Planned Changes to simulate_change() Function and Detection Curve Concept

Background

The current `simulate_change()` function only compares the earliest and latest years within a site and generates predictions for the most recent year using the fitted GJAM model. However, this approach does not simulate a +20% change in abundance nor does it examine year-to-year detectability comprehensively.

Proposed Objective

Revise `simulate_change()` to assess the detectability of a 20% abundance change between **all consecutive year pairs** within each site.

Planned Enhancements to `simulate_change()`

Core Logic

1. **Identify all consecutive year pairs**:
2. For example, from years 2014 to 2020, generate pairs: (2014-2015), (2015-2016), ..., (2019-2020).
3. **For each year pair**:
4. Subset site data for just those two years.
5. Fit the GJAM model to this subset if needed (or reuse the full-site model if compatible).
6. Simulate a +20% increase in abundance in the **later year** (e.g., multiply species values by 1.2).
7. Generate new predictions using `predict.gjam()` or re-fit GJAM with perturbed data.
8. **Compare posterior distributions**:
9. Evaluate whether the model detects the simulated change.
10. Compute detection probability, such as the fraction of posterior draws where the simulated abundance is meaningfully greater than the original.

Output Structure

- For each site:
- A list of results for each year pair:
  - `year_start`, `year_end`
  - `detection_prob` (possibly per species)
  - `summary_stats` (e.g., mean difference, overlap of posteriors)

Detection Curve Concept

Definition

A "detection curve" is a summary visualization or matrix that captures the ability to detect a 20% change in species abundance **across all year pairs** for a given site.

Why It Is Informative

- Shows **temporal resolution** of detectability (e.g., strong detection in some years, weak in others).
- Indicates whether detectability is **improving or degrading** over time.
- Highlights species or time windows where change is most or least detectable.
- Supports evaluation of **monitoring adequacy** (e.g., how many plots are needed to detect change in short vs. long time frames).

Future Enhancements

- Integrate with sensitivity-to-plot-number analyses.
- Compare detection curves across sites or habitat types.
- Link to environmental drivers or external disturbances.

Next Steps

This detection curve enhancement will be revisited after initial model fitting is confirmed to be working reliably. A new function, tentatively named `simulate_year_to_year_change()`, will be developed at that stage and integrated into the existing `targets` pipeline.