Reproductive Management of Goats 101 (and Beyond)

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Reproductive Management of Goats 101 (and Beyond)

- **Goals**
  - Increase profitability
    - Select appropriate animals for breeding
    - Tailor production schedule to market niches
    - Decrease losses in peri- and post-partum periods
  - Minimize stress and maximize enjoyment
Goats 101: Reproductive Management

• Objectives
  – Normal reproductive physiology of the doe and buck
  – Routine breeding management
  – Artificial insemination
    • Fresh-extended semen
    • Frozen-thawed semen
My Qualifications

• Who I am
  – Veterinarian specializing in reproduction
  – Clinician educator
  – An operator of a small (sheep) farm in Missouri

• Who I am not
  – Nutritionist
  – Expert in parasitic diseases
  – A life-long farmer
Dawna Voelkl

- Born and raised in a small town in western Pennsylvania – NOT on a farm!
- Attended Bryn Mawr College outside of Philadelphia
- Pursued a variety of careers prior to entering veterinary school
- Veterinary education at Cornell
- Residency training at Minnesota and Penn
- Arrived in Missouri in 2006
Normal Reproductive Physiology
Doe

• Sexual maturity: age of attainment multifactorial
  – Season of birth
  – Nutrition
  – Buck exposure
  – Breed
    • European breeds: 6-8 months
    • Pygmy: ~3 months
Normal Reproductive Physiology
Annual Reproductive Cycle

Does are…
Seasonally Polyestrous
Short-day Breeders
Normal Reproductive Physiology
Annual Reproductive Cycle

• Breeding season
  – Spontaneous cyclicity
  – Darkness → pineal melatonin → ↑ GnRH → ↑ HPG axis stimulation → cyclicity
  – September-December
Normal Reproductive Physiology
Annual Reproductive Cycle

• Transition
  – Erratic cyclicity
  – Cyclicity may be induced using buck exposure or pharmacological manipulation
  – Non-breeding to breeding transition
  – Breeding to non-breeding transition: pineal becomes refractory to short-day stimulation
  – August-September; January-March
Normal Reproductive Physiology
Annual Reproductive Cycle

- Non-breeding season (anestrus)
  - No spontaneous cyclicity and not in transition
  - In most individuals, pharmacologic manipulation required for “out of season” breeding
  - Long days/little darkness $\rightarrow$ nadir [melatonin] $\rightarrow$ ↓ GnRH $\rightarrow$ ↓ HPG axis stimulation $\rightarrow$ anestrus
  - April-July
Normal Reproductive Physiology

Estrous Cycle

• Length of cycle

European breeds: 20-21 days

Pygmy goats: 18-24 days
Normal Reproductive Physiology

Estrous Cycle

• Proestrus
  – ~ 1 day
  – Attractive to buck but will not stand to be bred

• Estrus
  – ~ 0.5-2.0 days
  – Physical manifestations
    • Cervical mucus: clear → cloudy → cheesy
    • Vulvar swelling, moistness, hyperemia (inconsistent)
Normal Reproductive Physiology

Estrous Cycle

• Estrus
  – Behavioral signs
    • Interest in buck
    • Stimulated by buck odor ("buck rag")
    • ↑ Vocalization
    • Tail-flagging
    • Attractive to male and will permit breeding
Normal Reproductive Physiology

Estrous Cycle

• Ovulation
  – ~ 0.5-1.5 days after onset of estrus
  – May be hastened by buck exposure
    • Induction of the LH surge
    • Useful as a management tool
Normal Reproductive Physiology

Estrous Cycle

• Metestrus
  – Interval between ceasing to stand for breeding and formation of the CL
  – Variable length

• Diestrus
  – 17-19 days
  – Corpus luteum and progesterone dominate
  – $\text{PGF}_2\alpha$ released on day 17-18
    → luteolysis → doe returns to heat
Normal Reproductive Physiology
Buck

• Age at which bucks reach sexual maturity is highly breed specific
  – Average of ~5 (3-8) months
  – Smaller breeds usually mature earlier
• May be delayed by
  – Overcrowding
  – Early weaning
  – Poor nutrition
  – Being a twin or triplet
• Penile frenulum must break down
Normal Reproductive Physiology

Buck

- Seasonality controversial
  - Bucks in temperate climates collected artificially → no alteration in libido or seminal quality
  - During non-breeding season, bucks in a herd situation may experience decreases in
    - Libido
    - Buck odor
    - Testes size
    - Semen quality
Normal Reproductive Physiology Buck

- Complete cycle of spermatogenesis: 59-64 days
  - Spermatogenesis: ~49 days
  - Epididymal transit and maturation: 10-15 days
- Clinical relevance for breeding soundness evaluations, natural breeding and AI programs
Routine Reproductive Management
Pre-Breeding Recommendations

• Doelings
  – Wait until achieve 65% of mature body weight
  – Optimally, on 3rd or 4th cycle afterwards
    • Successful earlier breeding may require pharmacologic intervention
Routine Reproductive Management
Pre-Breeding Recommendations

• Breeding soundness evaluation of the buck
  – Pre-purchase
  – Prior to using for breeding
  – Poor pregnancy/kidding rate
  – Prior to cryopreserving sperm
The Breeding Soundness Evaluation
What is It?

- A complement of examinations and evaluations that allow us to formulate an opinion as to whether or not a male is capable of breeding and successfully impregnating a given number of females under prevailing industry management conditions.
The Breeding Soundness Evaluation
What is It Not?

• A guarantee of fertility
  – Breeding sound does not guarantee fertility
  – Poor performance on a breeding soundness evaluation does not necessarily mean that a male is sterile or infertile
The Breeding Soundness Evaluation

General Goals

- Selection of genetically superior individuals to promote continued genetic improvement across a group/breed/species
The Breeding Soundness Evaluation

General Goals

• Discrimination against heritable diseases
  – Has resulted in the reduction or elimination of the prevalence of certain diseases in production animals
  – More difficult in working with companion animals, including horses, due to goals other than sustaining an industry
    • Emotional
    • Rapid profit taking
The Breeding Soundness Evaluation

General Components

• History
  – Primarily as it relates to reproductive performance
  – But also general health, musculoskeletal disease/lameness
• Positive identification of animal
• General physical examination (of variable comprehensiveness)
• Examination of the external genitalia
• Indirect examination of the internal genitalia/accessory sex glands
• Semen collection and evaluation
• +/- Evaluation of libido, breeding behavior and serving capacity
• +/- Testing for the presence of infectious and/or genetic diseases
• Collation of data and pronouncement of classification
Breeding Soundness Examination
Buck

• Physical examination
  – External genitalia
• Scrotal circumference
  – NO prescribed standards by breed or age
  – General guidelines by weight for meat breeds
Breeding Soundness Evaluation
Buck

- Electroejaculation performed, but not well tolerated
- Semen collection via artificial vagina preferred method
Breeding Soundness Evaluation

Buck

- Buck artificial vagina (miniature bull AV)
  - Firm outer tube
  - Rubber jacket anchored by bands
  - Rubber liner with adaptor for collection vial
  - Collection vial suspended in warm water bath

- Teaser/mount doe
Breeding Soundness Evaluation
Buck
Breeding Soundness Examination of Buck
Semen Evaluation - Gross

• Visual inspection
  – Opacity
  – Consistency
  – Color
  – +/− Volume

• Olfactory
  – Urine contamination?
Breeding Soundness Examination of Buck Semen Evaluation - Microscopic

- Gross/mass motility
  - Individual motility
  - Concentration
- Progressive motility
  - Individual motility ONLY
Breeding Soundness Examination of Buck
Semen Evaluation - Microscopic

• Gross/mass motility
  – Undiluted
  – Hanging drop
  – Subjective rating
    • Poor, fair, good, very good
Breeding Soundness Examination of Buck Semen Evaluation - Microscopic

- Individual progressive motility
  - Usually requires dilution (physiologic saline, extender)
  - Subjective assessment
  - Minimum
    - 30% in the field
    - 70% in controlled, clinic environment

<table>
<thead>
<tr>
<th>Minimum Recommended Motility is: 30% or FAIR (F)</th>
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<tr>
<td>Mass Activity (Gross)</td>
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<tr>
<td>Rapid Swirling</td>
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<td>Slower Swirling</td>
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<td>Generalized Oscillation</td>
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<td>Sporadic Oscillation</td>
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Breeding Soundness Examination of Buck Semen Evaluation - Microscopic

• **Sperm morphology**
  – Preparation of sample
    • Eosin-nigrosin stain, light microscopy, 1000x, oil
    • Buffered formyl saline, phase contrast microscopy, 1000x
  – Count ≥100 sperm
Breeding Soundness Examination of Buck
Semen Evaluation - Microscopic

• Sperm morphology
  – List percentages of primary and secondary defects
  – Note any frequently occurring defects
  – Minimum of 70% normal sperm required for satisfactory classification in the buck
Breeding Soundness Examination of Buck

The Bottom Line

- Satisfactory potential breeder
  - Equal/surpass minimum standards
    - Scrotal circumference
    - Sperm motility: 70%
    - Sperm morphology: 80%
  - Be free of defects that would compromise breeding ability
    - Heritable
    - Physical
  - Be free of obvious infectious reproductive disease
  - Absence of the urethral process does not preclude satisfactory classification
- Implies that a buck is capable of impregnating at least 30 does in a 32-day breeding season
Routine Reproductive Management
Breeding

- Mating systems
  - Natural service
    - Pasture
    - In hand
  - Artificial insemination
    - Fresh extended semen
    - Frozen-thawed semen
Natural Mating of the Doe

• Pasture-breeding
  – Meat goat breeds
  – Bucks in with does ≥ 32 d
  – If good libido, breeds 20-30 times/day (not the same doe!!!)

• Hand-mating
  – Dairy goat breeds
  – Breed at first standing, 12 h later, corresponding to mid to late estrus
  – Breed up to 4-6 times/cycle
Routine Reproductive Management
Breeding

- Buck deposits semen into the vagina of the doe
- Ejaculate characteristics
  - Low volume (0.5-2.0 mL)
  - High concentration (1.4-4.0 billion sperm/mL)
Natural Mating of the Doe

• Male: female ratios
  – Buck: doe when females spontaneously cycling: 1:30
  – Buck: doe when does synchronized: 1:7-1:8
Natural Mating of the Doe

- Expected pregnancy rates
  - Per cycle: 65%
  - Seasonal: > 90%
Artificial Insemination
Why Bother?

• Access to superior genetics without having to own expensive buck
  – Usually only genetically superior billies with excellent fertility qualify for frozen semen programs
• Ability to breed to deceased males
• More rapid genetic progress within a herd than with natural mating systems
• Reduces facilities/logistical complications while allowing breeding to multiple different bucks
• Allows for easier out-of-season breeding
• Decreases risk of disease transmission
Artificial Insemination
Requirements

• Method of timing insemination
  – Estrus (heat) detection
  – Estrus synchronization → estrus detection
  – Estrus synchronization → fixed time insemination

• Equipment
  – Vaginal specula with direct light source
  – Pipette and syringe for fresh extended semen or insemination gun for frozen-thawed semen
  – Sterile non-spermicidal lubricant
  – For frozen semen: thawing unit with thermometer, tweezers/forceps, straw cutters, paper towels
  – Record keeping system!!!
Estrus Monitoring

- Estrus detection relevant only when doe is to be bred in-hand or via artificial insemination
- Predominant methods
  - Behavioral observation (+/- intact or teaser buck)
  - Observation of physical changes
- May be used in concert with estrus synchronization
  - Breeding occurs on observed estrus
  - If estrus not observed, does may be bred at a fixed time as dictated by the protocol
- Behavioral signs last 12-48 hours
Estrus Monitoring

Behavior Observation

- Paces along fence near buck
- Stands to be investigated by buck
- Urinates frequently
- Vocalizes
Estrus Monitoring
Behavior Observation

- Lifts and rapidly wags tails
In absence of buck, a rag impregnated with his odor may be used to elicit behavioral signs of estrus in the doe.
Estrus Monitoring
Teaser Animals

• Indications
  – Advance cyclicity and stimulate synchronization during transition
  – Estrus detection in AI programs

• Surgical procedures
  – Penile translocation + vasectomy or epididymectomy

• Medical options
  – Androgenization of wethers (with penile translocation), does, or intersex animals

• Fit with marking harness
Estrus Monitoring

Observation of Physical Changes

- Edema and hyperemia of the vulva in some does
- Mucoid cervical discharge, best seen through speculum
  - Clear
  - Cloudy
- Breed doe when mucus turns from clear to cloudy, corresponding to mid to late estrus

Images courtesy Dr. Cliff Shipley
Artificial Insemination
Fresh Extended Semen

• Most often used by dairy and purebred goat breeders
• Semen collected and extended
• Timing
  – > 12 hours after onset of estrus
  – At time mucus turns from clear to cloudy is optimal
Artificial Insemination
Fresh Extended Semen

- Intra-uterine insemination via vaginal approach
  - Clean perineum
  - Pass vaginal speculum with light source to cranial vagina
  - “Lock” cervical os into speculum
  - Pass AI pipette or gun through speculum and manipulate through rings
  - Deposit semen in cervix or uterine body (if you get there!)

- Dose: 150-200 million PMS
- Expected pregnancy rate for single insemination: 50-85%
Artificial Insemination
Frozen-Thawed Semen

- Not routinely performed
  - Intra-uterine insemination via vaginal approach (as described above)
  - Laparoscopic (as for sheep)

- Buck semen does not generally survive cryopreservation well due to deleterious effects of egg yolk on sperm

- Dose: 20 million PMS

- Expected pregnancy rate for single insemination: 20-90% for laparoscopic intra-uterine insemination

- Requires good estrus synchronization
Artificial Insemination
Fresh Extended Semen

• “Getting there” can be problematic!!!
  – Challenge of “locking” the cervix
  – Cervical rings

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<tr>
<th>Table 15.2</th>
<th>Kidding rates in relation to depth of cervical insemination in crossbred Angora does</th>
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<tr>
<td>Depth of cervical insemination</td>
<td>Fresh diluted semen No. does kidded per inseminated (%)</td>
</tr>
<tr>
<td>up to 1 cm</td>
<td>37/88 (42.0%)</td>
</tr>
<tr>
<td>1.0 to 3.0 cm</td>
<td>74/127 (58.3%)</td>
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<tr>
<td>into uterus</td>
<td>56/81 (69.1%)</td>
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Estrus Synchronization Using Single Dose of PGF$_{2\alpha}$

IN SEASON BREEDING ONLY!!!

14/20 does have CL susceptible to PGF$_{2\alpha}$ → up to 60-70% will demonstrate behavioral estrus 36-40 hours after PGF$_{2\alpha}$ administration
Estrus Synchronization Using Two Doses of PGF$_{2\alpha}$

At the time of the 2$^{nd}$ PGF$_{2\alpha}$ injection 11 days later...

Does that had susceptible CL when given 1$^{st}$ PGF$_{2\alpha}$: 14/20 (70%) will be ~ day 7-9

Does that were in heat when given 1$^{st}$ PGF$_{2\alpha}$: 2/20 (10%) will be ~ day 10-11

Does that were 1-4 days post-ovulation when given 1$^{st}$ PGF$_{2\alpha}$: 4/20 (20%) will be ~ 12-15 day

90-95% of does should be in estrus within 36-40 hours

ALL does should have a susceptible CL!!!

IN SEASON BREEDING ONLY!!!
Estrus Synchronization Using Progestins

More commonly employed for AI and ET programs than PGF$_{2\alpha}$ protocols

For frozen-thawed semen: AI 30 hours after CIDR w/d/54 hours after PGF$_{2\alpha}$ +/- Cystorelin (if no PG600®)
Estrus Synchronization
CIDRs

- Controlled intra-vaginal drug-release device containing 0.3 gram progesterone
- NOT labeled for use in goats in the US
- Preferred by most over feeding of MGA
- Wear gloves when placing
- Trim nylon tails after insertion
Accelerated Kidding Programs

- Advantages
  - Evenly distributed kidding → continuous supply of milk in dairy herds
  - Production of kids to coincide with peak market demand
- Target: doe kids 3 times in 2 years or 5 times in 3 years
- Challenges
  - Out-of-season breeding and, therefore, pharmacologic intervention required
  - Early weaning in meat breeds
  - Nutrition must be excellent for does and bucks