

Availability of Theriogenology Training at North American and Caribbean Veterinary Colleges

Margaret V. Root Kustritz ■ Ahmed Tibary ■ Peter J. Chenoweth

ABSTRACT

A survey of the veterinary colleges in North America and the Caribbean was undertaken to determine the extent of availability of theriogenology training. Didactic training in at least one species was required at all schools that responded to the survey. Laboratory experience in at least one species was required by 75.0% and clinical theriogenology experience in at least one species by 72.7%. The mean number of board-certified or board-eligible theriogenology faculty did not vary between 1995 and 2005, but there was a decrease in the number of such faculty at 57.2% of the schools that responded to the survey.

INTRODUCTION

Theriogenology is the study of animal reproduction. Within veterinary medicine, theriogenology is a specialty that requires knowledge of all species and crosses many disciplines, including medicine, surgery, pathology, genetics, nutrition, physiology, pharmacology, toxicology, and behavior. In veterinary colleges in North America, the resources dedicated to theriogenology have declined over time, yet theriogenology contributes to a vital part of the national economy. In addition, a significant proportion of veterinary practice is theriogenology related.¹

In cattle, theriogenology is the farmer's livelihood; cows that do not become pregnant and carry the pregnancy to term do not give milk or provide feeder calves for meat. Annual financial losses in the United States in dairy cattle because of poor reproductive efficiency are estimated at \$155 per cow, or more than \$300 million per year.^{2,3} Determination of breeding soundness in bulls yields a return of at least \$17–25 for every \$1 invested in the breeding soundness examination by decreasing the number of times cows must be bred before becoming pregnant and increasing the calf crop.⁴ Beef cattle improvement programs are considered to demonstrate an economic benefit to producers of more than \$295,000 by means of improved reproductive performance and decreased illness and death in cows and calves.⁵ Globally, re-privatization of farms and decreasing on-farm populations in many countries have left farmers with limited personal experience responsible for beef, dairy, and small ruminant production. Decreased veterinary support for livestock producers is a source of concern for international organizations such as the Food and Agriculture Organization of the United Nations.⁶

The importance of theriogenologists in the equine industry became apparent during the recent outbreak of mare reproductive loss syndrome (MRLS) in Kentucky and Ohio. Horses and mules represented Kentucky's number one agricultural commodity in 1991 and accounted for 89% of the total US value of that commodity in that year.⁷ It is estimated that 5% of the 2001 thoroughbred foal crop in Kentucky was lost to MRLS,⁸ with an estimated

economic impact of \$336 million.⁹ Losses were widespread, encompassing direct foal loss; loss of fees for stud service, sales, training, boarding, racing, and showing; management, including veterinary services, transport, feeds, and hay; and indirect effects due to decreased spending by the horse industry nationwide.⁷

Dog breeding and showing are growing in popularity. The American Kennel Club (AKC) registered 915,668 dogs in 2003.¹⁰ Dog showing is popular both at the local and national levels and exists to prove the worth of potential breeding stock.¹¹ The number of entries in AKC events in 2002 was 2,336,292.¹⁰

Reproduction of rare domestic species and endangered wild species is a global concern. Theriogenologists play a vital role in species conservation and management plans worldwide. Little is known about the reproductive physiology of many wild species, and research in domestic species often is used to allow extrapolation to wild species. For example, study of reproduction in domestic cats by theriogenologists and reproductive physiologists has contributed greatly to success in reproducing big cats, all species of which are endangered or threatened.^{12,13}

The Society for Theriogenology is a veterinary organization dedicated to dissemination of knowledge to veterinarians interested in the practice of veterinary reproduction. The American College of Theriogenologists is composed of those veterinarians who have completed specialty training and licensure as reproductive specialists. The society and the college work together closely to help ensure appropriate education in theriogenology for veterinary students and topical continuing education programs for practitioners. However, it appears that many colleges of veterinary medicine are cutting back on the number of theriogenologists employed. A survey was undertaken within North America and the Caribbean to quantify theriogenology training opportunities available for veterinary students, graduate students and residents, and practitioners.

Numerical data were evaluated using the Student *t*-test when appropriate.

RESULTS

Surveys were sent to the veterinary colleges in the United States, Canada, and the Caribbean. Thirty-one of 35 colleges were represented, for an overall participation rate of 88.6%. Data were organized by geographical region (see Table 1).

Basic information about the colleges was collected, including total student enrollment and percentage of students tracking small animal, mixed, or large animal, if applicable (see Table 2). For the purposes of this survey, "tracking" was defined as any curriculum allowing students to take a significant portion of didactic or clinical

courses in their species of choice. Designations used were small animal (canine and feline), large animal (bovine, small ruminant, and equine), and mixed (all species). Twelve schools that declared tracking as part of their curriculum provided more information about their programs. Three of them (25.0%) allowed students to begin to choose classes by species preference in the first year of the curriculum, one (8.0%) in the second year, three (25.0%) in the third year, and five (42.0%) in the final year of the curriculum.

Twenty-four schools provided data about required and elective didactic courses in clinical theriogenology by

Table 1: Veterinary colleges participating by geographic area

South Region (N=10)	Auburn, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, Tennessee, Texas A&M, Tuskegee
Midwest Region (N=8)	Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, Wisconsin
East Region (N=6)	Atlantic, Cornell, Ontario, Pennsylvania, Tufts, Virginia-Maryland
West Region (N=5)	California-Davis, Oregon, Washington, Western College (Canada), Western University (USA)*
Other	Montreal, Ross

*This college is in development; results will change as classes complete the curriculum.

Table 2: Enrollment information from participating veterinary colleges by region

	South (N=10)	Midwest (N=8)	East (N=6)	West (N=5)	Other (N=2)	Total (N=31)
Total enrollment	3,191	3,137	2,119	1,327	900	10,674
Mean enrollment	319	392	353	265	450	344
# of colleges allowing tracking*	5	3	4	2	1	15
% of students tracking small animal**	61.4	67.0	52.0	43.0	50.0	54.7***
% tracking mixed	26.6	21.3	30.0	20.0	25.0	24.6
% tracking large animal	12.0	11.7	18.3	24.0	25.0	18.2

*Tracking = curriculum allowing students to choose a significant portion of didactic or clinical courses in their species of choice. Representatives from the schools themselves defined whether or not tracking was a part of their curriculum.

**Percentages are calculated only from students in schools that allow tracking.

***Percentages do not total 100 because some schools excluded those students enrolled in unique programs that do not qualify under the above designations and some schools provided numbers averaged for several years.

Table 3: Didactic clinical theriogenology courses required or elective by species at 24 veterinary colleges

	Equine		Small Animal		Food Animal (Bovine)		Large Animal		All Species	
	Required	Elective	Required	Elective	Required	Elective	Required	Elective	Required	Elective
Lecture										
Mean	10.3 ± 9.1	9.0 ± 6.0	7.3 ± 3.8	12.3 ± 9.3	11.3 ± 7.4	20.0 ± 22.9	11.0 ± 0	24.0 ± 0	34.0 ± 17.0	26.5 ± 0.5
hours ± SD (N)	(3)*	(7)	(3)*	(3)	(4)*	(5)	(1)	(1)	(23)	(2)
Laboratory										
Mean	7.8 ± 8.4	19.6 ± 23.5	6.0 ± 0	20.0 ± 0	11.5 ± 8.3	34.7 ± 42.5	6.0 ± 0	45.0 ± 54.6	18.5 ± 13.1	5.5 ± 0.5
hours ± SD (N)	(4)*	(5)	(1)*	(1)	(4)*	(7)	(1)	(3)	(12)	(2)

*For at least one institution, lecture or laboratory requirements are coupled with the track chosen by the student (e.g., small animal theriogenology lecture and laboratory are required only for those students tracking small animal).

species (see Table 3). All schools require students to attend lectures in at least one species; 23 (95.5%) require students to attend didactic clinical lectures covering the “major” species (canine, bovine, and equine at all schools; some schools also include some small ruminant, porcine, and feline lectures), with a minimum requirement of four hours and a maximum requirement of 60 hours of lecture. Eighteen (75.0%) of schools that responded require students to attend theriogenology laboratory sessions in at least one species, with a minimum requirement of three hours and a maximum requirement of 42 hours.

The same 24 schools provided information about clinical theriogenology rotations offered at their institutions. Data from 22 schools are included in Table 4; one school did not provide complete information, and one (Ross University) does not have a clinical program. Of the 22 respondents, six (27.3%) require no clinical experience in theriogenology of students before completion of the final year. Bovine/food animal rotations and rotations covering all species were those most commonly required. Small animal clinical theriogenology, as a sole discipline, was required at none of the institutions responding and was available as an elective at only six. These data do not quantify theriogenology experiences students may receive during other rotations

(medicine, surgery, field service/ambulatory) or in externship situations.

Information about theriogenology teaching collected included number of theriogenologists on staff, number of residents, and number of graduate students in theriogenology programs. *Combined residency and degree programs* were defined as those in which a given individual completes the requirements of a clinical residency and a master’s or PhD degree at the same time. *Theriogenology graduate programs* were defined as master’s or PhD programs under the direct mentorship and financial support of a boarded or board-eligible theriogenologist (see Table 5). Twenty-one schools provided information about the number of boarded or board-eligible theriogenology faculty, theriogenology graduate students, and theriogenology residents in 1995 and 2005. Mean number of boarded or board-eligible theriogenology faculty did not vary significantly from 1995 to 2005 (mean \pm SD: 3.4 ± 1.9 and 3.3 ± 2.1 , respectively; $p > 0.05$). However, there was a decrease in the number of such faculty at 12 (57.2%) of the schools that responded to the survey. The number of theriogenology faculty increased at six schools and did not change at three of the schools responding. The mean number of theriogenology graduate students did not vary significantly from 1995 to 2005

Table 4: Number of clinical theriogenology rotations required or elective by species at 22 veterinary colleges

Equine		Small Animal		Food Animal (Bovine)		Large Animal		All Species	
Required	Elective	Required	Elective	Required	Elective	Required	Elective	Required	Elective
6*	12	0	6	10**	8	3***	1	4	3

*At three institutions, this rotation is required only for equine track students.

**At three institutions, this rotation is required only for food animal/bovine track students. At five institutions, this requirement is considered to be fulfilled by student enrollment in a field service/ambulatory rotation.

***At one institution, this rotation is required only of large animal track students.

Table 5: Theriogenology programs information from participating veterinary colleges by region

	South (N=10)	Midwest (N=8)	East (N=6)	West (N=5)	Other (N=2)	Total (N=31)
# of boarded or board-eligible theriogenology faculty (mean, range)	3.9 (1-9)	2.6 (1-5)	4.5 (3-8)	2.8 (1-5)	1.5 (1-2)	3.1
# of theriogenology residents at a given school (mean, range)	1.3 (0-4)	0.6 (0-1)	0.8 (0-2)	1.6 (0-8)	1 (1)	1.1
# of schools without a theriogenology resident	4	3	2	4	0	13 (41.9%)
# of residents in a combined program* (mean, range)	0.7 (0-4)	0.5 (0-1)	0.5 (0-1)	0.6 (0-3)	0	0.5
# of theriogenology graduate students** at a given school (mean, range)	1.2 (0-5)	0.9 (0-4)	0.5 (0-2)	0.4 (0-1)	0	0.6

**Combined programs* were defined as those in which a given individual completes the requirements of a clinical residency and a master’s or PhD degree at the same time.

***Theriogenology graduate programs* were defined as master’s or PhD programs under the direct mentorship and financial support of a boarded or board-eligible theriogenologist that were not accomplished at the same time as a clinical residency.

Table 6: Continuing education information from participating veterinary colleges by region

	South (N= 10)	Midwest (N= 8)	East (N= 6)	West (N= 5)	Other (N= 2)	Total (N= 31)
# of colleges offering continuing education by their theriogenology faculty	8 80.0%	6 75.0%	5 83.3%	4 80.0%	1 50.0%	24 77.4%
# with theriogenology programs offered by a non-university agency within last three years*	4 40.0%	6 75.0%	1 16.7%	3 60.0%	1 50.0%	15 48.4%

*Most theriogenology courses offered from a non-university source were offered through state or regional veterinary medical associations.

(mean \pm SD: 1.5 ± 2.0 and 1.4 ± 2.0 , respectively; $p > 0.05$). The number of theriogenology graduate students increased ($N = 8$) or did not vary ($N = 8$) at the majority of the schools responding. The mean number of theriogenology residents did not vary significantly from 1995 to 2005 (mean \pm SD: 1.1 ± 0.9 and 0.9 ± 1.0 , respectively; $p > 0.05$). The number of theriogenology residents increased at six schools, decreased at six, and stayed the same at nine of the schools responding. Finally, information was collected regarding provision of theriogenology courses by the college or outside agencies in the area within the three years prior to the survey (see Table 6).

DISCUSSION

Few surveys have been completed documenting the efficacy of veterinary training of any kind for practice. In 1989, a manuscript analyzing the teaching of swine medicine and management in American veterinary colleges posited that decreasing emphasis on this discipline in veterinary curricula would have a detrimental effect on swine production and the ability of veterinary colleges to produce swine practitioners;¹⁴ however, there was no apparent follow-up to this study, and swine curricula continue to decline. A recent study evaluating performance of new graduates from the veterinary college in Liverpool, UK, documented that both the new graduates and the practitioners for whom they worked wished the students had had more exposure to the "bread-and-butter" work of everyday life while in school.¹⁵ This category includes reproductive work, especially in large animal species, where theriogenology represents a significant portion of practice activities.¹

It is self-evident that veterinary education should mirror the needs of the practitioner, so that new graduates can make a meaningful contribution to practice as they leave school. Veterinary debt load is high upon graduation; in 2004, the average indebtedness of new graduates from American veterinary colleges was \$81,052, while expected annual income of employed new graduates averaged only \$42,978.¹⁶ It is incumbent upon the veterinary colleges to educate students in a way that allows them to generate revenue for the practices for which they work and to receive direct financial benefit from this revenue generation. In 2001, one small animal veterinary corporation expected

newly hired veterinarians to generate revenue equal to four times their salary in a year.¹⁷ This is an undue burden on new graduates if they leave veterinary college without adequate training.

It is difficult to know how much training in veterinary college is enough to meet the needs of veterinary students as they enter practice. For those students enrolled in large animal tracks, especially those intending to go into dairy practice, rectal palpation and transrectal ultrasound of cows are valuable skills essential for practice. But only 75.0% of schools in this survey required a laboratory theriogenology experience, and only 45.5% required a ruminant theriogenology clinical experience in the final year of instruction. More than 54% of students in schools that allow tracking are pursuing small animal work, yet no school requires a small animal theriogenology clinical experience in the fourth year and only 27.3% of schools have a dedicated small animal theriogenology elective. Will all students choose those elective rotations that will best serve them in their future occupation? Is it reasonable to assume that all students can gain adequate clinical experience in theriogenology from the variable exposure they may receive on medicine, ambulatory, or other rotations?

Over the last 10 years, the number of board-certified or board-eligible faculty in theriogenology has decreased in 12 (57.2%) of schools surveyed. Theriogenology faculty from the veterinary colleges provide the bulk of the continuing education in theriogenology required of practitioners. As faculty numbers decrease, the burden on the remaining faculty increases, taxing their ability to maximize teaching and research opportunities.

The Society for Theriogenology is interested in determining from practitioners in the field whether they graduated with the technical skills and knowledge base in theriogenology required to practice efficiently and in determining whether consumers of these services can find practitioners they consider to be adequately trained. To that end, we have created a survey to be sent to practitioners in several regions of the United States, soliciting data and opinions regarding the importance of skills in theriogenology including management, assisted reproductive technologies, and medical and surgical skills in bovine, equine, ovine and caprine, camelid, and small animal species; and to consumers of

theriogenology services, soliciting opinions regarding training of the practitioners they hire. Data from those surveys are forthcoming.

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AUTHOR INFORMATION

Margaret V. Root Kustritz, DVM, PhD, Dipl. ACT, is an Associate Professor at the University of Minnesota College of Veterinary Medicine, 1352 Boyd Ave., St Paul, MN 55108 USA. E-mail: rootk001@umn.edu. She specializes in small animal reproduction. Dr. Root Kustritz is a co-author of the text *Canine and Feline Theriogenology* and president-elect of the American College of Theriogenologists.

Ahmed Tibary, DVM, PhD, Dipl. ACT, is an Associate Professor of Theriogenology at Washington State University College of Veterinary Medicine, Pullman, WA 99164-6610 USA. E-mail: tibary@vetmed.wsu.edu. Dr. Tibary's special interest is in equine and camelid reproduction, and his current research is in camelid theriogenology. He is the co-author of two equine reproduction texts published in French, *Reproduction equine: l'étalon et les biotechnologies de reproduction [Equine Reproduction: The Stallion and Reproductive Technologies]* and *Reproduction equine, tome 1 : la jument [Equine Reproduction: The Mare]*, and of *Reproduction in Camelidae*.

Peter J. Chenoweth, BVSc, PhD, Dipl. ACT, holds the Coleman Chair in Food Animal Production at Kansas State University and is an adjunct professor at the University of Nebraska. Current research is in bovine theriogenology. Dr. Chenoweth is president-elect of the Society for Theriogenology. He is currently Professor of Veterinary Reproduction at the School of Agricultural and Veterinary Sciences, Charles Sturt University, Locked Bag 588, Wagga Wagga NSW 2678 Australia. E-mail: pchenoweth@csu.edu.au.