

“Old Model”

This model incorporates field data from the previous year and includes the minimum number of wolves, birth, death, immigration and emigration as it is collected in each of the three recovery areas. The model also adds an additional 10% of the minimum population to represent lone/dispersing wolves.

Fundamental assumptions include:

- rates of birth, death, immigration and emigration are known with certainty and are constant and equal to observed rates in each area the previous year;
- mortality rates are constant for individual wolves;
- immigration results in the formation of new packs of a consistent age structure and at a constant rate within each area;
- reproduction results in a consistent number of pups and only in packs that existed the previous year;
- harvest mortality is random and additive.

Once the baseline wolf population dynamics are determined, the model “builds” the wolf population present immediately before the hunting season. Different harvest amounts (representing additive mortality) expressed as rates of the simulated population are removed from that population via random assignment of mortality to individual wolves. Each application of a specific harvest rate is simulated 1000 times with the average of these 1000 predictions for number of wolves and breeding pairs being the predicted outcome of the specific harvest rate.

Given the field information is collected for individual recovery areas, this model speaks to both recovery area and statewide scales and provides predicted total wolves, packs, and breeding pairs.

“New Model” (lambda/growth rate model)

This model also incorporates field data but uses a regression model to predict wolf population growth one year into the future. The regression model is based on minimum wolf count data, wolf pack data and wolf mortality data all from 1999-2009. With annual population growth rate as the dependant (predicted) variable, the independent (input) variables in this regression are human-caused mortality rate and recruitment rate. Additional models have been built to predict these two independent variables. The best predicting model for human-caused mortality rate is the previous year’s minimum wolf count (as that count increases, so does human-caused mortality rate). The best predictive models for recruitment rates rely upon the previous year’s minimum count and recovery area boundaries, and these models indicate recruitment rates decrease with increased minimum counts and are different among recovery areas. From this, the actual regression equation to forecast wolf population growth is then portrayed as: *wolf population growth = f (human-caused mortality rate + recruitment rate)*.

This model's multi-step process begins with the prediction of the current year's human-caused mortality rate and recruitment rate for each recovery area. Again, both are based upon the previous year's minimum count. Proposed quota amounts are then added to this predicted human-caused mortality resulting in an adjusted annual human-caused mortality rate. These two predicted independent variables (human-caused mortality rate and recruitment rate) are then applied to the regression formula *wolf population growth = f (human-caused mortality rate + recruitment rate)* to predict wolf population growth rate. This rate is then applied to the previous year's minimum count to arrive at a predicted current year minimum count. The process is repeated for different harvest rates but does not incorporate multiple iterations of the same harvest rate.

Given the field information is collected for individual recovery areas, this model speaks to both recovery area and statewide scales and provides predicted total wolves (but not packs or breeding pairs).

Model vs. Model

Due to the fundamentally different structure of the models as described above, the two models predict different outcomes to the same harvest level. For the 220-wolf quota proposed (approximately 40% harvest rate at statewide scale), the "old" model predicts a resulting population of 425 wolves (25% decline from 2010 year-end count of 566). The "new" model predicts a resulting population of 528 (7% decline from 566). That is, the new growth rate model reflects a smaller response to harvest. The reason for this discrepancy is nested within the model structures themselves. Those structures are fundamentally different with one using annual data to first build and then reduce a predicted population while the other uses a correlative model developed from 10 years of data. In both cases, the models predict population declines at the 220-wolf quota level, but it is difficult to know at this point which model more accurately predicts wolf population declines. Reliable validation of predictions for wolf population declines is not possible at present simply because wolf population declines in the Northern Rockies have been such rare events in the last 3 decades. Management intent is to maintain both models until one or the other (or neither) is recognized as the better predictor.