Lay-person's discussion of
DEER CARRYING CAPACITY

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Carrying capacity for deer is often discussed, but it is seldom defined in meaningful terms. Even the scientific literature has referred to the phrase as "a slippery shibboleth."

There is a range of common uses. One end suggests that carrying capacity is reached when deer begin to "damage" their habitat. Another definition indicates that carrying capacity is where a "balance" exists between deer foraging and vegetation growth.

Given the first definition, one could argue that habitat damage begins with a single deer. The second definition seems equally difficult to pin down because the so-called "balance" moves around depending on environmental variability. Moreover, many ecologists believe it is not meaningful to expect a balance point at all.

The purpose of this article is to offer a widely accepted definition of carrying capacity and to explain how carrying capacity relates to establishing deer population goals.

Some Science

Newly established deer herds tend to increase over time in an S-shaped fashion like many other animal populations. Initial per-capita productivity is high, but numerical growth is slow as there are few females. As the number of females increases, numerical growth rate increases until competition for food and space begins to reduce reproduction and survival rates. Ultimately, the population reaches a point where birthrate and chronic death rate (in the absence of harvest) are the same. This point is the maximum biological carrying capacity, often abbreviated as KCC.

The changes in per-capita rates of productivity and survival as herds increase or decrease are called "density dependent responses." Demonstrating density dependent responses and KCC in the real world is difficult, especially when attempting to compare one year to another as density-effects are usually masked by weather-effects.

Controlling Factors

The natural factors that determine annual KCC for deer are habitat quality and weather. Understanding importance of habitat quality seems simple as most habitats don't change dramatically in the short term.

Aside from local and infrequent acorn crops, the quality of forested habitats changes slowly. For example, tree growth and the gradual loss of aspen, oak, and openings to other forest types reduces carrying capacity for deer. Even cropping patterns on farmlands change rather gradually in response to economic conditions. So, habitat

conditions are fairly predictable from year to year and significant changes may be noted only over a decade or longer.

However, the dynamic factor is weather. When managing deer, it is impossible to predict annual KCC because of short-term weather patterns. KCC and its utility makes sense, especially for setting deer population goals, only when viewed in a longer-term context. Long-term average KCC is really a product of habitat quality and climate.

Climate does not change rapidly and is characterized by a 30-year rolling average of weather data. So, while weather patterns cannot be accurately forecast for the next year or decade, one can reasonably expect that future weather will be characteristic of the climate.

Climate and Latitude

Climate and latitude are strongly correlated in mid-continent North America. Plant phenology (leaf growth, flowering) in spring progresses northward at the rate of about 15 miles per day. The climate of southern Wisconsin is considerably milder than in northern Wisconsin. The growing season is longer in the south and winters are longer in the north. KCC for deer in a given habitat type declines as one moves north because of climatic difference and the energy demands it places on deer.

An Allegory. The George Reserve in southern Michigan is a 2-square mile deer enclosure that is mainly forested. It has a documented KCC of100 deer/sq.mi. The Reserve is on a latitude corresponding to Waukegon Illinois. If we could hook Paul Bunyan's blue ox, Babe, to the Reserve and drag it to Wisconsin Rapids without appreciably changing the habitat (also not possible!), KCC would likely decline by about half. If we could continue dragging it north to Mercer, KCC would likely drop to about 25/sq.mi or fewer. If we were to drag that same habitat just north of Lake Nippigon in Ontario, KCC for deer would fall to zero. Winters there would be consistently too long and would exceed the energy endurance of white-tailed deer. The George Reserve would become moose range.

Estimating Maximum Carrying Capacity (KCC)

Severe winters clearly reduce fawn production and survival. Mild winters do not. The impact of these extremes has different effects depending on deer population size. High numbers (densities) of deer are less resilient than lower numbers. Intuitively, one should know that deer at low densities are able to put on more fat because there is less competition for available food. Productivity and survival will be higher from low-density herds than high-density herds, all else being equal.

KCC for an area can be estimated by examining deer herd performance (e.g., productivity, antler development) relative to herd density and weather over many years. For example, breeding of fawns seems to stop when herds exceed 60% of KCC. Estimates of average KCC have great utility for defining the average ability of a unit of

land to produce deer. Once this average capability is established by biologists, an upper sideboard to deer population goals is defined.

Deer Population Goals

A goal could be set virtually anywhere below KCC. Clearly, one would not want to manage a deer herd at KCC because, on average, there would be no net increase to provide an annual harvest. Plus, deer would be in very poor physical condition and would be putting maximum pressure on food plants. If the objective were to maximize antler growth or minimize impacts on vegetation, a low goal should be chosen.

The highest sustainable annual harvest could be taken with a goal that is just over half of KCC. For many hunters, this seems illogical because many believe that higher populations automatically produce higher annual harvests. However, it is at about half of KCC where there is an optimum number of breeders and good survival of offspring. Higher populations have lower productivity, poorer survival, and smaller deer.

In farm country, KCC is largely irrelevant to goal setting because KCC often greatly exceeds human tolerance for deer damage. Broad experience has shown that over-winter density goals of 15-25 deer per square mile of permanent cover provide a level acceptable to most interests. These goals are a relatively small fraction of KCC in farm country, so these herds are highly productive and bucks can manifest their genetic potential to produce larger antlers. Ample harvest opportunity is also provided without great risk of herds out-producing the ability of hunters to keep herds near the goal.

In units of the Northern Forest, KCC becomes highly relevant to goal setting because KCC varies greatly depending on unit. Management units dominated by aspen, oak, and young forests have relatively high KCCs and can have higher population goals than units dominated by maple timber and lowlands.

However, surveys indicate that most hunters would rather SEE more deer than shoot more and larger deer. So, there is a strong tendency to set goals too high in the most marginal range. Balancing the public interest and environmental impacts is an art that requires biological, ecological, and sociological considerations when establishing deer population goals. This is a major responsibility of States under the Public Trust Doctrine. A responsible deer density goal should be low enough to insure productive herds and to minimize damage to habitat and human interests.

Confounding Factors

KCC, deer distribution, and deer behavior change wherever artificial feeding is being practiced.

Some might argue that population goals should be increased while thinking that these supplemental foods not only have increased KCC but also serve as a buffer to protect natural foods from being over-browsed. However, this thinking is flawed. No person

protects a garden by putting a corn pile in the center of it. Moreover, artificially increased carrying capacity is normally followed by population increases and the cycle of damage continues. Population goals should not be predicated on artificial foods.

Many botanists believe that herd levels should be lower than at present. Studies are underway in the region to better understand deer impacts. If science proves that herd levels are irresponsibly high, goals will need to be lowered. If that happens, some northern hunters may be surprised to find that they will be able to harvest more and larger deer even if they see somewhat fewer deer.

SUMMARY

Many articles in hunting magazines advocate managing deer herds at "carrying capacity." Clearly, they can't be referring to KCC. Readers should expect authors to define terms.

Long-term KCC is determined by climate and habitat quality. Average KCC can be estimated by examining long-term patterns of herd performance relative to herd size. An estimate of KCC helps define the upper limits for setting a management goal.

Experience to date suggests that a maximum deer population goal in forested regions should not exceed 65% to 70% of KCC. This level seems to result in reasonably healthy, productive deer and acceptable environmental impact. However, there are respected scientists that argue that goals should be much lower.