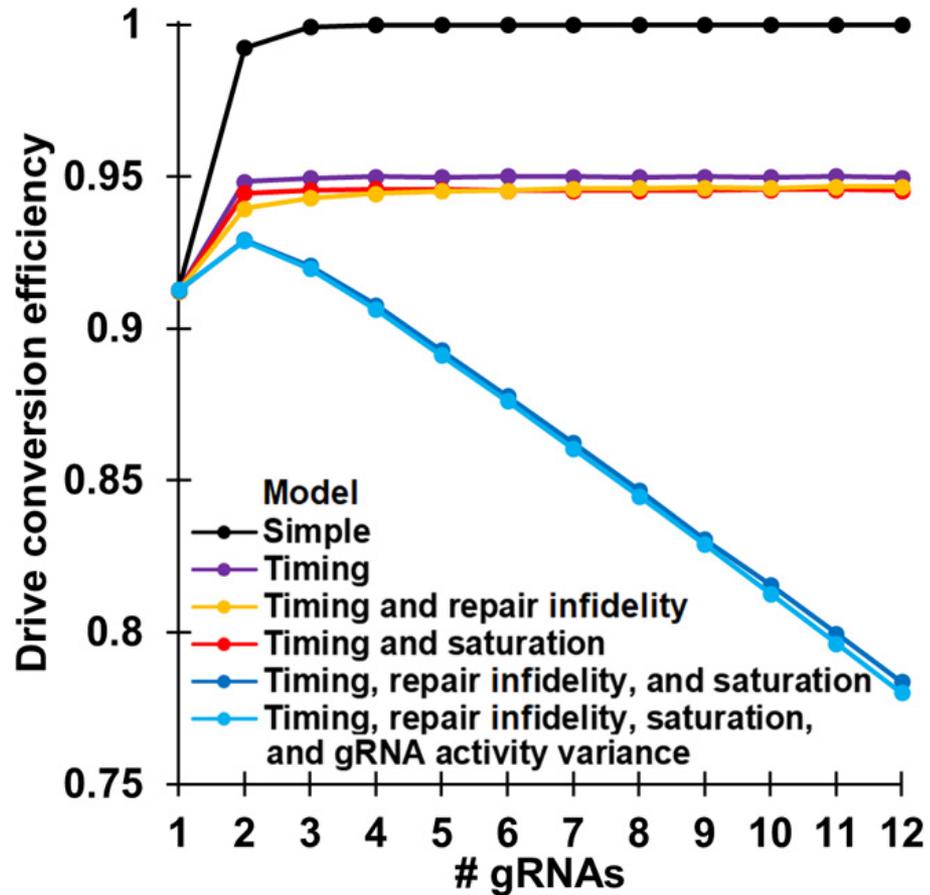
What do we expect to learn from a modeling analysis?

2. Quantitative predictions about the dynamics of the drive:

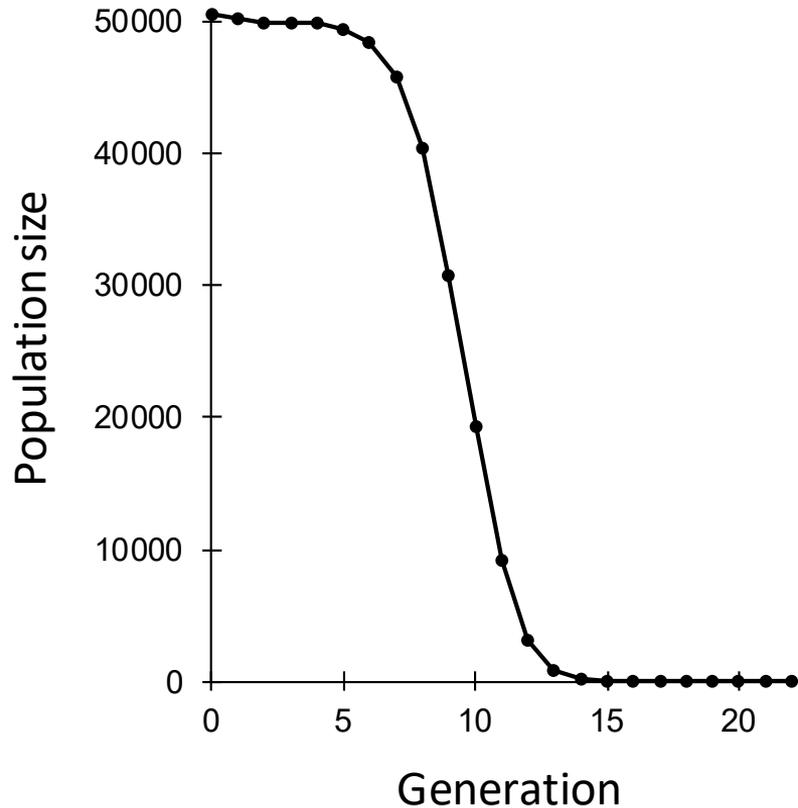
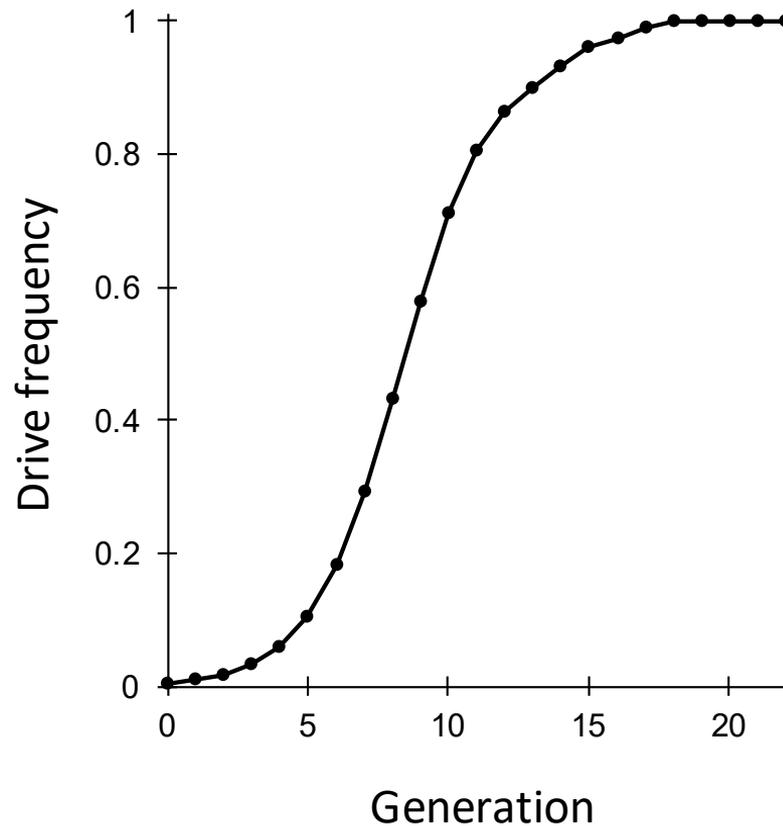
- How fast will the drive spread?
- What maximum frequency will it reach in the population?
- How long would it take until resistance evolves?
- Under which population parameters can the drive be confined?

What level of biological realism needs to be included in a model so that it can make accurate predictions?

- 1. Genetic complexity**
- 2. Demographic complexity**
- 3. Ecological complexity**



Suppression homing drive in model of a randomly mating population:



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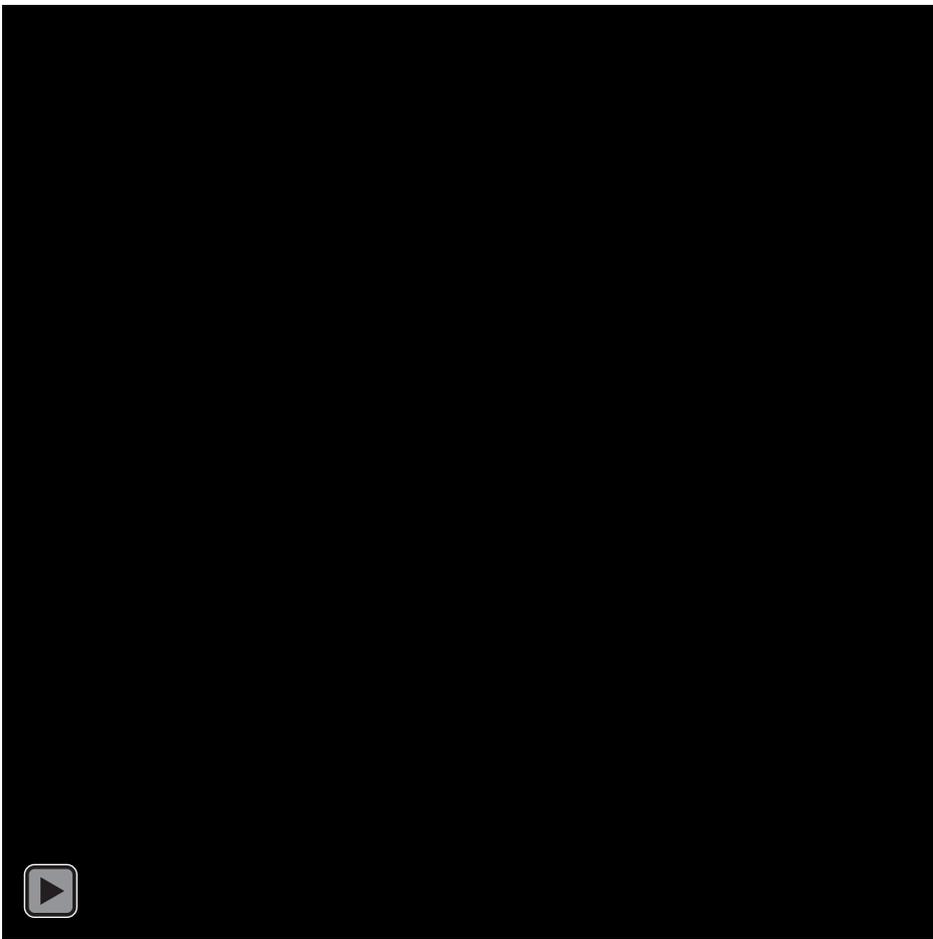
Evolution, Medicine, and Public Health [2019] pp. 66–81
doi:10.1093/emph/eoz014



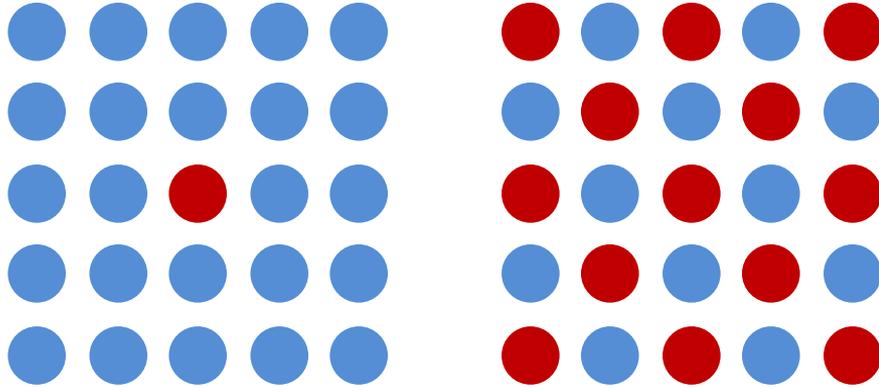
EVOLUTION,
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PUBLIC HEALTH

Gene-drive-mediated extinction is thwarted by population structure and evolution of sib mating

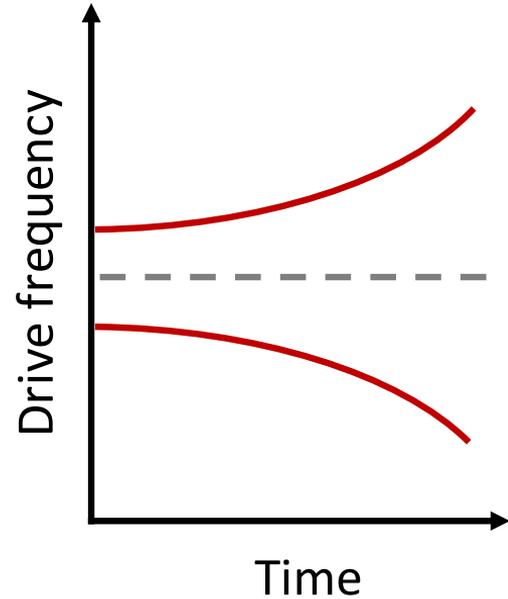
James J. Bull,^{*}¹ Christopher H. Remien² and Stephen M. Krone²

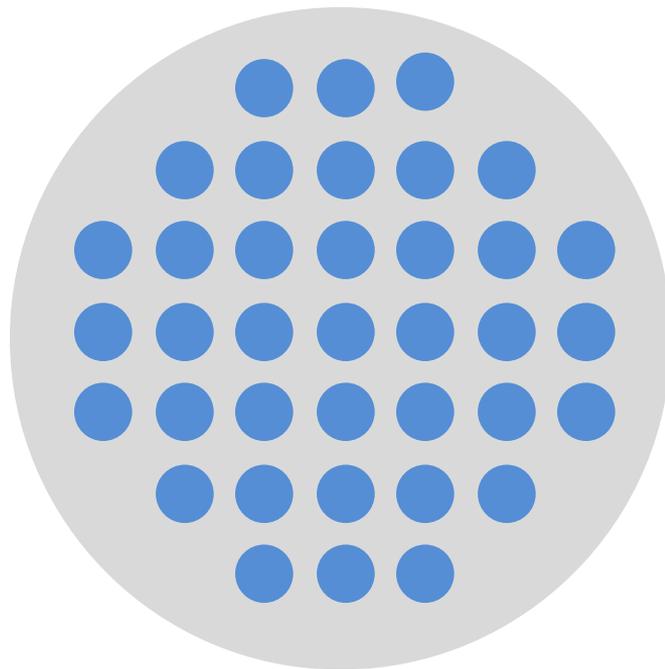
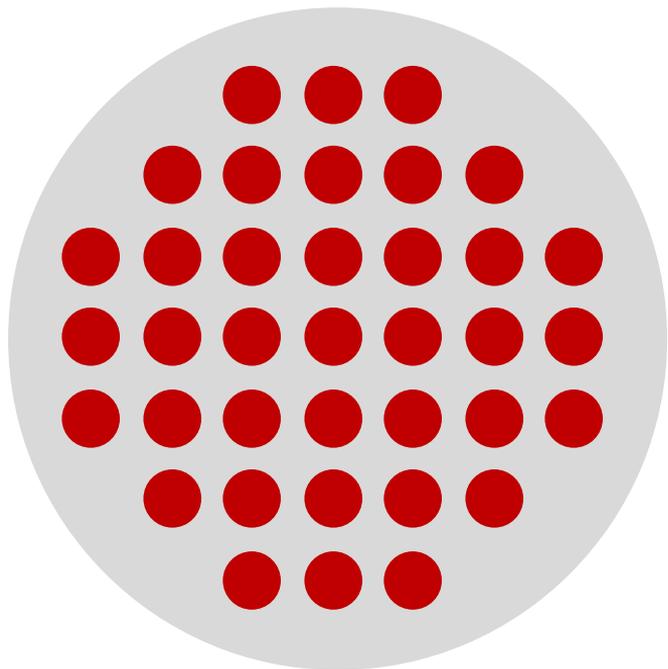


The concept of a threshold-dependent gene drive



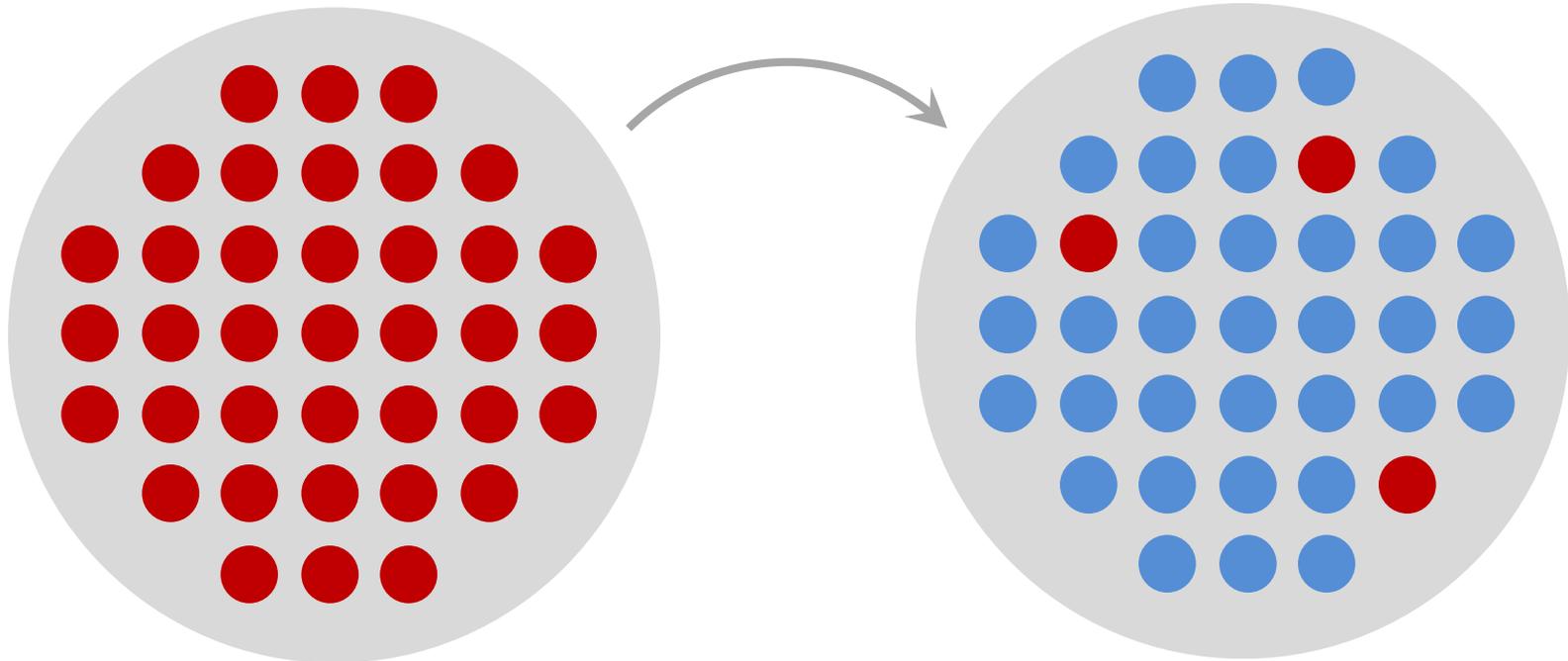
-  Drive carriers
-  Wild type individuals





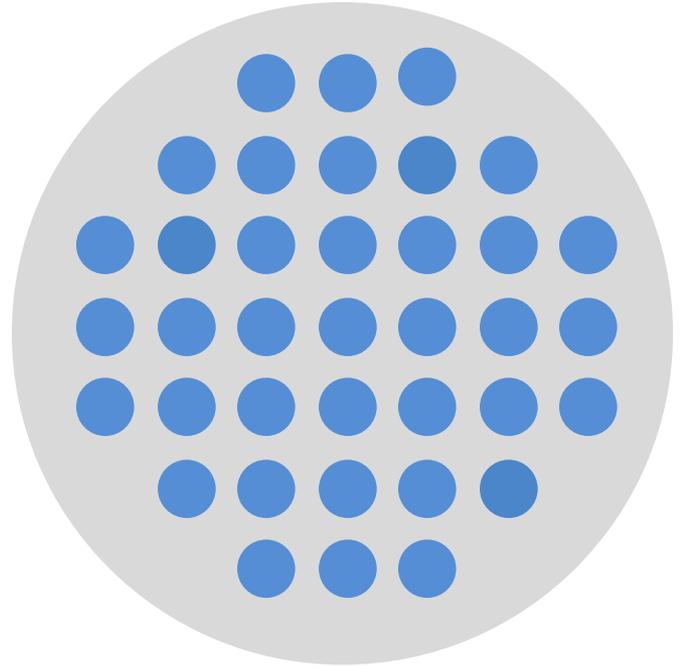
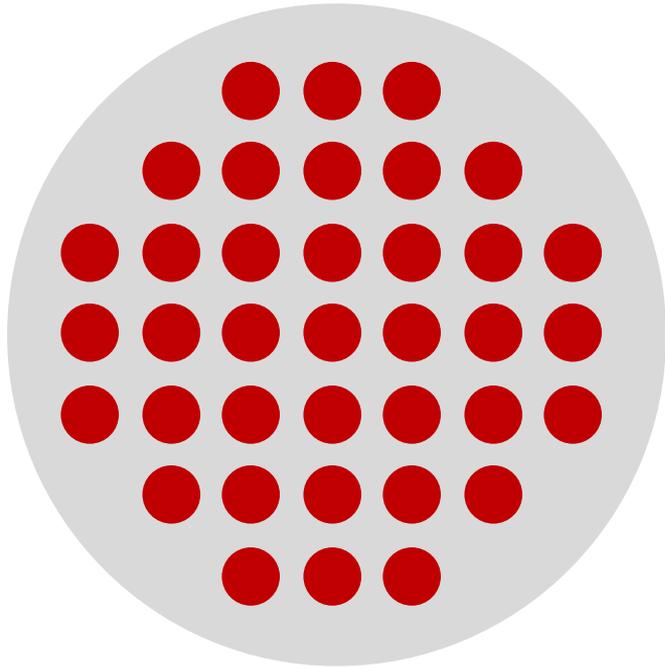
● Drive carriers

● Wild type individuals



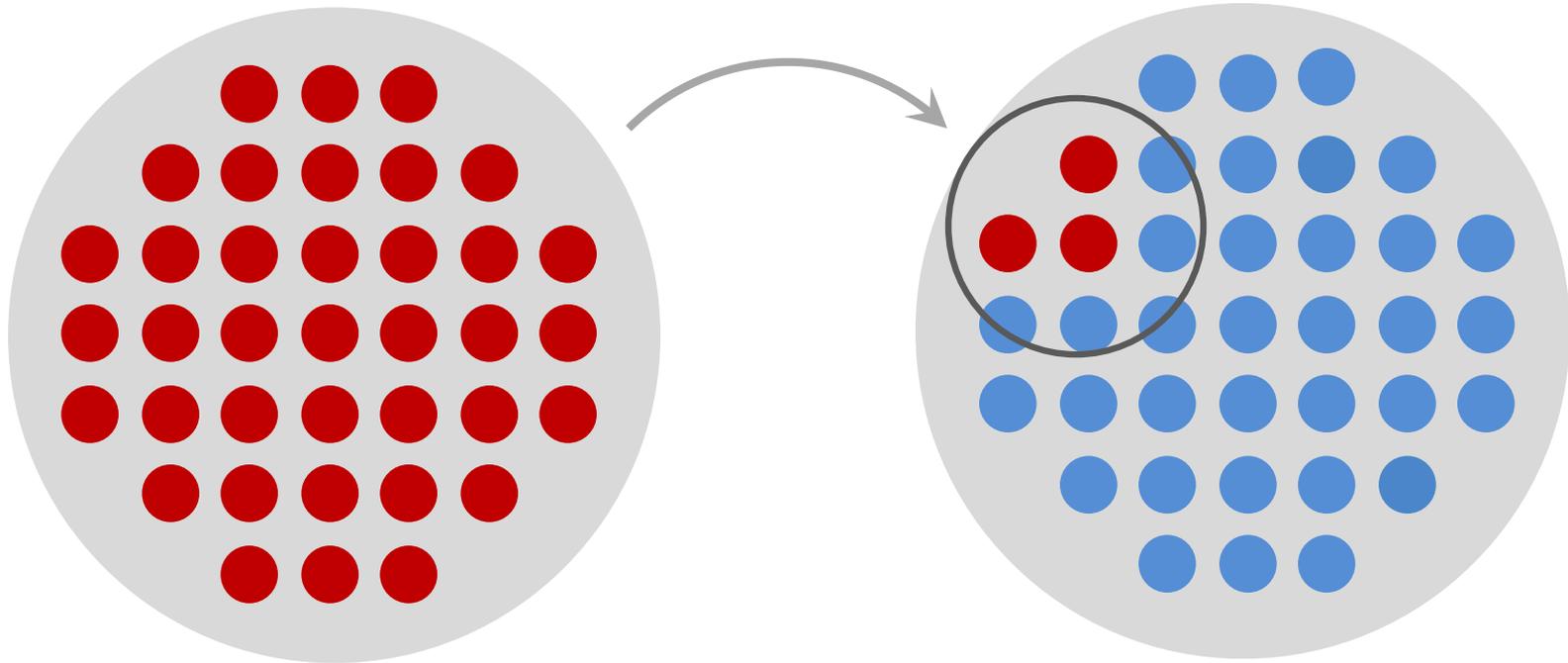
● Drive carriers

● Wild type individuals



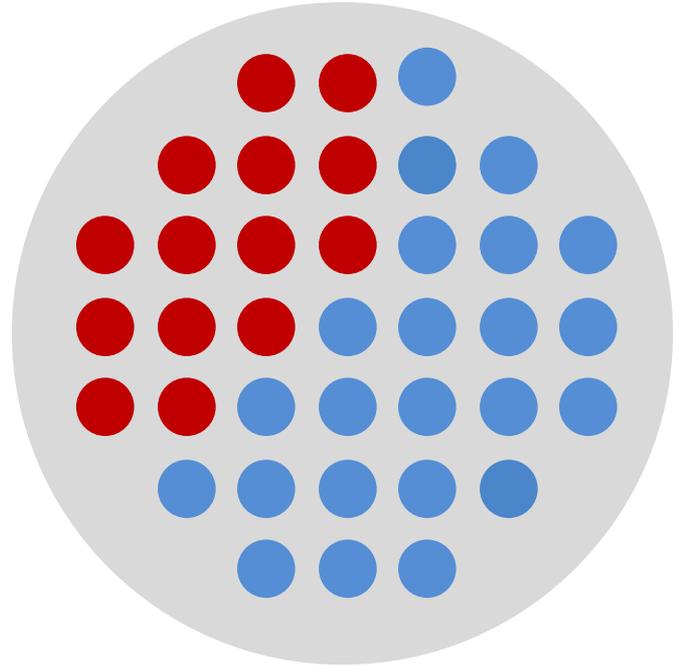
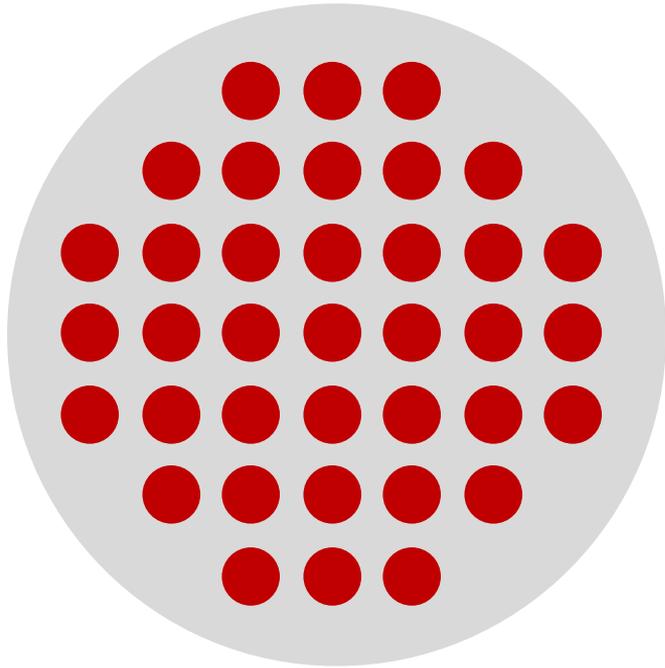
 Drive carriers

 Wild type individuals

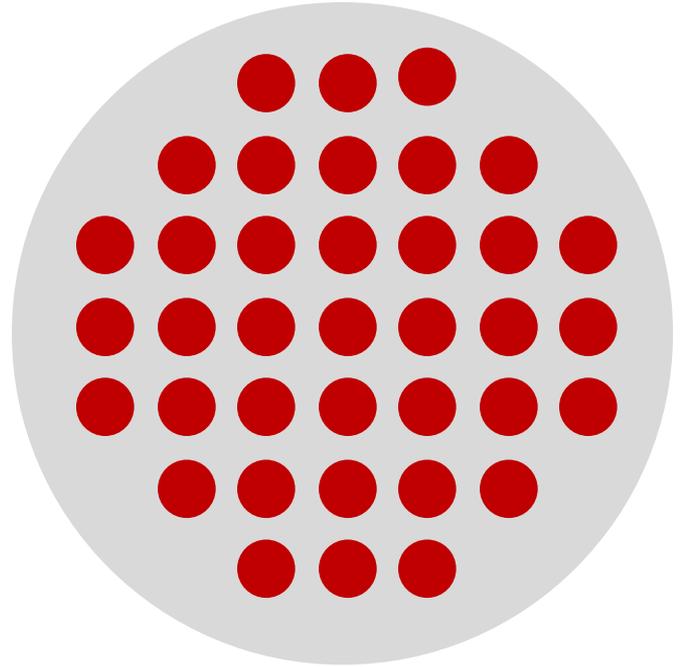
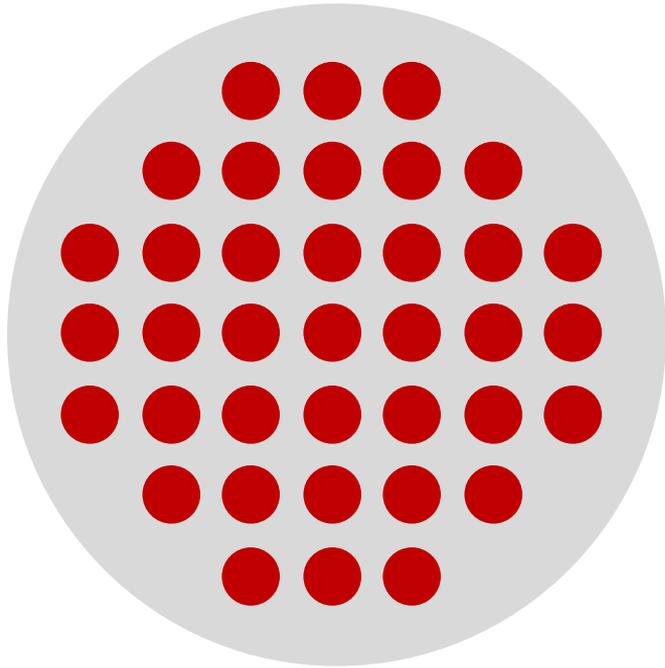


● Drive carriers

● Wild type individuals



- Drive carriers
- Wild type individuals



● Drive carriers

● Wild type individuals

- Modeling allows us to study the expected behavior of a gene drive before any real-world application is considered.
- However, model assumptions (genetic, demographic, or ecological) can change the expected outcome in fundamental ways.
- This can raise questions about key concepts such as the notion of a “confineable” gene drive strategy.
- To assess whether any given model is appropriate and makes accurate predictions, experimental verification will remain critical.