Appendix 10. Graphs Showing Weighted Objective-Function Values

Graphs showing the weighted objective-function values throughout the Island Parallel Genetic Algorithm search—removing 10, 20, 30, 40, and 50 wells from the existing monitoring network. The objectives are described as follows: (1) Minimize the normalized root-mean-square deviation between kriged concentrations estimated using the existing and reduced monitoring networks. (2) Decrease spatial interpolation errors by minimizing the ratio between the sum kriging variance estimated for the reduced and existing monitoring networks. (3) Preserve significant long-term monotonic temporal trends in wells by minimizing the maximum fractional change per year estimated from survival-regression analysis, in wells removed from the existing monitoring network. (4) Preserve continuous record blocks that have the largest variability by minimizing the maximum normalized range of concentrations estimated from local-regression analysis, in wells removed from the existing monitoring network. The weighted sum of the objectives is minimized using Island Parallel Genetic Algorithms (ISLPGAs). This is a distributed multiple-population genetic algorithm (GA) where the population of candidate network designs is partitioned into several subpopulations and assigned to separated islands. Independent GAs are executed in each island and periodically the best performing designs are exchanged among the islands. The interval between exchanges is called an *epoch*. The *range* of weighted-objective values indicates the relative influence of an objective in determining the near-optimal solution.

Figures

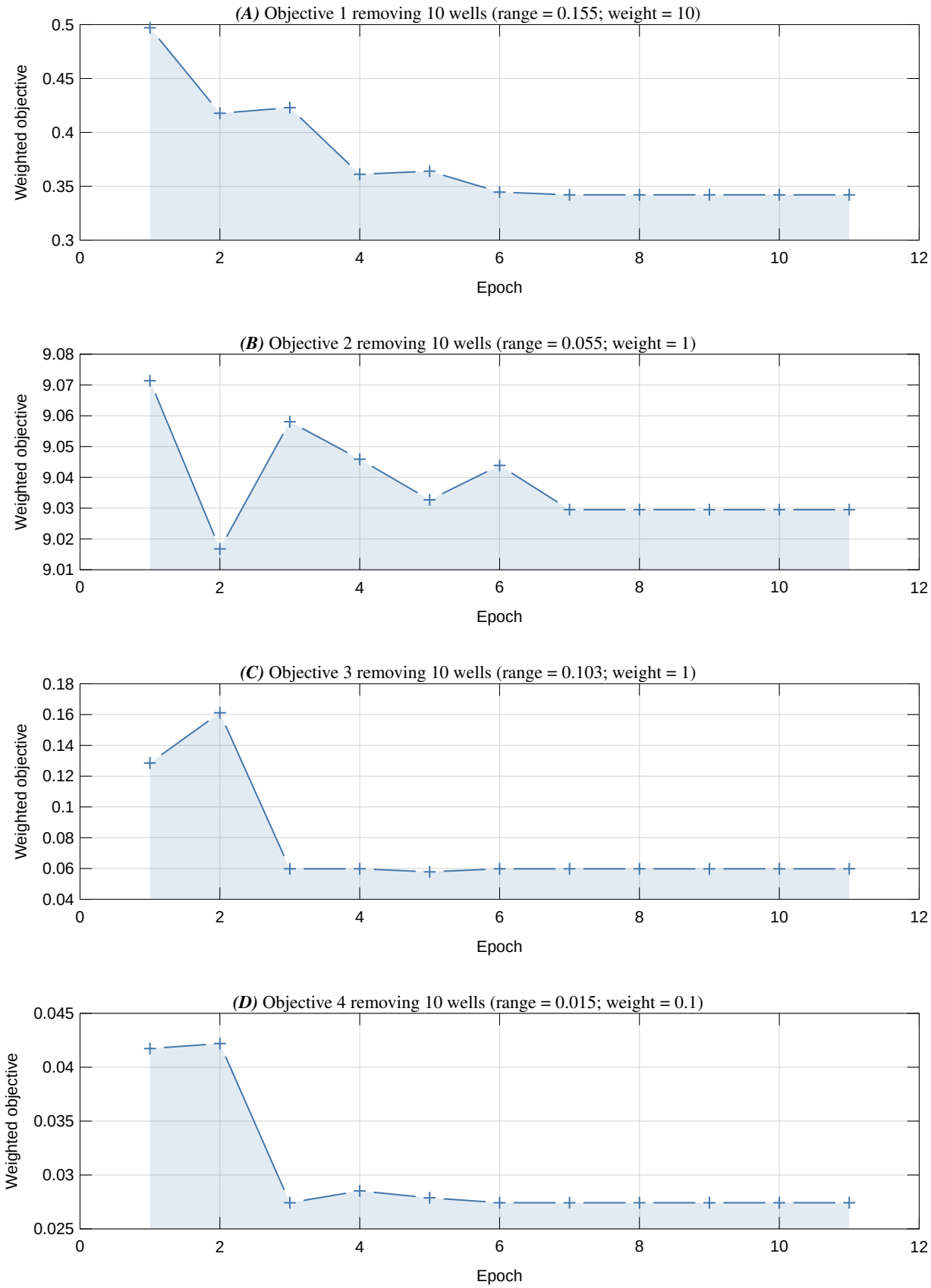

Figure 10.1. Weighted fitness versus epoch for (*A*) Objective 1, (*B*) Objective 2, (*C*) Objective 3, and (*D*) Objective 4 of the fitness function and removing 10 wells from the existing monitoring network.

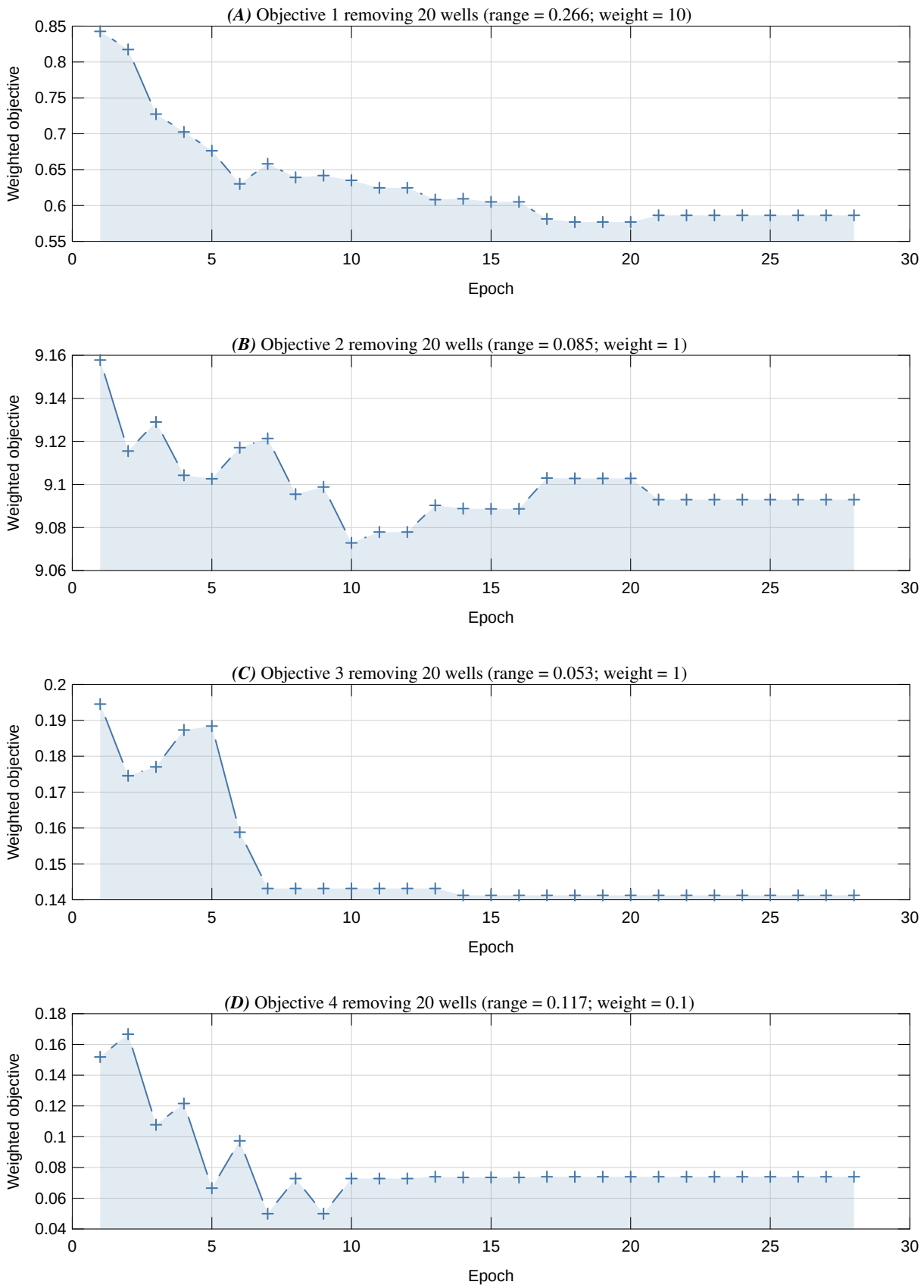

Figure 10.2. Weighted fitness versus epoch for (*A*) Objective 1, (*B*) Objective 2, (*C*) Objective 3, and (*D*) Objective 4 of the fitness function and removing 20 wells from the existing monitoring network.

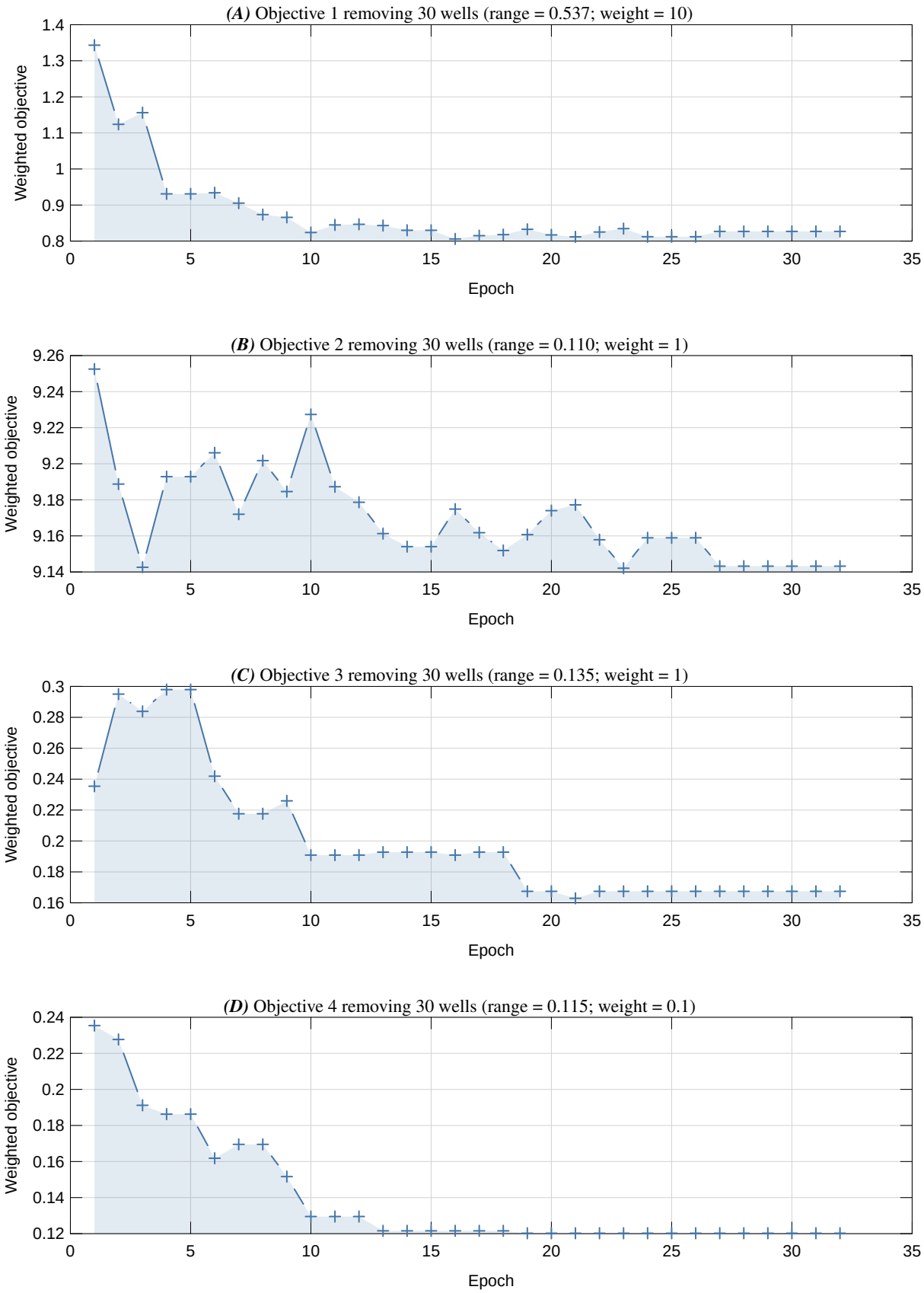

Figure 10.3. Weighted fitness versus epoch for (*A*) Objective 1, (*B*) Objective 2, (*C*) Objective 3, and (*D*) Objective 4 of the fitness function and removing 30 wells from the existing monitoring network.

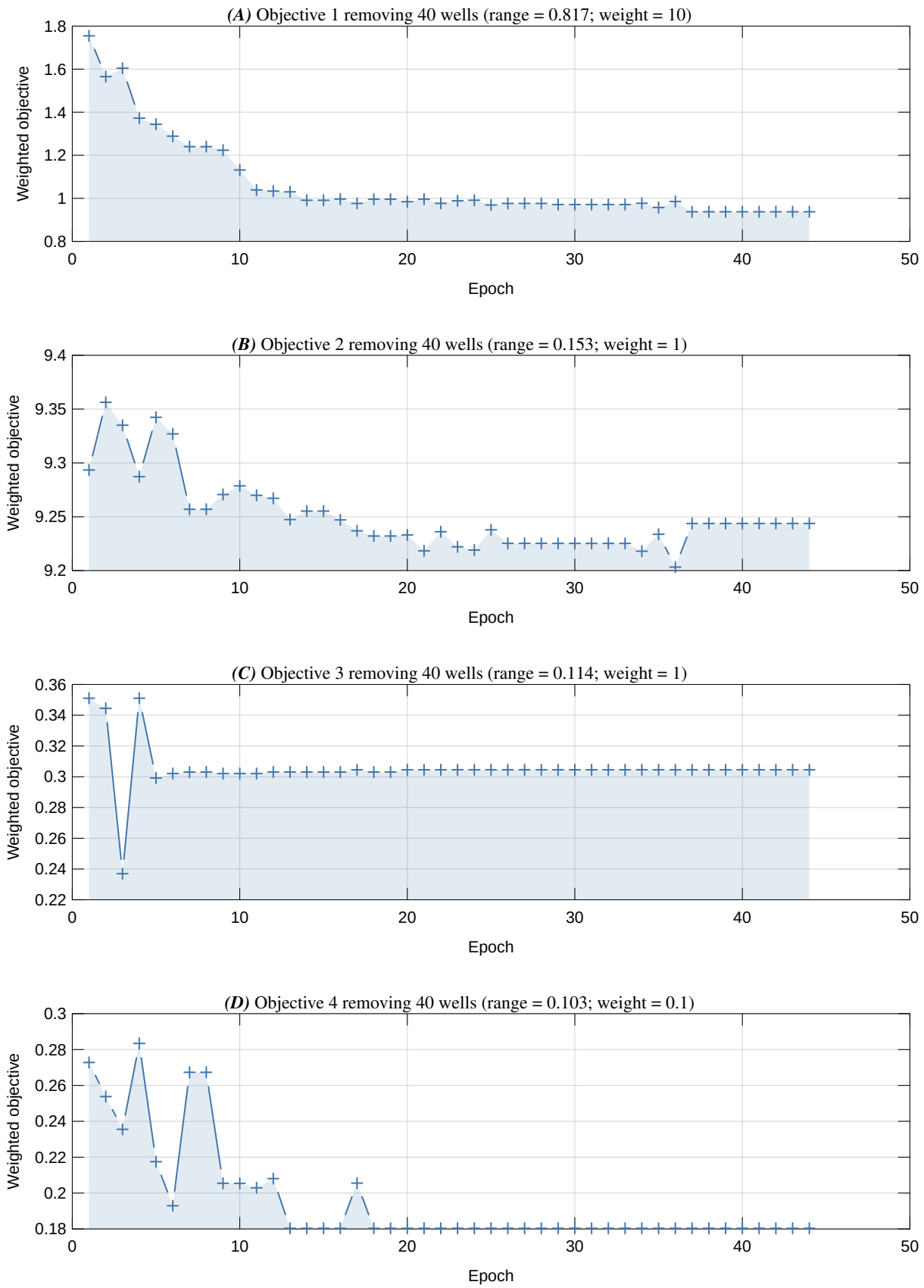

Figure 10.4. Weighted fitness versus epoch for (*A*) Objective 1, (*B*) Objective 2, (*C*) Objective 3, and (*D*) Objective 4 of the fitness function and removing 40 wells from the existing monitoring network.

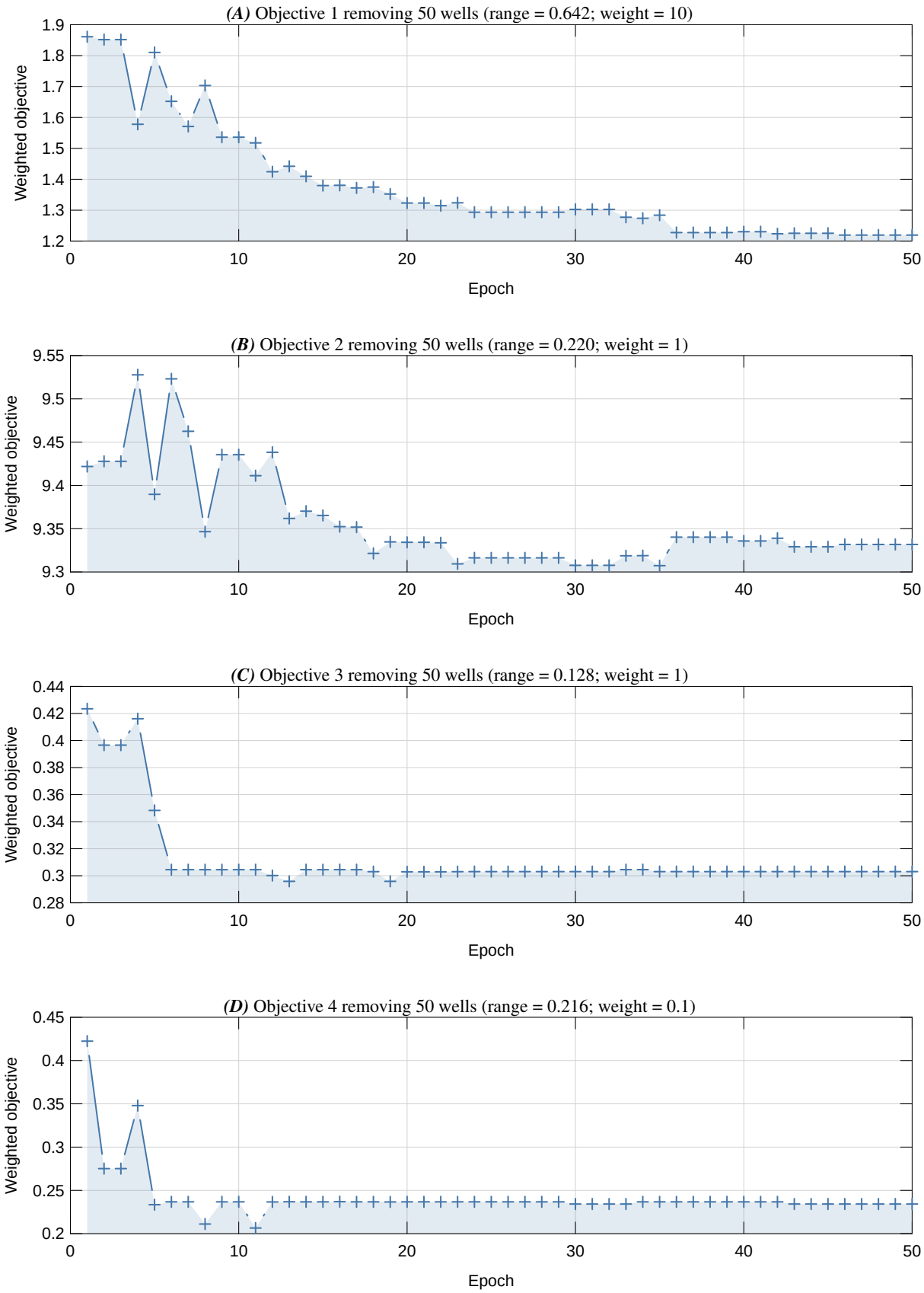

Figure 10.5. Weighted fitness versus epoch for (*A*) Objective 1, (*B*) Objective 2, (*C*) Objective 3, and (*D*) Objective 4 of the fitness function and removing 50 wells from the existing monitoring network.