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Original Article

Perspectives of Wildlife Conservation Professionals on Intensive Deer Management

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ABSTRACT Intensive deer management (IDM) is fundamentally changing how one of the most important game species in North America is being managed, but little is known about how wildlife conservation professionals view these changes. The IDM approach encourages privatization of deer (*Odocoileus* spp.) through practices including feeding, high fencing, artificial insemination and markets in deer semen, and translocation. To evaluate support for IDM practices, we surveyed 208 registrants of the 2010 Southeast Deer Study Group Meeting held in San Antonio, Texas, USA. Specifically, we evaluated support for IDM practices using state-agency wildlife biologists, private wildlife managers, and academics, and we evaluated how geographic region and employment type are related to opinions about IDM. Using Principal Components Analysis, we created 3 new scales that measured respondents' opinions about deer management, deer husbandry, and deer hunting. We detected strong opposition to IDM among respondents, with respondents from universities having the strongest opposition, followed by state-agency employees from Texas, and private consultants from Texas (the latter having the greatest support for IDM). Our study highlights the need for critical and empirical evaluation of the articulation between IDM and the North American Model of Wildlife Conservation, particularly the tenets that assert wildlife are held in the public trust and advocate elimination of markets for wildlife. © 2015 The Wildlife Society.

KEY WORDS deer management, North American Model, *Odocoileus virginianus*, privatization, Texas, white-tailed deer.

White-tailed deer (*Odocoileus virginianus*) may be the most important game species in North America, and they shape management priorities across their range. White-tailed deer are broadly distributed throughout urban and rural environments and are the most popular hunted animal on the continent (Leonard 2004). In 2011, U.S. hunters spent US $34 billion, and 85% of hunters pursued big game, including deer (U.S. Fish and Wildlife Service [USFWS] 2012). In Texas, the captive cervid industry generated an estimated US $652 million in total economic activity and supported about 7,335 jobs in 2006 alone (Frosch et al. 2008). Further, deer cause billions of dollars in damage each year in association with vehicle collisions, agricultural losses, and human deaths (Conover 2011, McShea 2012).

Trends toward privatization and commercialization of white-tailed deer have emerged alongside efforts to produce higher "quality" deer. Quality deer management (QDM) formally emerged in 1988 with the founding of an association by the same name (Quality Deer Management Association [QDMA] 2014). The QDMA has been the chief advocate for implementing and practicing QDM and had nearly 50,000 members from all 50 states and several foreign countries in 2014 (QDMA 2014). Quality Deer Management involves efforts to shape population size, age structure, and habitat to make deer more valuable to hunters (Peterson 2004). Intended by-products of this management include more mature males and larger antlers on those males. Components of QDM have been adopted (at least in part) by 22 state agencies (8 in the Southeast; Adams et al. 2012). Eight of the states have antler restrictions statewide (4 in the

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Southeast; Adams et al. 2012), and an increasing number of hunters have expressed interest in QDM (Collier and Krementz 2006, Harper et al. 2012). Both the large investments in producing higher quality deer, and the high prices paid to hunt such deer, create incentives to privatize and commercialize deer.

The growing list of activities linked to privatizing and commercializing deer are labeled Intensive Deer Management (IDM). There is no universally accepted definition of IDM, and the degree of privatization and commercialization of deer varies drastically in different contexts. Knox (2011) suggested IDM included high fencing and supplemental feeding at minimum. Privatization and commercialization are inextricably intertwined because trends toward privatizing deer provide owners more exclusive control over deer at the same time they facilitate pushing deer management toward a market-based activity (i.e., commodification). For instance, giving landowners the ability to collect and sell genetic material from deer (e.g., semen straws, pregnant females, materials for cloning) simultaneously commodifies deer by supporting new markets for their parts. The diverse practices associated with IDM can be broadly grouped into those aimed at individual deer (e.g., penning animals, artificial insemination, and cloning), those targeting herd management (e.g., supplemental feeding, predator reductions, selective culling, high fencing), and those affecting how hunting occurs (e.g., canned hunts, hunting over bait).

These practices have become so pervasive among some Texas landowners that IDM has been colloquially referred to as "the Texas model of deer management" or the Texas Model. Opponents of IDM have even referred to Texas as the "evil empire" (Schreiber 2010:26). Brown and Cooper (2006) noted most practices conceivably linked to commodification of deer and deer management are allowed to some degree in Texas. The development of IDM on private lands in Texas makes sense for 3 reasons: 1) the state is 97% private land; 2) it has a large deer population (Young and Richards 1996); and, 3) it generally interprets property rights in favor of the landowner. For example, Texans have a right to pump and capture groundwater beneath their land without concern for impacts on other properties' wells (Texas Water Law 2014). Additionally, landowners in Texas that have a wildlife management plan on file with the Texas Parks and Wildlife Department are protected by confidentiality (Texas Constitution and Statutes 2014), essentially meaning the state agency could not disclose (to other state or federal agencies) information about wildlife on such a property without written consent of the landowner.

Little research to date has addressed beliefs of people in the wildlife management profession about IDM. Controversy surrounding IDM makes it a salient issue for exploring how wildlife conservation professionals view wildlife privatization and commercialization. We addressed this issue with a survey of registrants of the 2010 Southeast Deer Study Group meeting, held in San Antonio, Texas. Specifically, we evaluated support for key IDM practices among state-agency wildlife biologists, private wildlife managers, and academics, and we evaluated how geographic region and employment type are related to opinions about IDM.

METHODS

We pretested the survey on undergraduate and graduate students and faculty ($n = 25$) in North Carolina (USA) State University's Fisheries, Wildlife, and Conservation Biology Program. We asked pretest participants to identify questions that were difficult to understand and provide comments for improving them. We completed cognitive interviews (Desimone and Le Floch 2004) with 10 individuals to gather general feedback and confirm understanding of questions. This study was approved by the North Carolina State University Institutional Review Board (1634).

We administered the survey to all 2010 Southeast Deer Study Group registrants ($n = 326$) via e-mail. The e-mail included our objectives, instructions for completing the

Table 1. Percent support and disapproval of intensive deer management practices included in the survey of ($n = 208$) registrants of the 2010 Southeast Deer Study Group Meeting held in San Antonio, Texas, USA. Mean support is the mean score (with SE) on the 5-point scale (1 = strongly disapprove, 3 = neutral, 5 = strongly support).

Deer management practices	% support	% disapproval	Mean support	SE
Penned breeding of captured deer	9.2	71.3	1.97	0.07
Translocation of breeding deer within a state	13.4	75.0	1.98	0.08
Translocation of breeding deer between states	2.4	90.3	1.44	0.05
Artificial insemination of deer	7.0	78.2	1.77	0.07
Cloning deer	0.9	92.6	1.36	0.05
Predator reduction	50.0	14.8	3.49	0.07
Providing food plots	78.2	3.2	3.93	0.07
Providing emergency feed during extreme weather events	41.6	24.5	3.23	0.07
Providing seasonal supplemental feed	46.3	26.9	3.20	0.08
Providing year-round feed	36.6	40.7	2.86	0.08
Providing supplemental water	61.1	9.3	3.69	0.07
Vaccinating deer	8.8	65.2	2.08	0.07
Treating deer for worms	11.6	62.5	2.17	0.07
Using high fences	28.7	46.3	2.63	0.09
Selling breeder males	6.5	78.7	1.73	0.07
Selling male semen	7.9	79.2	1.74	0.07
Selling fertilized females	7.9	77.3	1.76	0.07
Culling males	65.2	18.5	3.68	0.08
Reduce neighbors' impacts	58.1	8.9	3.60	0.06

Table 2. Percent support and disapproval of deer hunting tools and techniques included in the survey of ($n = 208$) registrants of the 2010 Southeast Deer Study Group Meeting held in San Antonio, Texas, USA. Mean support is the mean score (with SE) on the 5-point scale (1 = strongly disapprove, 3 = neutral, 5 = strongly support).

Deer hunting tools and techniques	% support	% disapproval	Mean support	SE
High fences	29.3	45.2	2.58	0.09
Expanded seasons for those who participate in state Deer Management Programs	76.4	7.7	4.00	0.06
Using telescopic sights on rifles	91.3	0.5	4.38	0.04
Using telescopic sights on muzzleloaders	53.4	20.2	3.29	0.10
Using in-line muzzleloaders during muzzleloader season	46.2	20.7	3.18	0.09
Using crossbows during archery season	39.4	31.3	2.93	0.10
Using laser rangefinders	70.2	5.7	3.93	0.06
Using deer calls	77.4	2.4	4.03	0.05
Using camouflaged clothing	89.9	0.0	4.30	0.04
Using scent-free clothing	64.4	2.9	3.59	0.09
Hunting over bait	42.3	38	2.96	0.09
Hunting over food plots	75.9	3.4	3.97	0.05
Using listening devices	30.3	16.9	2.91	0.08
Using deer urine	51.9	8.7	3.27	0.08
Using deer decoys	47.6	12.0	3.19	0.08
Using cover scent	63.9	1.4	3.54	0.08
Using tree stands	93.7	0.5	4.09	0.09
Using ground blinds	91.9	0.0	4.04	0.08
Using trail cameras	81.2	2.4	3.90	0.09
Using remote TV cameras while hunting	12.0	58.2	2.10	0.08

survey, and the link to the survey, which was hosted by Survey Monkey (surveymonkey.com). After an initial mailing, we sent e-mail reminders every 3–4 days until all respondents had received the e-mail reminder $\geq$3 times.

We asked respondents to rank their support for, or disapproval of, various deer management techniques (Table 1) using a 5-point scale (i.e., "strongly support," "support," "neutral," "disapprove," and "strongly disapprove"). Respondents used the same scale to share opinions about deer hunting tools and techniques (Table 2). Also, we asked respondents to indicate how often they voiced opinions to colleagues, the media, and the public about deer management; the avenues used for sharing their opinions; and how important other people's opinions were in influencing their willingness to express opinions about deer management. Finally, we asked demographic questions that included the affiliation they represented at the meeting (e.g., state agency, university, private sector), gender, state of residence, and whether they hunted deer or not.

We performed a Principal Component Analysis with Varimax rotation in SPSS (IBM SPSS Statistics, Armonk, NY) to determine components related to support for the various management practices and hunting tools and techniques. We retained the top 3 components

Table 3. Weights for each retained deer management practice and deer hunting tool or technique on the 3 respective components of a Principal Component Analysis of opinion data obtained from registrants ($n = 208$) of the 2010 Southeast Deer Study Group Meeting held in San Antonio, Texas, USA. We retained practices and techniques with a weight >0.4 to form new scales; A = Deer Husbandry Scale, B = Deer Management Scale, and C = Deer Hunting Scale.

Deer management practices	Weight	Deer hunting tools and techniques	Weight
Penned breeding of captured deer (A)	0.819	High fences (B)	0.766
Translocation of breeding deer within a state (A)	0.853	Expanded seasons for those who participate in state Deer Management programs (B)	0.455
Translocation of breeding deer between states (A)	0.677	Using telescopic sights on rifles (C)	0.699
Artificial insemination of deer (A)	0.863	Using laser rangefinders (C)	0.500
Cloning deer (A)	0.661	Using deer calls (C)	0.504
Predator reduction (B)	0.453	Using camouflaged clothing (C)	0.671
Providing emergency feed during extreme weather events (B)	0.595	Hunting over bait (B)	0.725
Providing seasonal supplemental feed (B)	0.759	Hunting over food plots (C)	0.575
Providing year-round feed (B)	0.714	Using tree stands (C)	0.846
Providing supplemental water (B)	0.740	Using ground blinds (C)	0.831
Vaccinating deer (A)	0.484	Using trail cameras (C)	0.731
Treating deer for worms (A)	0.451		
Using high fences (B)	0.745		
Selling breeder males (A)	0.903		
Selling male semen (A)	0.896		
Selling fertilized females (A)	0.904		
Culling males (B)	0.544		
Reduce neighbors' impacts (B)	0.503		

(i.e., eigenvectors that represent the underlying structure of the data) for subsequent analysis because their eigenvalues were >1, they explained 56% of the variance, and the addition of subsequent components did not contribute markedly to the explained proportion of variance. Survey questions within the retained components with weights >0.4 were used to form new scales because visual inspection of the weights showed a break around 0.4; weights (or factor loadings) represented how much the particular survey question helped explain the component. We named the new scales based on the subjects of the questions that were included in the component. Thus, the 3 new scales were Deer Husbandry, Deer Management, and Deer Hunting; and they contained 10, 11, and 8 questions, respectively (Table 3). We tested the new scales for internal reliability using Cronbach's α. After scales were deemed reliable (Cronbach's $\alpha > 0.7$), we calculated new scores on each new scale for all respondents, with higher support corresponding to higher scores. We assigned all items a weight of 1. For example, for the new Deer Husbandry Scale, respondents could receive scores from 10 (extreme disapproval; voted 1 on each question) to 30 (neutral) to 50 (extreme support; voted 5 on each question). Scores on the Deer Management Scale could range from 11 to 55, and scores on the Deer Hunting Scale could range from 8 to 40. To test whether job category (state agency, university, private) or state (TX vs. other SE state) explained responses, we evaluated scores on the new scales using a 2-way Analysis of Variance with Tukey's Honestly Significant Difference pairwise comparison in JMP (SAS Institute, Inc., Cary, NC). Significance was assessed at $P < 0.05$.

RESULTS

We received 208 completed surveys (64% response rate). Respondents primarily were state-agency employees (33%, $n = 69$), university affiliates (23%, $n = 47$), and private consultants (19%, $n = 40$). Federal agency employees comprised 8% ($n = 17$) of the sample. Almost all of the respondents were male (95%, $n = 198$) and deer hunters (99%, $n = 205$). Residents of Texas comprised 40% ($n = 83$) of the sample. Respondents selected peer discussions (95%, $n = 198$), employer discussions (78%, $n = 163$), and professional meetings (74%, $n = 153$) as the most common forums they have used to express their opinions about deer management.

Respondents disapproved of IDM practices such as penned breeding of deer, cloning deer, and artificial insemination (Table 1). Overall, respondents supported most of the hunting techniques from the survey, with the exceptions being practices such as hunting within high fences and hunting with remote TV cameras (Table 2). Respondents' average scores on the 3 new scales from the Principal Component Analysis were as follows: Deer Husbandry = 17.99 (SE = 0.56), Deer Management = 35.56 (SE = 0.63), and Deer Hunting = 33.50 (SE = 0.31). Cronbach's α for the Deer Husbandry, Deer Management, and Deer Hunting scales were 0.95, 0.91, and 0.89, respectively.

We detected several differences among pairings of job category and residency. Private consultants from Texas scored higher than all other groups on the Deer Husbandry Scale (Table 4). Mean scores for the variable "deer husbandry," however, indicated opposition (i.e., mean scores <30) to deer husbandry among all groups of respondents, including private consultants from Texas (Table 4). Private consultants from other southeastern states and state biologists from Texas scored lower than private consultants from Texas but higher than all other groups on the Deer Management Scale (Table 4). However, groups were split between support (i.e., mean scores >33) and disapproval (i.e., mean scores <33) of the practices included in the Deer Management Scale. Private consultants from Texas, state-agency biologists from Texas, and private consultants from other southeastern states all showed support, whereas all other pairings did not (Table 4). On the Deer Hunting Scale, private consultants from Texas and other states scored higher than university affiliates from Texas, and all other groups had intermediate scores (Table 4). In this case, all groups supported (i.e., mean scores >24) practices included in the Deer Hunting Scale (Table 4).

DISCUSSION

Our study highlights the potential for conflict between wildlife conservation professionals over deer management and internal conflict for deer management professionals working for state agencies. Support for extreme versions of wildlife commercialization and commodification (deer husbandry, in our case) was low, but important differences

Table 4. Mean scores and standard errors (SE) for all job–residency pairings for 3 scales of support for or disapproval of deer management practices and deer hunting tools or techniques, derived from Principal Component Analysis of data obtained from registrants ($n = 208$) of the 2010 Southeast Deer Study Group Meeting held in San Antonio, Texas, USA. Job status included private consultants, state-agency employees, and university affiliates. Residency status included Texas and all other states. Lower scores reflect disapproval of practices included in each scale, whereas greater scores reflect support. Letters in the "Group" column indicate groups with significantly different mean scores.

Scale	Job–residency pairing	Mean score	SE	Group
Deer husbandry[a]	Private–TX	25.61	1.49	A
	Private–other	18.00	1.56	B
	State–TX	15.78	1.27	B
	State–other	14.12	1.23	B
	University–TX	16.30	2.26	B
	University–other	15.94	1.27	B
Deer management[b]	Private–TX	45.65	1.53	A
	Private–other	37.48	1.60	B
	State–TX	37.84	1.30	B
	State–other	29.00	1.26	C
	University–TX	31.00	2.32	BC
	University–other	31.31	1.30	C
Deer hunting[c]	Private–TX	34.26	0.90	A
	Private–other	34.14	0.95	A
	State–TX	31.94	0.77	AB
	State–other	33.44	0.74	AB
	University–TX	29.00	1.37	B
	University–other	33.47	0.77	AB

[a] Scores range from 10 to 50.
[b] Scores range from 11 to 55.
[c] Scores range from 8 to 40.

existed. Although conflicts over IDM may appear value-based (Moore 2014) because privatization clearly related to the fundamentally held and almost religious perspectives about the Public Trust Doctrine and North American Model of Wildlife Conservation (NAM; Nelson et al. 2011), our study indicates interest-based conflict may emerge as well (Moore 2014). Specifically, the group expressing the greatest support for IDM—wildlife professionals in the private sector in regions where markets exist (i.e., TX)—was also the only group with a financial interest in it. Thus, both understanding and addressing the growing support for IDM requires moving beyond ideology to include consideration of economics. Also, our study indicates potential internal conflict for state-agency employees who are advised by their professional society that wildlife is a public resource to be managed for the public benefit (The Wildlife Society 2015*a*), whereas they work for an agency that manages wildlife as private property intended to benefit landowners. These contradictions place wildlife professionals, especially in Texas, in difficult ethical quandaries and the phenomenon may expand alongside expansion of IDM.

Although support for IDM appears low among academics, funding changes associated with private sector and state agency interest in IDM can still shape academic research (e.g., research on supplemental feeding [Timmons et al. 2010]). The extent to which such funding shifts may influence support for privatization and commodification of deer in the academy is arguable, but is surely less important to on-the-ground wildlife management than what happens in the private sector and state agencies. In Texas, the privatization and commodification of deer clearly influences the private sector, but it has less support among wildlife professionals working for state agencies.

Our study highlights the need for critical and empirical evaluation of support for privatization and commodification of wildlife and the implications for wildlife management in North America. Everyone does not share the same views, even within the wildlife profession, of the need for and role of commercial aspects of harvest management. For example, wildlife conservation in the United States and Canada began to develop a distinct form in the mid-19th century, which resulted in the NAM (The Wildlife Society 2015*b*). The NAM is composed of 7 components, one of which advocates elimination of markets for wildlife (The Wildlife Society 2015*b*). The NAM denounces all markets for all wildlife species, rarely acknowledging the exception of fur markets, but IDM demonstrates that markets are still developing in other contexts. Indeed, the rapid and unchecked global expansion of governance through free markets (e.g., Robbins and Luginbuhl 2005) suggests aspects of the NAM that absolutely prohibit markets for all wildlife species may face future changes. Implications of wildlife privatization and commodification are not always believed to be negative. For instance, Scandinavian countries have matched North American countries in restoring large generalist species such as ungulates (e.g., Scandinavian Model of Wildlife Conservation; Brainerd and Kaltenborn 2010) at the same time they allowed selling and trading wildlife products (e.g., meat; Ljung et al. 2012). Similarly, license sales to residents have remained stable in Texas, and sales to nonresidents have risen alongside the evolution of IDM in the state (Schreiber 2010).

As a large private-land state, Texas may provide a unique context for expansion of IDM, but hunters in several other southeastern states are putting pressure on agency decision-makers to allow more IDM practices. For example, in the past few years, southeastern states (e.g., AL, GA, SC) have continued to push for legalized or expanded baiting opportunities for deer hunting; and in 2012, 10 states (GA, IN, MS, MO, NJ, NY, NC, OH, TN, and WV) debated legislation initiated by the deer breeding industry to enable or expand captive-deer breeding operations (Adams and Ross 2013). Much of the pressure to legalize or expand baiting came from within the hunting community, even in the face of ever-increasing communications regarding the disease risks associated with baiting (e.g., chronic wasting disease; Sorensen et al. 2014) and captive deer breeding (e.g., Tedeschi 2012). Disease risk may provide an important counterweight to the growing market pressure for IDM because wildlife disease threatens profit for livestock producers (including those treating deer as livestock), ecosystem functioning, and human health (Sorensen et al. 2014).

Our study was limited in demographic and geographic scope, yet highlights the need for similar research involving wildlife conservation professionals from other regions. Perhaps more importantly, an inquiry is needed to better understand the views of hunters and the nonhunting public in comparison with wildlife professionals. Such research could test several important hypotheses related to IDM because previous research demonstrated broad variability in attitudes toward wildlife ownership, even in a relatively small geographic area (Peterson et al. 2011*b*). For instance, do hunters recognize the processes of commercialization (e.g., selective breeding) behind commodities such as big deer and big antlers produced in IDM systems (Peterson et al. 2011*a*)? Answering this question is important because unless hunters see beyond the commodities, decisions about IDM will remain as the uncontested purview of wealthy landowners who were largely responsible for practices commonly lumped into the Texas Model. Further, research examining the extent to which IDM affects the nonhunting public's opinion of hunting will provide insight into how expansion of IDM will shape public support for hunting in the future. Support for hunting has been studied in various contexts (e.g., as a wildlife management tool [Campbell and MacKay 2003], as a tourism product [MacKay and Campbell 2004]). However, such studies have not addressed 2 other potential motivations behind IDM: larger male deer for hunters to shoot and revenue for the landowner(s) or manager(s). MacKay and Campbell (2004) demonstrated that public opinion generally favored generation of revenue through hunting license fees regardless of level of support for hunting, but other research showed that when hunting is motivated by trophy animals, it is perceived much more negatively than when motivated by acquisition of food (Duda and Young 1996). Although many

questions about IDM remain, the evolution of this approach to deer management will help shape future thinking related to the role and function of markets in wildlife management.

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