If not Sex-Age-Kill (SAK) than what?

Any discussion of alternative ways of monitoring deer abundance should consider the harvest management system in which the information will be utilized. What is the spatial scale of harvest management decisions (existing DMUs, counties, combined DMUs)? How often will harvest management decision be made? When will these decisions be made and will the data be available by then?

The Deer Trustee report suggests that the SAK model be applied at the state or regional levels and "other models similar to those used in other states (Virginia for example) would better serve deer management in Wisconsin" (page 12, #3). However, the report doesn't specify what Virginia uses to monitor deer abundance. The Virginia deer management plan states that deer population status is "monitored using an index of antlered buck kill per square mile of estimated deer habitat" (Virginia Department of Game and Inland Fisheries 2007, page 11). Using antlered buck harvest density as an index of deer abundance requires the assumption that buck harvest rates do not vary over time or among geographic locations and that the proportion of antlered bucks in the population does not vary over time and space.

The SAK Audit Report (Millspaugh et al. 2007) noted that many states use a variety of indices for monitoring deer abundance; however, they did not recommend relying solely on indices as an alternative to other population monitoring methods because the relationship between indices and true abundance is often unknown. Analyses of the age structure of harvested bucks shows that mortality rates of adult bucks varies among deer management units in Wisconsin and has varied over time (WDNR 2001). Such variation affects the value of a buck harvest density index for monitoring changes in deer abundance.

Millspaugh et al. (2007) reviewed a variety of alternative methods for estimating deer abundance including distance sampling, aerial surveys with sightability models, change-in-ratio methods, catch per unit effort methods, alternative population reconstruction methods (Downing and Lang and Wood), and statistical age-at-harvest analysis. They concluded that distance sampling was impractical for use at the scale of deer management units due to high labor costs. Accurate population estimation from aerial surveys requires estimating the proportion of animals not detected and this is affected by numerous factors including the number of animals in a group, animal behavior, vegetation density and the presence of snow cover. Development of sightability models usually requires radio-collaring of deer, consequently model development is expensive and the technique performs poorly in areas of dense conifer cover. Millspaugh et al. (2007) also noted the dangers to agency staff associated low-altitude aerial surveys.

Millspaugh et al. (2007) concluded that change-in-ratio methods are not robust to violations of the assumption of equal sightability of antlered and antlerless deer during pre- and post-harvest surveys and that these estimators are generally imprecise. Catch-effort models require data on hunter effort by day and are sensitive to violation of the assumption that deer vulnerability is constant during the hunting season.

Millspaugh et al. (2007) compared Lang and Wood and Downing reconstruction models to the Sex-Age-Kill estimator for 9 deer management units during 1987-2004 and found similar magnitudes of deer abundance and similar time trends. They concluded that there was no advantage in substituting either the Downing or Lang and Wood methods for the current SAK method.

Statistical age-at-harvest methods provide a formal framework for population reconstruction of both past and current cohorts (Skalski et al. 2005). Millspaugh et al. (2007) suggested age-at-harvest models might hold promise for deer population estimation in Wisconsin; however, auxiliary data would be needed that are typically obtained from expensive radio-tracking studies. While research projects to directly estimate buck survival and cause-specific mortality rates were started in 2011 the geographic scope of these projects are necessarily limited due to available resources. In subsequent discussions with Dr. Millspaugh, he suggested that it is unrealistic to perform statistical age-at-harvest analyses for all individual deer management units because individual models would have to be constructed and limitations on available aging and auxiliary data. Millspaugh believes this age-at-harvest analyses are possible at the regional level given the data available. A formal age-at-harvest analysis could help increase our overall understanding of temporal changes in buck harvest rates and should be strongly considered, but this approach is unlikely to be useful for decision making at the deer management unit scale in the foreseeable future.

Millspaugh et al. (2007, pages 53-54) concluded that, among the 21 states they surveyed, Wisconsin had one of the most thorough deer management programs in terms of the harvest and biological data collected and the process for using these data to help make deer management decisions. They felt the Wisconsin has done an excellent job of assessing data needs and developing methods to collect critical demographic data and that Wisconsin thoroughly evaluates the data at the scale at which management decisions are made. They also noted that Wisconsin exceeds all states surveyed in the amount of information about the deer management process that is available to their citizens and the transparent manner in which deer management decisions are made. They concluded that population reconstruction methods such as the SAK provide a cost effective method for broad scale demographic assessments and that statistically rigorous estimates of deer abundance for all deer management units are likely to be prohibitively expensive or logistically impossible.

Assuming we are going to continue to manage deer using the existing system of ~120 deer management units, and we desire to use the "best possible science" to inform harvest management recommendations, then I would recommend we continue to use sex-age-kill calculations in the majority of the state as a basis for those assessments. These calculations incorporate all available demographic data that we can cost-effectively obtain. In the event that an administrative decision was made to abandon making SAK calculations for individual DMUs, than I would recommend using a buck harvest index as the most cost-effective means of monitoring changes in relative abundance. I would recommend that the DNR continue to collect the data currently used to convert the index

into as estimate of abundance (harvest age composition and fawn:doe observations) because these data are critical for evaluating the performance of a buck harvest index. It should also be noted that a buck harvest index will suffer from some of the same factors that affect the accuracy of SAK estimates, notably annual variation in buck rates due to variation in hunting season conditions. (An analysis of past harvest data to better understand the effect of factors that may influence harvest rates is on the to-do list.)

If we are able to reinvent the system we use to manage antlerless deer harvest and are able to have fewer, bigger DMUs (~30-40), then we could consider other approaches to modeling deer abundance. An advantage of accounting models is that they are less sensitive to annual variation in hunting season conditions and therefore tend to smooth one some of the annual variation that is associated with SAK estimates.

Accounting models provide a framework for incorporating a variety of inputs into a population estimate (multiple trend indices including citizen observations). However, accounting models have substantially more inputs than SAK calculations and therefore are more labor intensive to construct and update. For example, updating models for the 40 farmland DMUs that had earn-a-buck regulations required 6 person-days compared to 1 day to perform SAK calculations for over 100 DMUs. A major reason why I do not currently run accounting models for all DMUs is the limited amount of time in the month of February.

Accounting models are very sensitive to the starting population size so it is important to have good independent annual indices or periodic population estimates to calibrate the models. My understanding is that Iowa runs accounting models for 20-25 DMUs and calibrates the models to at least 3 indices (spotlight counts, fixed-wing aerial transect surveys, and a roadkill index). Minnesota is using period helicopter quadrat counts and spot-light counts with distance sampling to calibrate their models.

With fewer, larger DMUs it may be possible to conduct index surveys (spotlight surveys/aerial surveys) in the farmland regions with a sufficient sampling effort to provide meaningful signals of population trend. I wasn't around when the decision was made to discontinue pellet-group counts and deer trail counts and put all of our eggs in the SAK basket but I always thought there is inherit risks associated with relying on a single monitoring method.