Population Biology, Abundance, and Management History of Michigan White-tailed Deer

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Abstract: *Statewide and regional abundance of white-tailed deer in Michigan has varied widely over the last several centuries, and deer hunting regulations have evolved with changing management needs. Recreational hunting continues to provide the only feasible management tool, though recent research raises concerns over the capacity of hunting to meet broad-scale population management objectives. Wildlife management is complicated by commonly held perceptions of simple cause and effect dynamics, though actual system function is considerably more complex. Modern deer management is further complicated by the diverse interests of the hunting public and other stakeholders, combined with the various expectations and concerns arising from deer abundance in recent decades.*

This summary is intended as a broad overview of trends in white-tailed deer (*Odocoileus virginianus*) abundance and management in Michigan. It is exhaustive in details at neither a historic scale nor geographic extent pertaining to localized conditions that vary greatly throughout the state. While I have attempted to provide an objective summary, I will openly admit that my review in particular of the significant challenges facing deer management in Michigan and suggested directions to take to address them reflect my own perspective. Though I suspect there are many that would agree with me on these points, I recognize that many individuals would potentially identify other challenges as more critical.

This material will be organized in four sections. "History Lessons" reviews historic abundance and identifies significant events in Michigan deer management. "Nuts and Bolts" describes the authority and general process of present-day deer management in Michigan. "Brain Surgery and Baseball" illustrates some of the challenges facing Michigan deer management, while "Plotting the Course" provides several suggestions regarding means to address those challenges.

As a final note, the informal style of this review is not intended to trivialize the importance of deer management in Michigan. As one of the leading states in the nation in terms of deer hunting participation and harvest (US Department of the Interior 1998), deer debates are somewhat akin to discussing religion and politics at the dinner table. My approach to addressing the topic is intended to be one small way of defusing that tension, and should not be interpreted as a failure to recognize it.

HISTORY LESSONS: DEER AND DEER MANAGEMENT IN MICHIGAN

At the risk of offending the residents and hunters of the Upper Peninsula (UP) and the Northern Lower Peninsula (NLP), the historic figures and events reviewed herein group those two ecoregions together as "Northern Michigan" and treat the Southern Lower Peninsula (SLP) separately as "Southern Michigan" (Figure 1). There are many differences between (and also within) the NLP and the UP, but most of the historic trends and issues of greatest significance differ most substantially according to these two basic regions. Many of the historic trends reviewed here are presented by Langenau (1994).

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It is worth noting that the common contention that modern deer abundance exceeds any ever experienced in North America is disputed by research that reviewed archaeological evidence and historic narratives in an effort to reconstruct historic deer populations (McCabe and McCabe 1984, 1997). Whether or not historic deer abundance has ever equaled or exceeded modern levels is not vital to this review, but does have important implications as to whether impacts of current deer populations can be assumed to be historically unprecedented. Of course, the North American human population is certainly larger than at any previous point in history, so substantial alterations to the ecology of the landscape have occurred regardless of any impacts of deer. Regardless, there is nothing inherently "wrong" with these altered biological interactions. Ultimately it is the view and values of our own species that identify wildlife populations as overabundant based on societal values regarding the consequences associated with such populations (McCabe and McCabe 1997), and it is the responsibility of professional resource managers to help frame such debates and identify appropriate courses of action.

Settlement, Industry, and Evolving Regulations in Michigan

Significant fluctuations in Michigan deer populations (Figure 2) have been driven most strongly by broad and substantial changes in habitat conditions, with the additional impact of little or no regulation of harvest in early years (Table 1). Michigan was officially recognized as a state in 1837, and the settlement that occurred around that time produced significant impacts on deer. Clearing of land for homesteads and farming eliminated cover, and unrestricted utilization of venison contributed to virtual elimination of deer in southern Michigan. However, as logging picked up in northern Michigan later that century, forest canopies were opened and deer habitat was ultimately improved.

In 1859, the era of regulation was entered when a seven month season was established on deer. Although a variety of other regulations were adopted at that time, the increase in northern Michigan logging camps and establishment of railroads created an opportunity for market hunters to access both deer and transportation routes to distribute venison. Added to this unlimited exploitation, the potential benefits associated with accelerating logging were limited by unmanaged slash fires that regularly prevented regeneration of early successional habitat. Northern deer populations, which had initially increased with improved habitat conditions, experienced a steep decline. In response, additional efforts were undertaken to regulate harvest, included hiring of the first Michigan Game Warden in 1887, and requiring deer hunters to purchase a license beginning in 1895.

Professional Resource Management

In 1921, a "buck law" was passed that limited hunters to the harvest of one deer (a buck) per year, and established the definition of a buck as a deer with at least one antler three inches or longer. The Department of Conservation was founded in the same year, and the Game Division was established in 1928 within the Department. Further support for science-based game management was provided in 1937 with the passage of the Pittman-Robertson Act for Federal Aid in Wildlife Restoration. This act collects a federal excise tax on hunting arms and ammunition to be returned to the state for research, land acquisition, and habitat development.

Around this same time, fire control efforts and the abandonment of agricultural lands during the Great Depression produced a flush of suitable deer habitat. In combination with the capacity for informed decisions to be made by a staff of wildlife managers supported by a growing body of research, deer populations experienced their first increase during the era of professional resource management.

Michigan Deer Peak and Decline (Again)

The growing abundance of deer began to be recognized by 1930. In the 1940s, the first regulated antlerless deer hunting since passage of the "buck law" was initiated, primarily to address concerns over crop damage. A system was established to define a limited area in which antlerless hunting could occur and restrict the harvest to a designated quota. Thus the modern

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system of regulating antlerless harvest arose out of a need to allow limited hunting in specific areas where deer were essentially exceeding human tolerance.

Deer populations continued to increase into the 1950s, by which time forests had matured in many areas, and those food sources that were available became heavily browsed. As a result, northern Michigan deer populations began a downturn in the 1950s and 1960s. The antlerless deer harvest system began expanding from simply establishing hunts in areas experiencing substantial crop damage, but was still limited to defined areas and a defined number of antlerless permits in those places where there was a widely recognized need to reduce deer. In 1956, antlerless harvests occurred in the Upper Peninsula for the first time since passage of the "buck law" in 1921 (Figure 3).

The first public discussion about the impacts of deer browsing on forested systems began during this period. Former Department of Conservation Director Dr. Ralph MacMullan explained the need to harvest antlerless deer even as populations were declining (MacMullan 1966: pages 11-12):

The popular way is not always the right way… Michigan deer seasons… must include as a basic principle the harvest of some antlerless deer every year. To do otherwise would mean not only a tragic waste of a valuable resource but also, and even more important, accelerated deterioration of the winter range and fewer deer for the future.

Challenges to efforts to improve deer habitat during this time were conveyed well by an Oscar "Oz" Warbach illustration (Figure 4). The demand for timber products and/or the unavailability of accessible mills prohibited large-scale treatments.

Several years later, in 1971, the Deer Range Improvement Program (DRIP) was initiated, which earmarked $1.50 from the purchase of deer licenses for improving, maintaining, or purchasing deer habitat. As timber market conditions improved, these efforts were increasingly efficient and successful, and northern Michigan deer populations again began to increase, even as southern Michigan deer populations began expanding to their highest levels in several centuries.

Lessons Learned

Two lessons were foremost amongst those learned during the two dramatic peaks and declines of Michigan deer populations from the 1800s through the late 1900s, with each one well illustrated by Oz Warbach. The first lesson was that deer population management and habitat management must be integrated. Population management essentially is habitat management, and certainly must be addressed if habitat management is to be successful (Figure 5). The second lesson was that, as public resistance to antlerless deer harvest delays proactive management of abundant deer, confusion results from the complex interactions of deer population dynamics, harvests, and habitat conditions. Popular consensus inevitably contends that antlerless deer harvests were the cause of, rather than the response to, deer population declines (Figure 6). This wasn't a lesson learned only in Michigan. Aldo Leopold, a forester by training and founder of the wildlife profession, experienced similar challenges as a Wisconsin Conservation Commissioner in 1943 (Flader 1974).

NUTS AND BOLTS: THE DEER MANAGEMENT SYSTEM IN MICHIGAN

An all-inclusive review of the system used to manage deer in Michigan is not feasible in the space allotted here. A basic review of the legal authority and administrative policy upon which management is based, the primary methods used to assess population size or trends, and the general process used to generate management recommendations and goals should suffice to establish appropriate connections between the history of deer populations and challenges facing deer management in Michigan.

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Regulatory Authority

A variety of legal authorities form the basis of deer management in Michigan. The first is Act 451, a public act passed in 1994, known as the Natural Resources and Environmental Protection Act. This legislation identifies all wildlife that are designated as game species in Michigan, establishes the basic framework of licenses and fees, and conveys authority over the method and manner of take of those game species to the Department of Natural Resources (DNR).

The Natural Resources Commission (NRC) is a 7 member board of individuals appointed by the Governor and approved by the Legislature. The NRC establishes policies of the DNR and hires the Director of the Department. As of 1996, following a ballot initiative in which voters adopted Proposal G, the authority for approval of regulations adopted for the taking of game was conveyed to the NRC. The annual cycles of regulations therefore involve the generation of recommendations by DNR biologists that are ultimately brought to the NRC for review, public comment, and adoption as they choose.

Michigan Deer Management Policy

The Department manages deer according to NRC Policy 2007, adopted in 1994. The policy establishes the goal to manage the deer herd using management practices based on scientific research to:
1. Maintain healthy animals and keep the deer population within limits dictated by the carrying capacity of the range and by its effect on native plant communities, agricultural, horticultural, and silvicultural crops and public safety.
2. Maintain an active public information program designed to acquaint the public with the methods of deer management and the conditions needed to maintain a healthy, vigorous herd.

These two components acknowledge both the biological and social aspects of deer management. Deer management recommendations formulated by the DNR must, therefore, address both of these general considerations.

Deer Population Trends and Condition Indices

Buck harvest trends provide a useful index to deer population density. While a variety of factors (e.g., weather conditions, the day of the week upon which hunting opens, etc.) can influence harvest, one of the most substantial influences of long-term harvest trends is actual deer population size. Each year, a mail survey of randomly selected deer license buyers is conducted following completion of the deer hunting season to estimate hunter participation, harvest, and hunting effort in Michigan (Frawley 2004*a*). In comparison to efforts at generating a complete count of deer harvested, using a probability sampling procedure to estimate the Michigan deer harvest has been found to result in reduced cost and greater speed, scope, and accuracy of results (Hawn and Ryel 1969). A recent assessment of methods utilized by state agencies to generate deer harvest estimates indicated that 26 of 48 (54%) survey respondents rely on mail surveys to collect hunter harvest information, and 22 of those states use mail surveys specifically to estimate total deer harvest (Rupp et al. 2000).

The Wildlife Division has been collecting and tabulating measurements from hunter harvested deer for over 50 years. These check station data are used to assess the sex and age composition and condition of the annual harvest and draw inferences to the composition and health of the statewide deer herd. Data are collected when hunters voluntarily bring harvested deer to a check station staffed by DNR employees and other volunteers who have participated in annual training sessions. Average antler beam diameter of yearling bucks serves as one useful index of herd condition in Michigan (Panken 2002), and elsewhere has been correlated with deer body weight (Severinghaus and Moen 1983), which was one of the best indicators of deer condition (Moen and Severinghuas 1981).

The annual number of reported deer-vehicle collisions (DVCs) in Michigan are compiled and summarized by the Michigan State Police. DVCs can be used as an index to deer population numbers, although factors other than deer population density, such as road densities, traffic

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volumes, and habitat types, also influence the DVC rate. The DVC index is therefore difficult to compare over extended periods of time or across different regions of the state as these factors change over spatial and temporal scales.

Hunters frequently use the presence of deer pellet groups as a measure deer use and abundance in an area. The pellet group survey is a formal extension of this common technique. The use of pellet counts to develop deer population estimates was a survey technique of primary focus in the 1930s and 1940s (O'Connell et al. 1999). Eberhardt (1955) concluded that this information could be used to develop reasonably reliable estimates of deer populations in Michigan. In general, they are useful as tracking overall trends in populations over broad areas. They're not as useful at generating deer population estimates.
Pellet surveys that were previously conducted in much of northern Michigan, but in recent years have mostly been limited to the use in the western Upper Peninsula.

The primary method for generating deer population estimates in Michigan is the sex-age-kill (SAK) technique. The procedure was originally described by Eberhardt (1960), and has been adopted for use in other states and with various modifications (Creed et al. 1984). The SAK technique estimates the number of bucks in the population using estimates of buck harvest generated through the hunter mail survey. The number of does and fawns in the population are then estimated using buck-to-doe and fawn-to-doe ratios calculated from check station data. These ratios are adjusted because Michigan hunters tend to check a higher proportion of the antlered harvest (Cook 2001). To generate estimates using the SAK procedure, the minimum sample for a specific area and time should include data from 100 antlered deer and 200 antlerless deer (Hansen 1998).

Deer Management Units

Management recommendations are provided to the NRC for each Deer Management Unit (DMU) in the state. In the year 2000, the NRC asked Wildlife Division to review and revise Michigan DMUs with consideration as to the clarity of DMU boundaries to hunters, landowners, and the general public, the geographic scale of the areas and the associated reliability of applying data at that scale, and the ecological associations of the units. Adjustments made to DMU boundaries at that time shifted Michigan from having the smallest mean DMU size in the Midwest to having a mean DMU size near the median of Midwestern units (Table 2). Current DMU boundaries within the NLP and SLP primarily follow county boundaries. Although ecological conditions vary widely within some counties, these boundaries are familiar to the majority of the residents of this more heavily populated region, and numerous sources of data that are relevant to deer management decisions (e.g., human population demographics, trends in deer-vehicle accidents, crop damage complaints) are available at this scale over extended time periods. County boundaries are more difficult to distinguish in the UP, and deer in this region are at the northern extent of their range, and therefore more heavily influenced by weather and habitat conditions. DMU boundaries in the UP therefore follow roads, rivers, and other clearly definable features in an effort to represent consistent patterns in climate and ecological condition.

Deer Regulation Recommendations

Wildlife Division uses a participatory system for generating deer management recommendations in which there are successive stages of review and revision. In recent years, the Deer Management Information System (DMIS) has played a significant role in evaluating data and management recommendations. DMIS is a desktop software application accessible to all DNR Wildlife staff for recording, maintaining and viewing information pertaining to deer management. DMIS seeks to provide real-time data access and standardized automated processes to MDNR Wildlife staff involved with deer management planning, implementation, and evaluation. Habitat Biologists, who initiate management recommendations, benefit from immediate access to electronic data to use for tracking hunting trends, generating indices and estimates of deer populations, and reviewing broad habitat composition. Data for each DMU include: (1) historical antlerless license quotas, application rates, and sales figures, (2) deer harvest mail survey results, (3) estimated deer densities, (4) general land ownership and habitat

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composition, (5) check station biological data by age and sex, and (6) an automated SAK model for population reconstruction. Research and management specialists are able to review summaries of factors used in making the recommendations and are available to assist field staff in interpretation of data and identification of management needs. Management Unit Supervisors are provided immediate review of regulation recommendations and are able to review the consistency of recommendations across areas and with statewide priorities. They are able to modify and approve recommendations online. The system allows more time for staff discussion, as well as online documentation of comments and modification or approval of recommendations.

Michigan Deer Population Goals

Wildlife Division staff are currently developing deer population goals for each DMU that will guide management recommendations for the 2006 through 2010 hunting seasons. While these goals will be expressed in terms of desired population sizes, justification for establishing these goals will be provided to demonstrate the intent to balance the positive and negative impacts of deer. Management recommendations will therefore be generated with the intent to manage deer abundance as necessary to achieve the broader objectives of modifying impacts of deer (Figure 7).

Field staff have generated deer population goal recommendations while soliciting input from other resource managers. Draft versions of these goals will be presented to the NRC for their review, at which time the public portion associated with the NRC meetings will initiate public input. An open public comment period will follow, and at least one public meeting will be held in each Management Unit (Figure 1) to address questions and collect comments.

BRAIN SURGERY AND BASEBALL: CHALLENGES TO DEER MANAGEMENT IN MICHIGAN

Deer management isn't brain surgery – it's harder. This is not necessarily because it's more complex, but because it's more controversial. Another Oz Warbach creation illustrates this point well (Figure 8). The "DOC", which conveniently represented the Department of Conservation at the time, is caught in the middle of a shouting match with which a brain surgeon would never have to contend while performing his job. What is at the root of this source of controversy?

A Large, Diverse Constituency

Michigan residents place a high value on white-tailed deer. Seventy-five percent of our citizens participate in wildlife viewing activities annually (Mertig and Koval 2001), and perhaps as many as 60% of those individuals observe, photograph, or otherwise enjoy deer (US Department of the Interior 1998). Ninety percent of all hunters in Michigan are deer hunters (Frawley 2004*b*). Michigan deer hunting licenses are purchased by more than 800,000 individuals annually, and ten to eleven million hunter days are ultimately invested in the pursuit of whitetails every hunting season (Frawley 2004*a*).

Critique and Criticism

If deer management is more controversial than brain surgery, then it is more like baseball, or professional sports in general. Just as so many individuals in our modern society are fixated on getting the latest updates from the world of sports through the internet and cable television, and as phone-in sports talk shows proliferate on the radio, the hunting population is becoming more interactive and analytical regarding the latest trends and changes in hunting season regulations. With so many individuals spending so many days scouting and hunting the woods and fields, there is ample opportunity to make observations and formulate impressions and opinions, and many of those individuals look for an outlet to share and debate those opinions. The increasing popularity of internet discussion forums are one indicator of this trend.

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One example of this debate playing out was provided recently by a recommendation Wildlife Division brought forward to the NRC to add seven days of hunting to the muzzleloader season in southern Michigan. This will certainly provide more recreational opportunity this fall, but the recommendation was suggested as a way to increase harvest of antlerless deer. It is important to note that, in recent seasons, antlerless deer account for 70% of the muzzleloader season harvest, but that these deer only amount to 10% of the overall harvest of antlerless deer (Frawley 2004*a*). Thus, we will have the chance to offer hunters additional recreational opportunity this fall, which will result primarily in an increase in the harvest of antlerless deer, but this will ultimately result in a relatively modest contribution to reducing deer populations. Our motivation and the likely outcome, however, were not viewed in this light by at least several outspoken participants on a popular discussion forum, as evidenced by the following quotes (www.michigan-sportsman.com/forum - Michigan Whitetail Deer Hunting, 4/17/05):

"Wiped 'em out [up] north. Now it is time to do the same in the Southern part of the state."

"I agree… until we have a year where there are zero car/deer accidents and no crop damage reports, the insurance lobbyists will keep the checkbook open."

Furthermore, it's pretty common to see debate initiated about a relatively narrow issue such as a modest extension of this particular season and see participants take the opportunity to expand the scope of their suggestions to something like this:

"*In [southern Michigan], it should be one buck, eight points or better, and one antlerless. Accidental button buck kills would require use of the buck tag… Mandatory deer check-in within 24 hours of kill… You wanna see big bucks… wait until a few seasons of these rules kick in.*"

Edits to this quote actually removed several other recommendations that this individual saw as the "solution" to the deer "problem" in Michigan, and particularly in southern Michigan. Each of these suggestions is not entirely without merit. My response to them and the inevitability this particular critic perceives would be the outcome, however, would likely be the same as the baseball manager that has studied sports psychology or spent an entire career in the major leagues and is now posed with a fan's analysis of his latest changes to the starting lineup… it's just not as simple as that. A few examples may demonstrate why this is the case.

White-tailed Deer Population Growth and Hunting Effort

Female white-tailed deer exhibit density-dependent responses to productivity (McCullough 1990). What this means is that, as competition for resources increases along with population density, fewer animals are in adequate physical condition to bear the maximum number of fawns of which they are capable. In Michigan, this can vary widely across different regions and age classes, but deer may conceive on average greater than 2 fawns each, or some age classes may be entirely incapable of reproducing (Ozoga et al. 1996). A plot of the increment of growth that a deer population will be capable of across a range of densities is, therefore, shaped like an arch, with a small amount of growth attributed to very small and very large populations, and the greatest growth occurring at moderate densities (Figure 9). What is the significance of this? It means that, as deer populations which are at or near their maximum possible sizes are reduced, their growth potential increases. The result is that even more animals must be harvested to maintain populations, let alone further reduce them, once these medium population densities are reached. It also means that largest populations do not provide conditions at which the maximum number of deer can be harvested every fall and replaced through reproduction the next spring. It's not intuitive that this theoretical smaller population can actually replace a higher harvest level and have healthy productive deer, and it is often a cause of confusion during conversations between deer hunters and deer managers.

Unfortunately, the highest sustained harvests of deer are not achieved at the point at which deer are most visible and most easily harvested (Van Deelen and Etter 2003). The average effort required for each deer harvested is highest at low population densities, and more

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importantly, as deer densities are decreased, effort increases in a nonlinear fashion (Figure 10). The manager's dilemma, then, is that reduction of a deer population this is near the limit of what the habitat can support will require removal of a greater number of deer than ever before, which will also require a greater amount of effort for each deer removed. The further dilemma is that, while a hunter may eventually see deer only half as often as at some point in the past, this does not necessarily mean there are only half as many deer as before. This is far from intuitively obvious, but has been demonstrated through research as well as hard-learned practical lessons.

Herbivory and Regeneration

Let's now move past concepts regarding the mechanism of management and look at a concept regarding the need for management. While it is apparent that browsing by abundant deer can impact the structure and species composition of forest vegetation, the interactions leading to such outcomes also demonstrate considerable complexity. Sage et al. (2003) examined factors related to failure of northern hardwoods regeneration over 50 years at a research area in the Adirondacks of upstate New York. A series of research projects, each focusing on one factor perceived to be contributing to regeneration failure, failed to provide insight that could be used to regenerate the desired sugar maple (*Acer saccharum*), yellow birch (*Betula allegheniensis*), black cherry (*Prunus serotina*), and white ash (*Fraxinus americana*). The desired regeneration could only be consistently achieved by integrating reduction of deer densities, control of understory American beech (*Fagus grandifolia*), and application of even-aged silvicultural treatments. Factors of herbivory, lighting regimes, and site conditions each were important contributors to the problem, but none of them were ultimately acting alone to frustrate managers' desired outcome.

The Fallout: Hunting as a Deer Management Tool

At this point, a deer manager demonstrating each of these considerations may sound like a baseball manager making excuses why his top payroll team of All-Stars failed to win a pennant. However, there is an important difference between debate over a baseball team and a deer management program that falls short of their goals. Those bickering over deer management step onto the field of play every fall, and it is their performance under the debated guidance of the management program that determines whether goals are met. An organization, whether that means a baseball team or a deer management program, will experience the greatest success only when the goals of the team and the goals of the manager are aligned, but our 800,000 deer management fans are our team.

So, how does our team identify the goals they set, and how can we align them with the direction we'd like to take with deer management in Michigan? A recent New York Times series examining shifting status symbols in the United States may shed some light on this question (Steinhauer 2005). A growing number of sociologists are contending that the old metaphor of "keeping up with the Jones'," or judging your own accomplishments according to those of your neighbors and closest peers, is now outdated. With the growth in specialized print media, cable television, use of the internet, and so forth, people have access to information like they never did before. While this "opens up the world" in some ways, it also isolates as well – fewer people know who their neighbors are than ever before. The new metaphor is "keeping up with the Gates'." The so-called "social norms" that establish what constitutes acceptable behavior and desirable goals are now much more by the lifestyle of millionaires and movie stars.

Now, I don't expect that deer hunters are trying to determine what camouflage pattern Bill Gates endorses, but I do expect that their desires are shaped more by the expanding media to which they are drawn than ever before. Furthermore, the accomplishments of elite hunters appear far more attainable than the accomplishments of the wealthiest entrepreneur or most popular movie star. Indeed, the hunting media enforces this perception by promoting their products and making their tips and tactics, available in each monthly magazine issue, relevant to all of their readers. If an average person with an average job can bag the deer of their dreams every year (Clancy 2000), shouldn't the average magazine subscriber be able to reach the same touted success? I've already discussed how apparently easy it is to assume the perspective

gained through repeated field observations can help determine best course of action. Added to the "luxury of choice" offered by the recent phenomenon of abundant deer – the chance to see and select from many deer through the course of a season – this trend in changing norms threatens to pull the goals of our team further and further out of alignment with the goals of the manager.

PLOTTING THE COURSE: THE FUTURE OF DEER MANAGEMENT IN MICHIGAN

Where does all of this leave us, and where do we go from here? While hunters are not likely to adopt a goal to sustain ecological integrity as the guiding principle of their hunting decisions (Holsman 2000), some common ground does exist between hunters and managers. Targeted outreach and education are necessary (Decker and Connelly 1989). We need to do more to identify and understand the distinct segments of our hunting population. For those individuals with selective interests in mature bucks and dedication to learning more about deer management, many of whom are also members of organizations such as the Quality Deer Management Association, demonstrating how management can sustain reduced, healthy, productive deer populations while also producing older, larger bucks would go far to identify mutual goals. For those that are more generally interested in deer hunting as a general form of recreation, we may stand to learn from those with experience in social marketing (Bright 2000). This would involve demonstrating that society at large benefits from having huntable but healthy deer populations, and that managers care about the quality of recreational experiences, but have broader management responsibilities as well. As Oz Warbach illustrates (Figure 11), deer managers, deer hunters, and deer populations are all passengers on the same ship, regardless of how well they do or do not get along. Controversy over deer management is nothing new, and not particularly easy to resolve (Woolf and Roseberry 1998), though some emerging concepts seek to integrate consideration of the entwined biological and sociological challenges faced in many wildlife management scenarios (Riley et al. 2003).

Build and Test Common Understanding

Efforts to build common understanding amongst resource managers and stakeholders will be necessary to move deer management forward. One approach would involve the use of conceptual models (Figure 7) to generate an abstraction of the system dynamics involved in the management of deer populations and impacts. These simplified representations can be useful not only in communicating ideas, but also in testing basic assumptions and examining the consequences faced if those assumptions are inaccurate (Starfield and Bleloch 1989). Perhaps baseball can provide a final useful analogy to deer management. The Oakland Athletics, while having the smallest player payroll of any major league team, managed to finish the season with the second best winning percentage in baseball, just behind the New York Yankees, who had the highest payroll. They accomplished this by questioning the traditional approaches to evaluating talent and team priorities, replacing dogma with analyses of readily available volumes of statistics on the performance of major league players, prospects, and teams (Lewis 2003). I have criticized deer hunters for making what seem to be intuitive assumptions that ultimately prove inaccurate, but I would also challenge managers to make additional efforts to test their presumed understanding of deer management issues if progress is to be made.

Scope of Management

In addition to making efforts to segment the population with a significant interest in deer management, it may be appropriate to segment the issues demanding management attention. For example, while the potential impacts of deer on the structure and species composition of forested systems have very serious consequences (Alverson et al. 1988, Mladenoff and Stearns 1993, Augustine and Frelich 1998, Didier and Porter 2001, Horsley et al. 2003, Cote et al. 2004), these dynamics are difficult to address. Research and management intended to address potential impacts on local areas of high silvicultural or conservation value, while still requiring

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intensive efforts, may offer better opportunities for success. Female deer in forested northern environments exhibit high site fidelity (Van Deelen et al. 1998, Nelson and Mech 1999) and associate in multigenerational social groups (Tierson et al. 1985, Nelson and Mech 1999). Localized management of matriarchal social groups (Porter et al. 1991, McNulty et al. 1997, Oyer and Porter 2004) may provide an opportunity to tailor deer management efforts and consideration of specific landowner attitudes to mitigate effects of abundant deer, although recent harvest history of female deer may also influence the utility of such an approach (Comer et al. 2005).

Embrace Ecosystem Management

Ultimately, the need to address management of deer populations and their impacts is an issue central to ecosystem management. Ecosystem management is a paradigm being embraced by many resource management agencies, although there is not always clarity in defining what any individual approach encompasses (Yaffee 1999). At a minimum, elevating the focus of above management of individual populations and focusing instead on interactions and ecological processes will require integrated efforts across multiple disciplines. Resource managers from different fields must make collaboration a priority, and individuals with training and experience in multiple areas will be in greater demand. Ultimately, deer managers must recognize that the ship on which they ride with the deer and deer hunters actually carries many more passengers, and making sure it follows the proper course will require levels of cooperation and challenges to which I hope we will be able to rise.

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Tables and Figures

Table 1. Selected historical events that significantly influenced Michigan deer habitat and harvest.

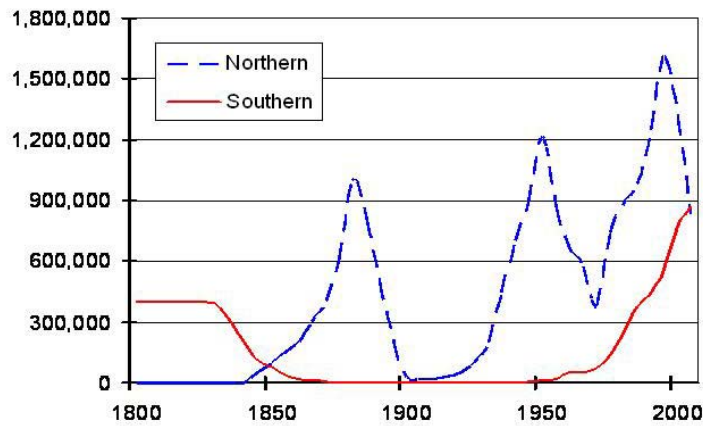| Year(s)	Event(s)
1837	Statehood gained, settlement accelerates, unregulated hunting
1859	Statehood gained, settlement accelerates, unregulated hunting
1881	Statehood gained, settlement accelerates, unregulated hunting
1887	Illegal to kill deer in water, or any deer in red or spotted coat
1895	First Michigan Game Warden hired
1921	License required to hunt deer
1921	"Buck Law" limits hunters to one buck per year
1940s	Department of Conservation founded
1950s – 60s	Antlerless deer hunting initiated to address crop damage
1956	Northern Michigan forests mature and severely browsed
1971	First antlerless deer hunting in the UP since the "Buck Law" Deer Range Improvement Program initiated

Table 2. Size of deer management areas (ca. 2000).

State	Unit	Number of Units	Mean Size (mi^2)
Michigan (2000)	DMU	159	360
Indiana	County	92	390
Wisconsin	DMU	118	460
Ohio	County	88	470
Illinois	County	102	550
Michigan (2001)	DMU	90	640
Minnesota	DMU	121	650
South Dakota	DMU	75	1,000
Missouri	DMU	59	1,200
North Dakota	DMU	43	1,700
Iowa	DMU	20	2,800
Kansas	DMU	18	4,100
Nebraska	DMU	17	4,500

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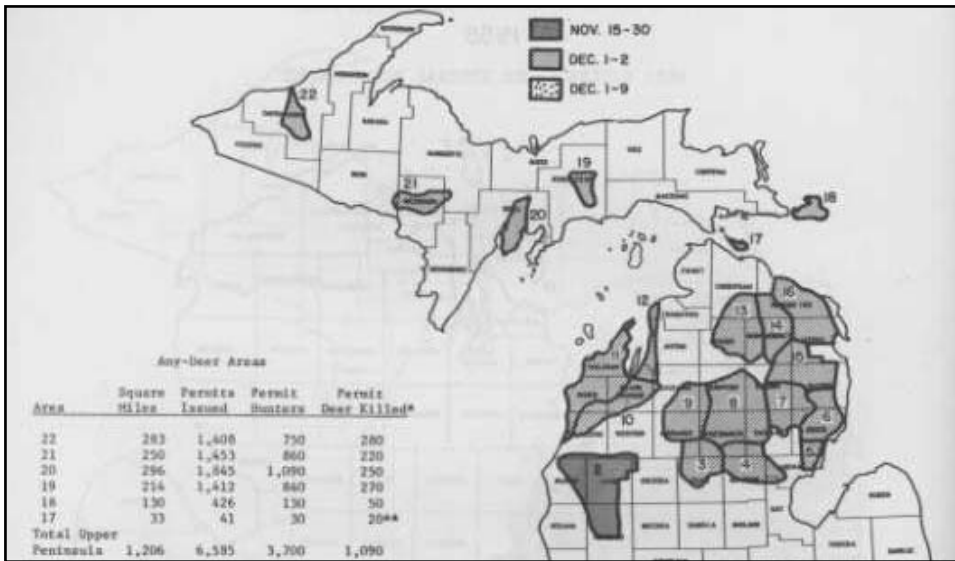*Figure 1*. Michigan's three broad ecological regions and the eight Wildlife Division administrative Management Units.

Figure 2. Trends in deer population estimates in two broad geographic regions of Michigan.

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Figure 3. Areas open to antlerless deer hunting in Michigan in 1956.
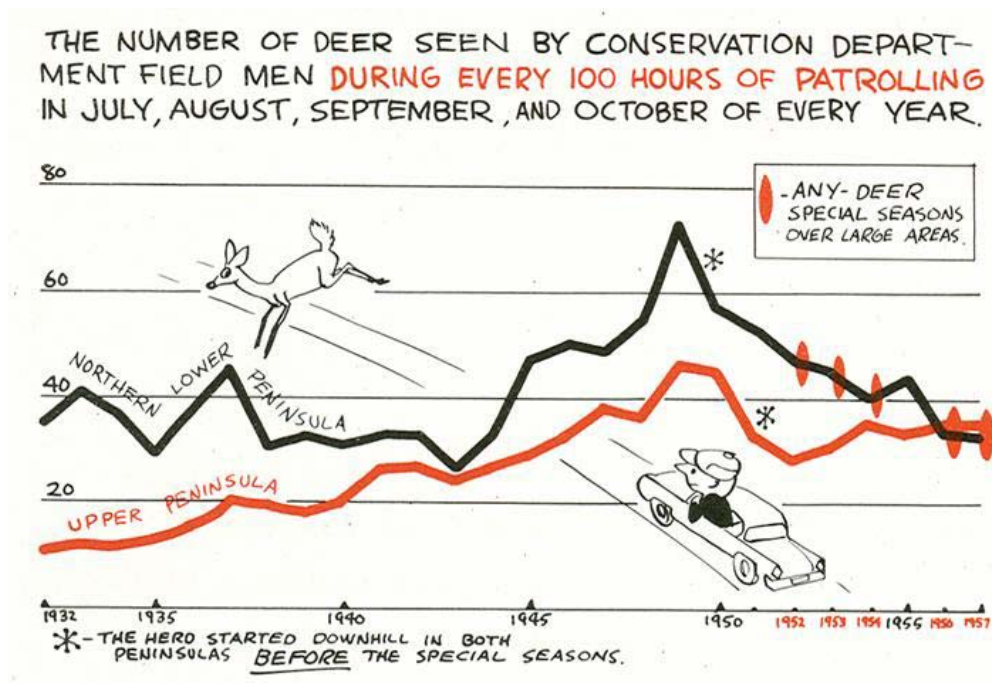

Figure 4. Oscar "Oz" Warbach illustration (ca. 1959) conveying that factors external to wildlife population management significantly impact habitat conditions.

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Figure 5. Oscar "Oz" Warbach illustration (ca. 1959) conveying that wildlife population management and habitat management must be integrated to be effective.

Figure 6. Oscar "Oz" Warbach illustration (ca. 1959) conveying that initiation of antlerless deer hunting occurred in response to, and was not the cause of, declines in northern Michigan deer populations.
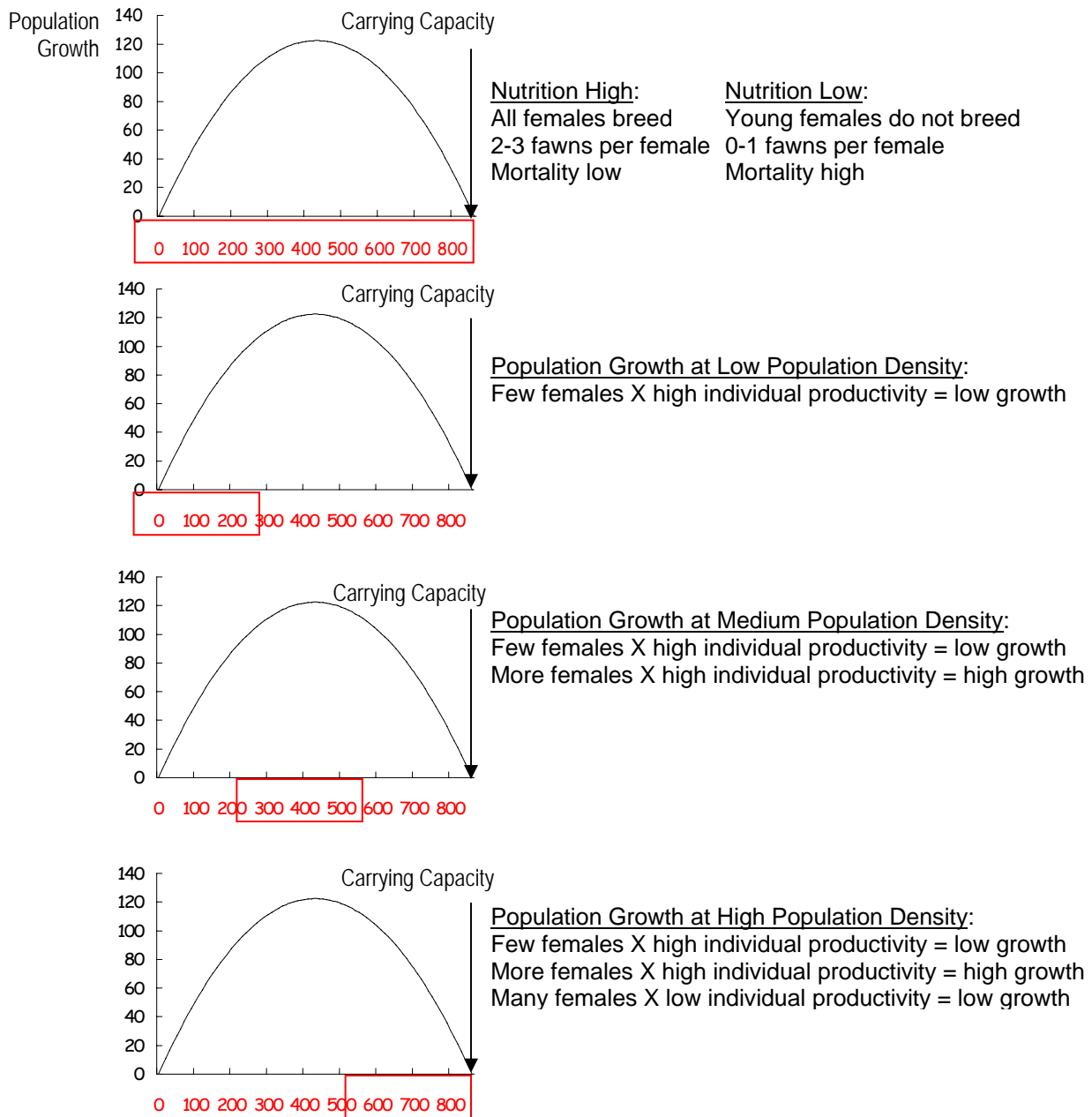
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Figure 7. *Conceptual deer population management model for evaluation of regulation of antlerless licenses (licenses) and harvest of antlerless deer for a deer management unit (DMU) of interest from year t to year t+1, where: quota = license quota, sales = total antlerless deer harvest, management = deer population in year t+1 as a function of deer population in year t and harvest, impacts = change in impacts (e.g., economic value of hunting, crop damage, browsing effects on forest structure and wildlife habitat) of deer population from year t to year t+1, and objective = desired optimal balance of impacts.*

Figure 8. *Oscar "Oz" Warbach illustration (ca. 1959) conveying the contentious atmosphere surrounding the management of Michigan deer populations.*

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Figure 9. *White-tailed deer population growth across a range of population densities.*

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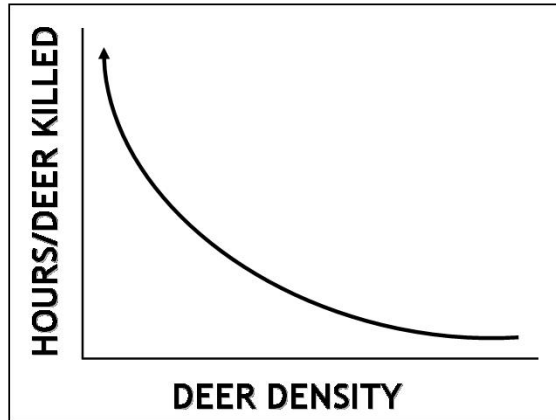
Figure 10. *Relationship between deer population densities and hunting effort.*

Figure 11. *Oscar "Oz" Warbach illustration (ca. 1959) conveying the relationships between deer managers and hunters through their roles in management of Michigan deer populations.*

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