

Increasing lamb production efficiency with accelerated production

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U N I V E R S I T Y

Extension

Major goal: Improve the efficiency of production

↑ Production : input

Improve efficiency by examining:

- Production level
- Labor input
- Feed inputs
- Health care inputs
- Capital investments

Key strategies to improve the efficiency of lamb production:

- **Flock management**
 - ✓ Strategic nutritional management
 - **Provide correct nutrients when needed**
 - Reduce cost of feed without hurting performance
 - ✓ Improve labor efficiency
 - Pasture management and forage utilization
 - Feeding systems
 - Birth management
 - Animal handling
 - ✓ Improve flock health status (preventative medicine and biosecurity)
- **Maternal genetics**
 - ✓ **Increase ovulation rate, survival birth to weaning, milk, mothering**
 - ✓ **Improve out-of-season conception**
 - ✓ Increase parasite resistance
- ***Production system-finding the right fit for your resource base***
 - ✓ ***Birth interval- annual or less***
 - ✓ ***Birth period timing and system***
 - ✓ ***Terminal sires-finding the right match for your ewe base to improve mass, efficiency and quality of lamb produced***

Overview:

- What is accelerated production and how does it compare to annual production systems?
- Resources required for a successful accelerated system
- Barriers to accelerated production success
- Approaches to insuring aseasonal breeding success

What is accelerated lambing?

- Production system that decreases lambing interval to less than 12 months.
 - ✓ Creates multiple birth periods
- Most accelerated systems have 2 major management groups:
 - ✓ Ewes in late pregnancy or lactation
 - ✓ Ewes exposed to rams or in early pregnancy

What potential advantages does an accelerated system have over a traditional, annual system?

- **Lambs born and survival to market age/ ewe**
 - ❖ Annual:
 - ✓ Lambs born: $0.95 \text{ births/yr} \times 2.0 \text{ lambs/birth} = 1.9 \text{ lambs/ewe/yr}$
 - ✓ Lambs to market age: $1.9 \times 85\% \text{ survival to market} = 1.6 \text{ lambs/ewe/yr}$
 - ❖ Accelerated:
 - ✓ Lambs born: $1.37 \text{ births/yr} \times 1.9 \text{ lambs/birth} = 2.6 \text{ lambs/ewe/yr}$
 - ✓ Lambs to market age: $2.6 \times 85\% \text{ survival to market} = 2.2 \text{ lambs/ewe/yr}$
- **Marketable lambs: lambs to sell per ewe/yr**
 - Ewe replacement rate is slightly higher in accelerated production but offset by increased lamb production
 - Marketable lambs/ewe, (lambs/ewe/year – ewe replacement rate)
 - ❖ Annual: $1.6 - 0.22 = 1.38$
 - ❖ Accelerated: $2.2 - 0.25 = 1.95$
 - ❖ **Accelerated: 41% greater annual ewe productivity**

What potential advantages does an accelerated system have over a traditional, annual system?

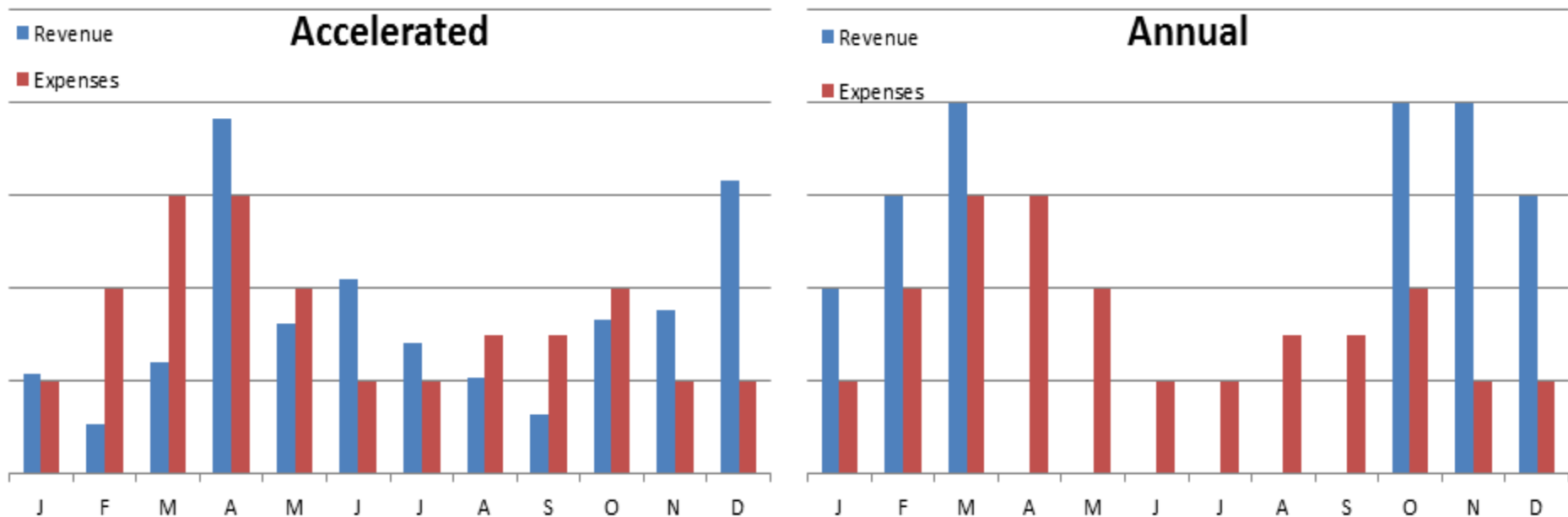
Marketing flexibility:

- Can hit a huge diversity of markets allowing more opportunistic marketing possibilities
 - ✓ Large, 140 lb lambs for traditional market
 - ✓ Small 40-100 lbs for non-traditional trade
- Year-round supply allows creation/access to new markets
- Reduced risk due to price fluctuations within a year
- Target specific seasonal markets

What potential advantages does an accelerated system have over a traditional, annual system?

- Cash flow advantages of accelerated production

Chart 1. Cash Flow: Accelerated versus Annual



* John Molenhuis, Ontario Ministry of Agriculture (OMAFRA), Proceedings of the Ontario Sheep Seminars 2013, Summary of 3 year benchmarking study on lamb production. Ontario Sheep Marketing Agency (OSMA) sponsored study

What potential advantages does an accelerated system have over a traditional, annual system?

Table 1. 3 year average results – top flocks – per lamb			
	Per Lamb	Accelerated	Annual
Revenue		\$202	\$195
Feed costs		\$78	\$77
Other variable costs (excluding labour)		\$51	\$54
Fixed costs		\$23	\$24
Net enterprise income per lamb (before labour expenses)		\$50	\$40
Marketable lambs per ewe		1.9	1.3
Number of Ewes		708	918
Net enterprise income (before labour)		\$66,906	\$48,103
Ewes per person (labour)		354	481
Net enterprise income per person		\$33,359	\$25,152

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What potential advantages does an accelerated system have over a traditional, annual system?

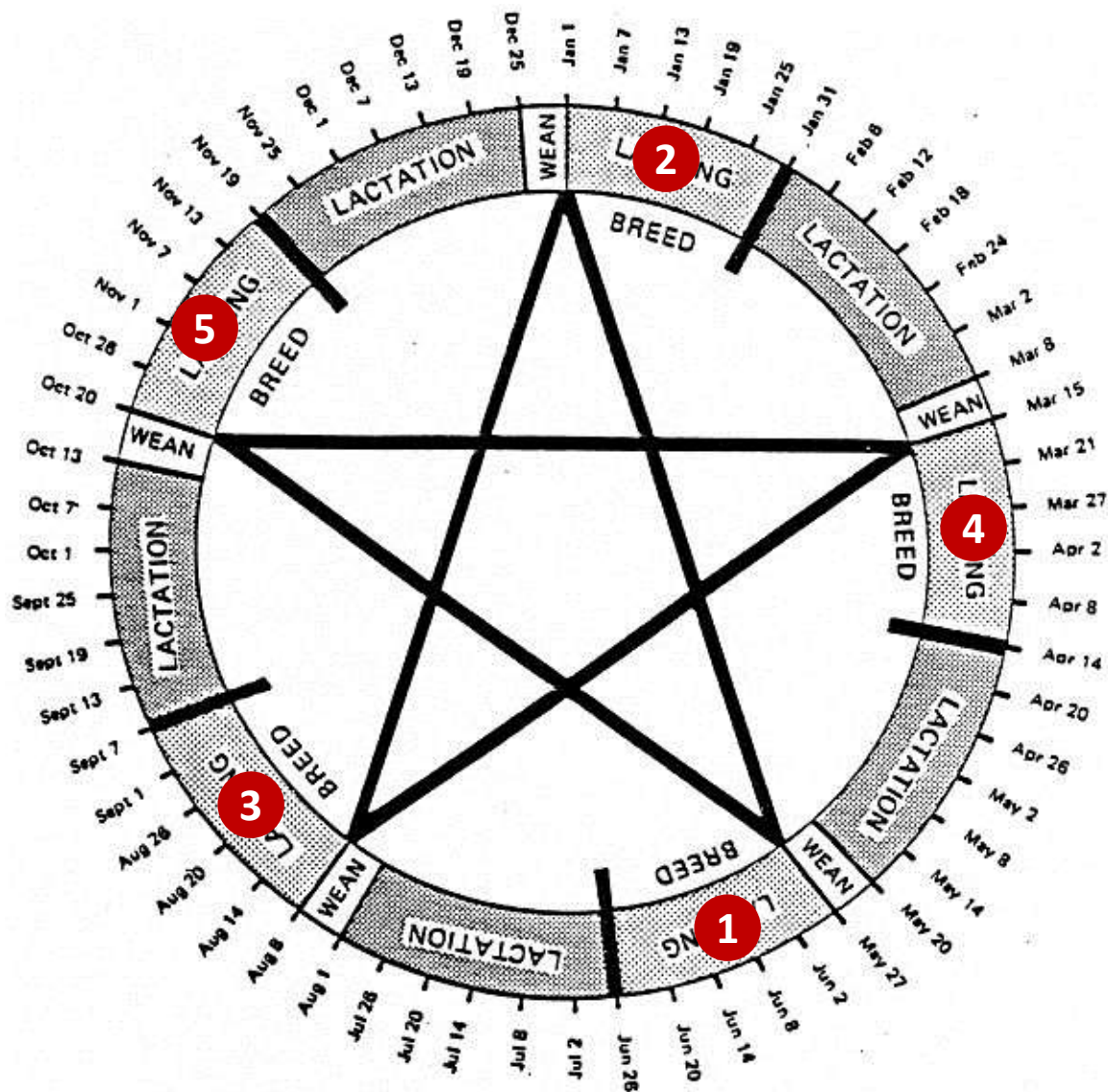
- **More lambs to sell/ewe/yr, >40%**
- **Greater net income (per ewe, lamb, unit labor or enterprise basis)**
- **Creation of year-round supply of lamb**
 - ✓ **Create and build markets**
 - ✓ **Reduced market risk**
 - ✓ **Improvement in farm cash flow**



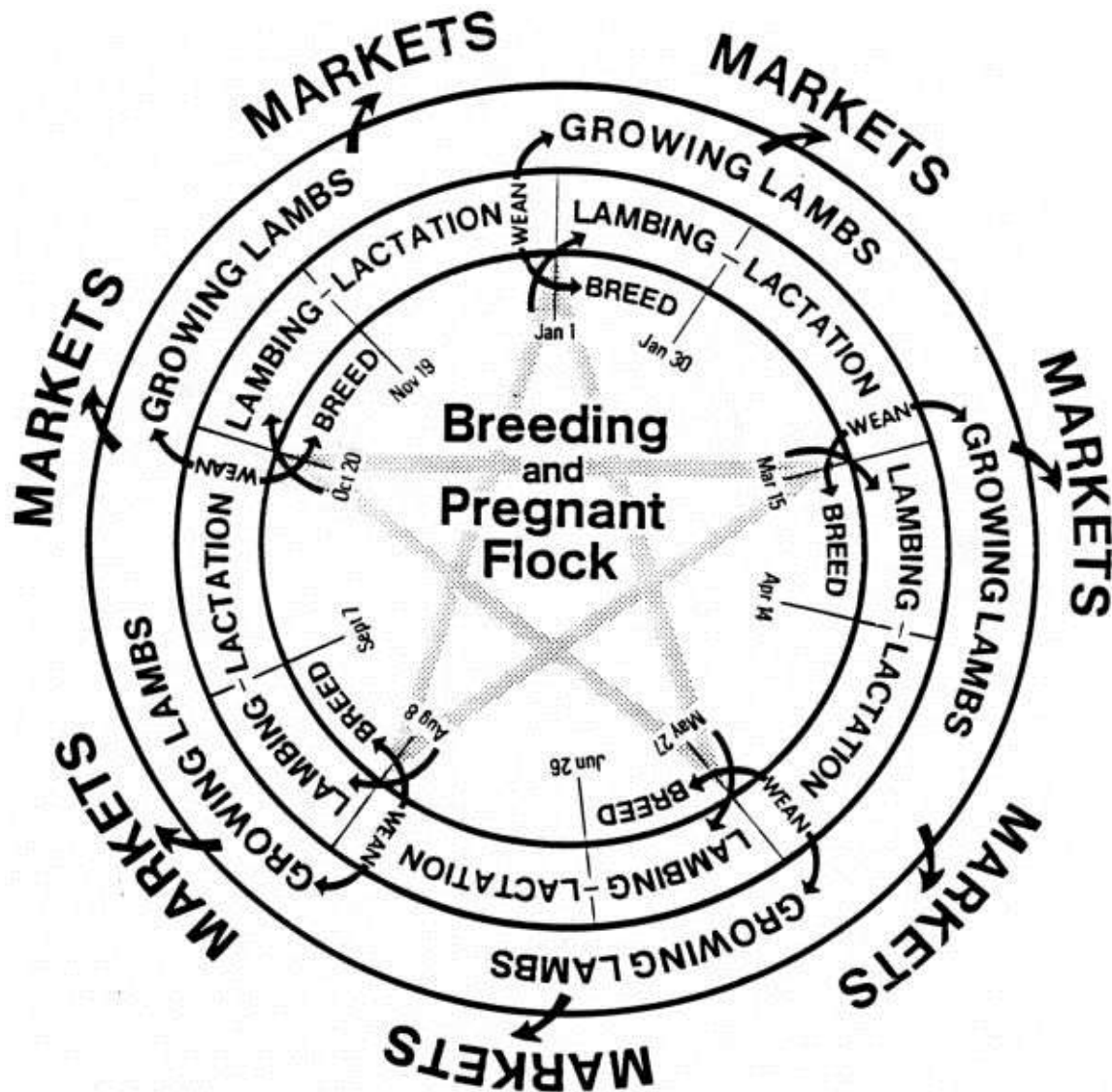
Accelerated production systems:

- **8 month system: 3 lambing periods in 2 years**
- **STAR system: 5 lambing periods in 3 years (7.2 month intervals).**

Cornell STAR[®] system



Cornell STAR[®] system



8 month system:

- Can alter birth periods a few weeks –creates flexibility to adjust for:
 - ✓ Labor availability
 - ✓ Need to hit specific market time table
 - ✓ Variation in lactation length
- If ewes do not breed (8 interval) they must wait 120 days to be rebred (12 mo interval)
- Can allow ewes a few weeks of “recovery” between lactation and breeding
- Can lengthen breeding periods >30 days
- **Can run a overlapping, dual 8 month system allowing lambing every 2 months**

Summary of Accelerated Systems:

	STAR	8 month
Birth interval	7.2 mo	7-9 mo
Lactation length	42-72 d	42-100d
Breeding period	<30 d	< 51 d
Lambing periods/year	5	3
Breeding periods/year	5	3
Max. # of births/ewe/yr	1.67	1.5

- **Either system can be further manipulated by photoperiod and/or hormone therapy**

Accelerated production: Theory vs. Reality

- Few formal comparisons of accelerated systems or deviations of systems.

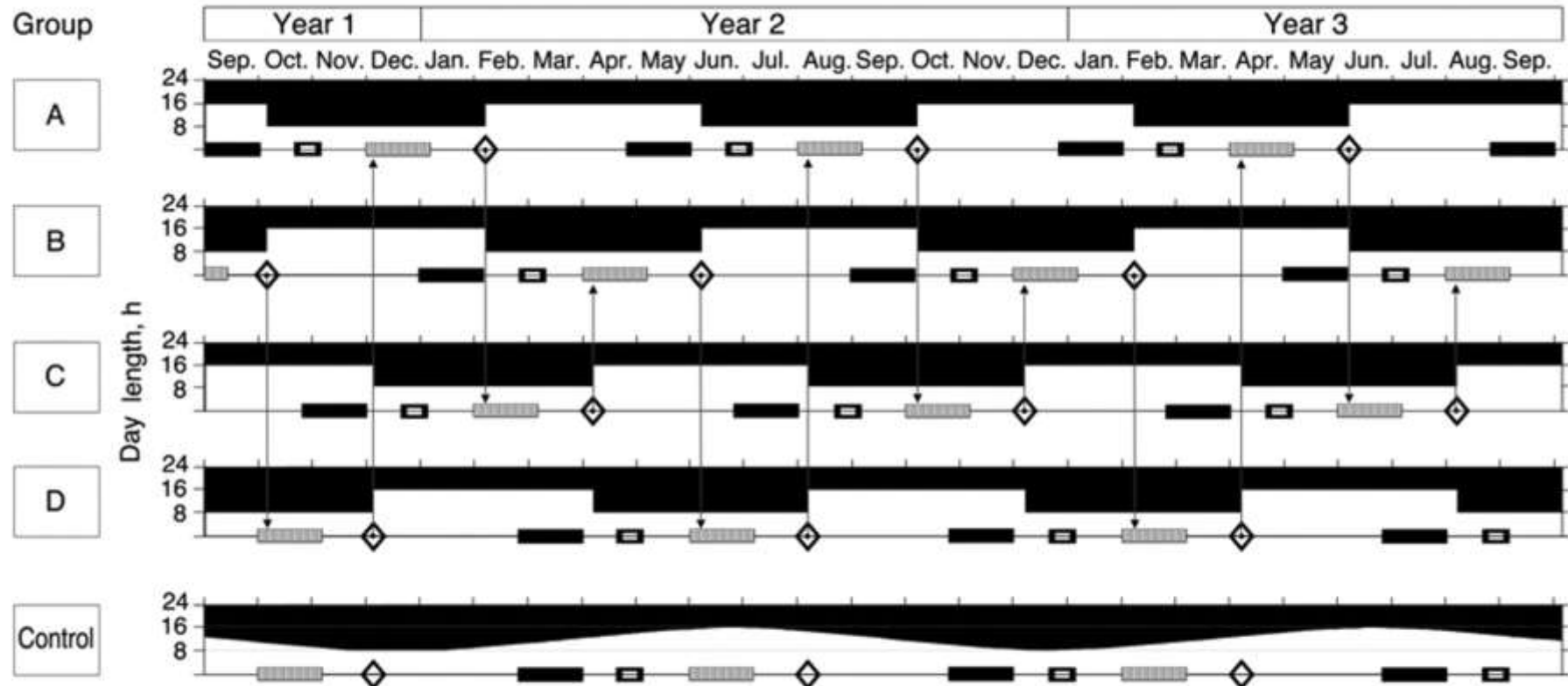
CEPOQ studies (Cameron et al. 2010):

	Births/ewe/yr (1.5 max.)	Lambs/birth	Lambs/ewe/yr
Lighting control	1.37	2.81	3.85
Progesterone therapy	1.26	2.27	2.86

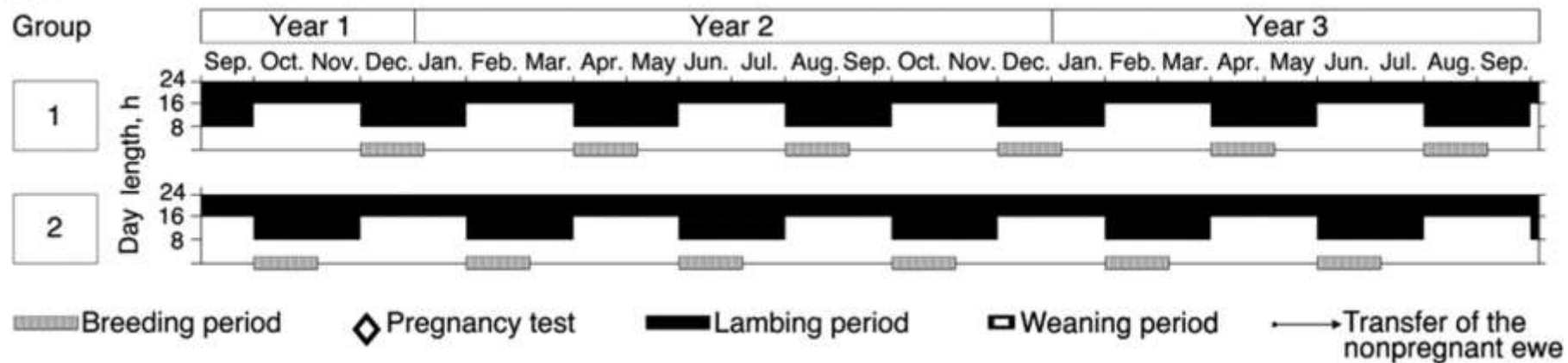
Note: this productivity is incredibly high compared to systems in the rest of the world!



a) Ewe



b) Ram





Kyle Farms, Avon, New York



2010-2013 production from 2000 ewes on an 8 month system: extended light

- 1.34 births/ewe/yr
 - ✓ 83% conception in October
 - ✓ 93% conception in May and Feb
- 1.73 lambs weaned/ewe/lambing
- 2.32 lambs weaned/ewe/year
- 2.07 lambs marketed/ewe/year
- 1.76 x maternal weight marketed in 2013



2009-2013 production from 150 ewes on an 8 month system: extended light and teaser rams

- 1.38 births/ewe/yr
 - ✓ 86% conception in October
 - ✓ 93% conception in May and Feb
- 1.90 lambs weaned/ewe/lambing
- 2.62 lambs weaned/ewe/year
- 2.36 lambs marketed/ewe/year
- 1.79 x maternal weight marketed in 2013

Resources required for accelerated production

- *Birth facility* capable of housing 2/3 of flock
- *Must provide a higher plane of nutrition over the year than annual birth* as females are in a more productive state a greater proportion of the time
 - ✓ High energy forages (grazing or harvested)
 - ✓ Energy concentrates at critical windows (lactation)
- *Chronic disease* issues are more apparent in accelerated lambing (foot rot, OPP, Johnes) as any ceiling imposed on production is more apparent in highly productive animals. Health issues must be rigorously managed
- *Precise management: nutrition, reproduction, health*
 - ✓ An Ontario study* suggests that the productivity benchmarks for lambs marketed /ewe/year must be >1.3 for annual and >1.9 for accelerated for either system to be profitable.
 - ✓ *Implication? If your annual system cannot produce >1.3 marketable lambs per ewe per year, work on improving that before considering a switch to accelerated production.*

* John Molenhuis, Ontario Ministry of Agriculture (OMAFRA), Proceedings of the Ontario Sheep Seminars 2013, Summary of 3 year benchmarking study on lamb production. Ontario Sheep Marketing Agency (OSMA) sponsored study

Optimizing accelerated production:

- Nutrition
- Genetics
- Lighting protocols
- Hormone therapies
- Ram effect
- Male libido/fertility

Primary Barrier for Accelerated Systems

- *Aseasonal fertility (ewes pregnant/ewe exposed) varied from 18-92% between surveyed farms in New York in 2004.*
- *Producers reported large variations in aseasonal fertility from year to year within their flocks.*
- *A change in aseasonal fertility from 92% to 18% translates into a profit loss of 36% per ewe/year in a 3 lambings per year system.*

Why does aseasonal fertility vary so much within and between farms?

- *Genetics*
- *Environment*
 - *Nutrition*
 - *Chronic disease*

Which is more limiting, male or female reproduction?

Sheep breeds that exhibit aseasonal fertility

Horned Dorset

*Polled Dorset**

Rambouillet

Merino

Romanov

Finn

Many hair breeds of West African decent

- *Aseasonal fertility is inversely related to the latitude unless selection pressure was exerted (i.e. Finn, Romanov, Dorset).*

Cross breeding enhances aseasonal fertility:

Heterosis and complimentarity

Examples of crosses used in accelerated lambing:

Romanov x Dorset

Finn X Dorset

Finn x Dorset x Ile de France x Romanov

Finn x Dorset x Rambouillet

Composites:

Rideau Arcott

Polypay

Field Study to identify factors that influence aseasonal fertility

Two flocks chosen that share the same genetic background-
Finn x Dorset with a trace of Romanov and Rambouillet.

	<i>Fertility average over 3 years</i>	
	<u>April-June Mating</u>	<u>Sept.-Dec. Mating</u>
High Fertility Flock	84%	92%
Low Fertility Flock	25%	87%

Supported by SARE (Sustainable Agriculture Research and Education)

Ewe fertility and lambing percentage in 2 flocks sharing the same genetics :

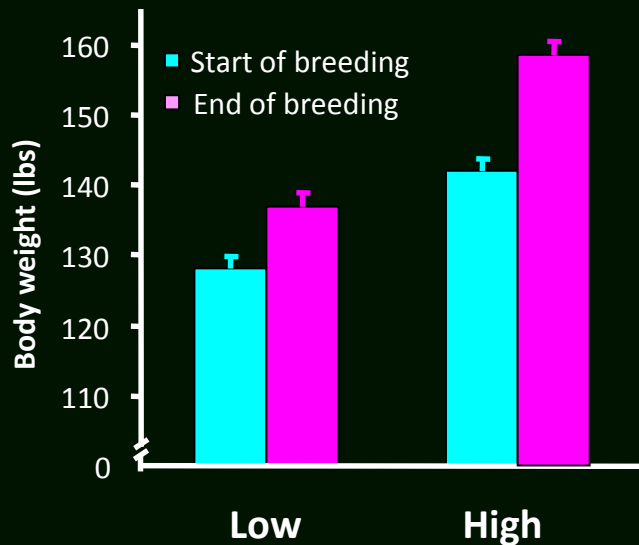
	<i>Low Fertility</i>	<i>High Fertility</i>
Fertility ¹ :	32%	92%
Lambing Percentage ² :	133%	206%

¹ Fertility expressed as ewe lambed/ewe exposed x 100%

² Lambing Percentage expressed as lambs born/ewe lambed x 100%

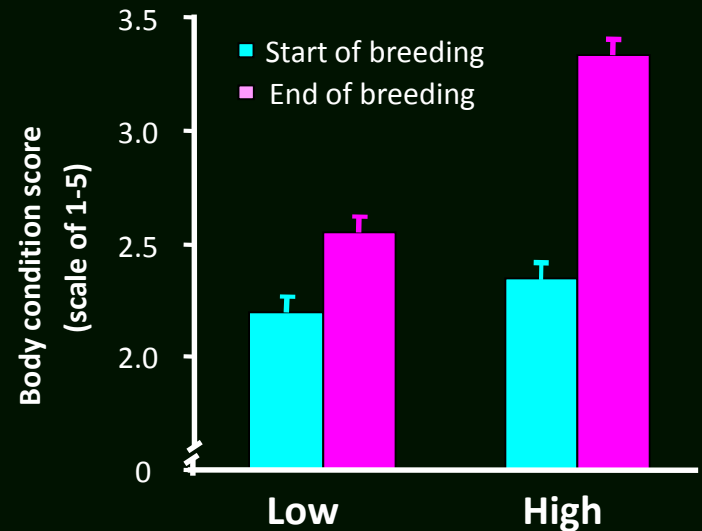
Nutritional status of ewes at the start and end of the breeding season

Body weight



$P < 0.001$ Flock
 $P < 0.001$ Time
 $P < 0.001$ Flock x time

Body condition score



$P < 0.001$ Flock
 $P < 0.01$ Time
 $P < 0.001$ Flock x time

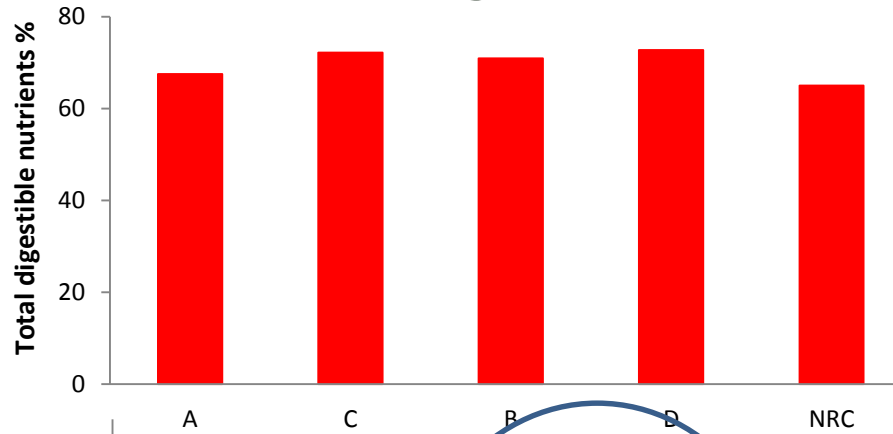
Comparison of energy requirements between annual and accelerated systems at 200% crop (expressed relative to maintenance, 1.0):

Period:	12 mo	8 mo
3wk pre-breeding	1.4	1.4
day 0-40 PC	1.2	1.2
day 40-115 PC	1.1	1.1
day 115-term	2.0	2.0
day 0-40 lactation	2.2	2.2
day 40-60 lactation	1.9	2.2

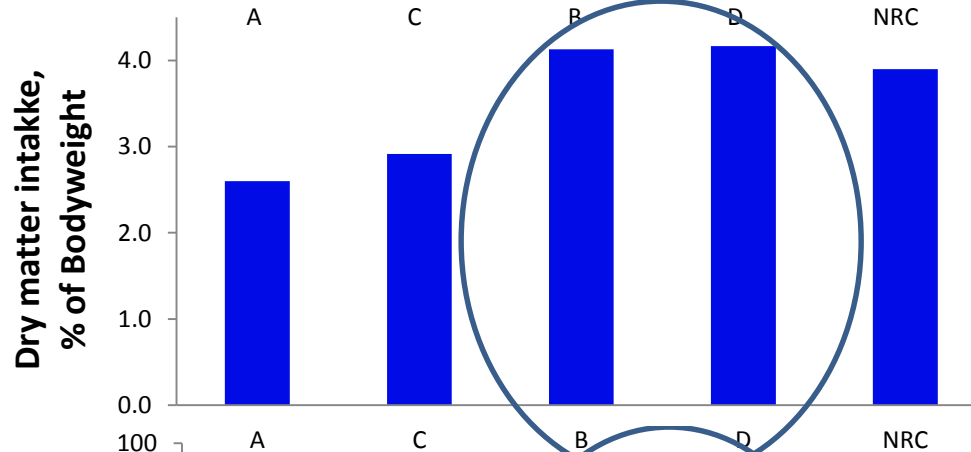
4+ months of non-productive maintenance feeding in annual production, very little in accelerated production over a given year

Energy nutrition during peak lactation (day 30) in 4 accelerated flocks during the winter rearing period

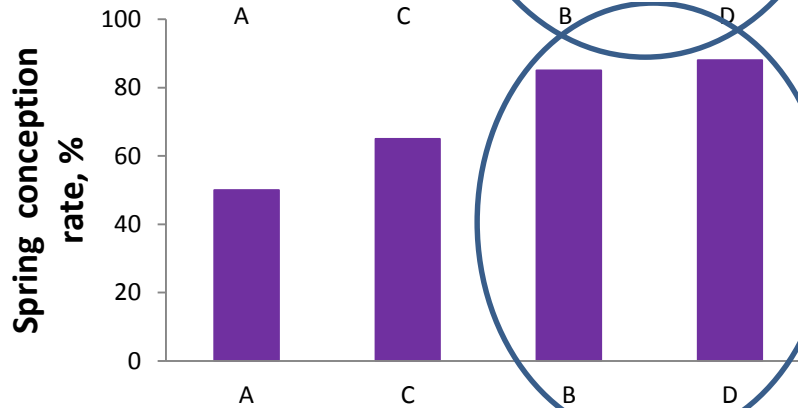
Dietary energy concentration



Feed intake



Spring conception rate



Forage quality as measured by fiber digestibility differed markedly between high and low out of season conception farms

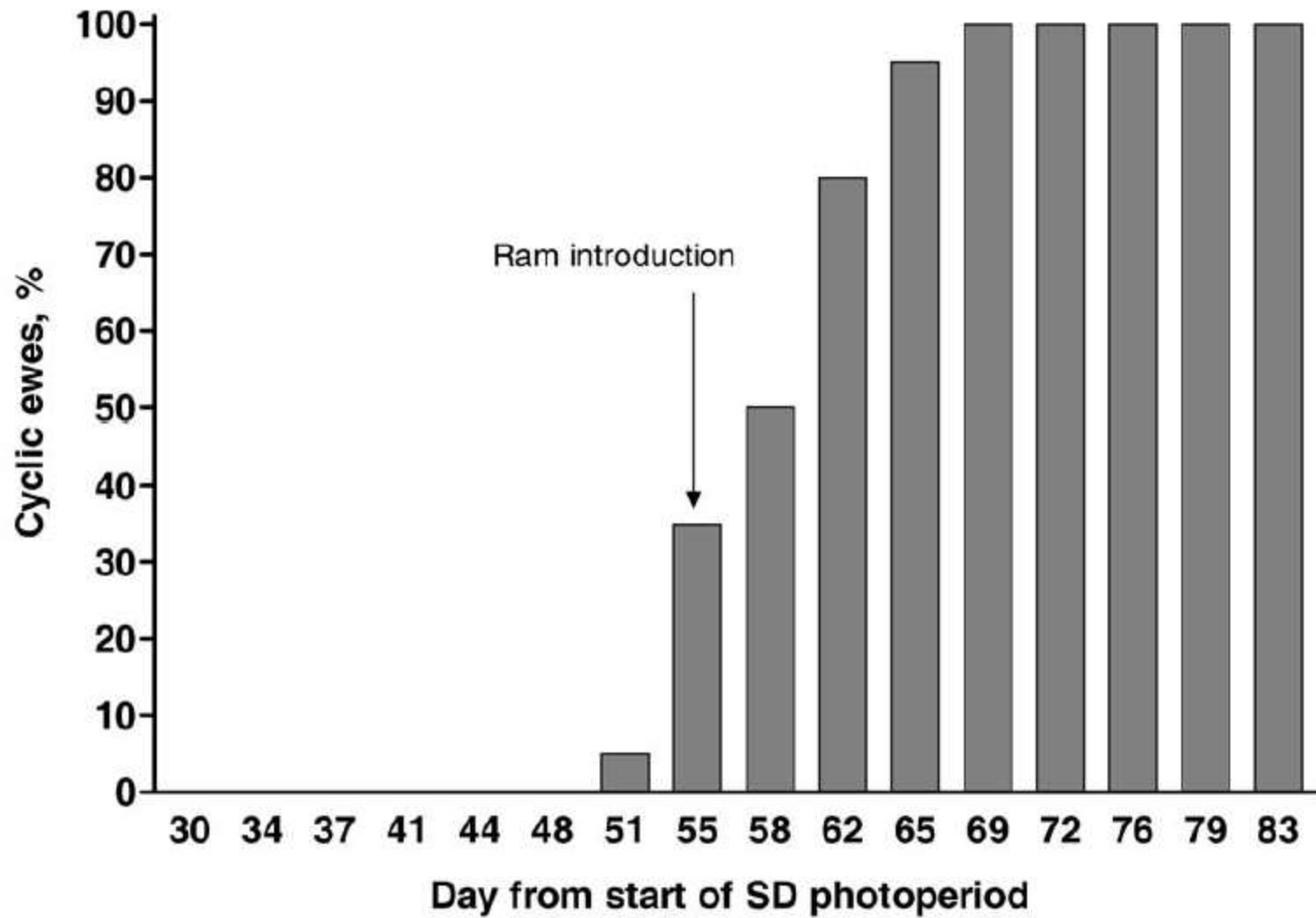
Nutritional management of accelerated lambing

- Critical aspect yet has received little study
- Important windows (?):
 - ✓ Energy intake during lactation
 - ✓ Energy intake before the breeding season
 - ✓ Energy intake during the breeding season
- Field observations indicate a link between energy intake during lactation and subsequent spring breeding success. Intake may be limited by:
 - ✓ Diet energy density
 - ✓ Mass fed
 - ✓ Neutral detergent fiber (NDF) content and digestibility
 - ✓ Starch content

Extended day protocol:

- 60 days of 24 hrs light followed by 60 days of ambient lighting condition - turn in rams.
- 100 lux (10 FC) at ewe eye level (3.5 FC minimum)
- How I do it:
 - ✓ Bring ewes in from winter pasture on Jan 5.
 - ✓ Set lights to come on at dusk and off at dawn starting Jan 5.
 - ✓ Ewes lamb Jan 25 - Feb 20
 - ✓ Turn lights off on March 5, natural light thereafter
 - ✓ Put in rams May 5.





Extended day: under evaluation...

Field application in 2008 with 300 ewe flock:

- No change of spring conception rate in aseasonal ewes (Finn x Dorset x Ile de France, n=140-182).
 - ✓ 92% natural light (3 yr average [2005-7], n=132-186)
 - ✓ 94% extended day (2008, n=182)
- Huge change in spring conception rate in seasonal ewes (purebred and $\frac{3}{4}$ suffolk ewes,).
 - ✓ 0% natural light (2 yr average [2006-7], n=13-17)
 - ✓ 92% extended day (2008, n=16)

Hormonal therapeutics to insure successful out of season breeding and to tighten birth management:

- Progesterone CIDRs
 - ✓ FDA approved for use in sheep
 - ✓ 40-85% conception in spring
- Melengestrol acetate (MGA) plus gonadotropin
 - ✓ Not approved for sheep
 - ✓ Ceiling of $\approx 70\%$ conception in spring as reported in commercial production in Canada

Male fertility:

- Male fertility and libido have a huge impact on the success of out of season breeding programs.
- ***How can you ensure that males are not limiting conception?***

Ensuring male fertility:

- Feed males 1.5X maintenance for 3-4 weeks pre-breeding
- Perform breeding soundness exam
 - ✓ Documents fertility but are all fertile males active breeders (have high libido)?
- Light priming: works well on all genotypes
 - ✓ 120 day protocol: 30 d (16h L/ 8h); 30 d (8h D/ 16 L), 30 d (16h L/ 8h); 30 d (8h D/ 16 L) then introduce rams/bucks.
 - ✓ Ensures high libido even in seasonal breeding rams/bucks



Accelerated: reduced birth interval with multiple birth periods

- **Pros**

- ✓ Year-round supply: create new and build existing markets
- ✓ Improve cash flow
- ✓ Reduced market risk
- ✓ Greater net income (per ewe, lamb, labor unit, enterprise)
- ✓ Spreads labor out more evenly over the year

- **Cons**

- ✓ Higher level of management: nutrition, reproduction, health
- ✓ Requires a winter lambing period and facilities
- ✓ Steady labor requirement
- ✓ Requires higher quality forage (grazing or machine harvested)

Factors to consider in choosing accelerated production:

1. Land value: accelerated production systems are well suited for higher value, more productive land.
2. Genetics: aseasonal genetics are key, light control protocols reduce risk.
3. Can you buy or produce high quality forages?
4. Investment: accelerated production requires a greater initial investment (indoor lambing facility, feeding infrastructure) however the higher productivity creates lower fixed cost/lamb produced when depreciated over time.
5. Labor: accelerated production evens labor over the year but is a *steady* requirement.
6. Management benchmarks: If your annual program cannot attain >1.3 lambs marketed/ewe, it is unlikely that accelerated production will be a profitable option.



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STAR system facts:

- Five, 73 day periods in one year
- Ewes can lamb at 7.2 mo intervals
- If ewes do not breed at first chance (7.2 mo) they can be rebred 72 days later (9.5 mo)
- 30 day lambing period
- 30 day breeding period
- 43-73 day lactation period
- Lambs are 43-73 days old at weaning

Ram “male” effect:

- Induces estrus in females “on the edge” of anestrus; synchronizes females that are naturally cycling
- 1 vasectomized male: 50 females
- Isolate females from males 30 days prior to exposure
- Introduce vasectomized males and remove 14 days later, females will exhibit estrus in two modes either 17-18 or 22-23 days following initial male exposure.
- *Does it work on females that are deep in anestrus?*
- ***IT IS A VERY GOOD SYNCHRONIZATION TOOL!***

Consequences of poor out-of-season breeding success:

Conception Rates					Number of ewes lambing (300 Ewe Flock)							
Program	Conception	Breeding Season			Year 1			Year 2			Total 2 years	Relative to Annual
		Jan	May	Sept	Jan	May	Sept	Jan	May	Sept		
Accelerated	Excellent	0.93	0.92	0.90	140	148	137	151	137	147	859	1.54
Accelerated	Average	0.93	0.90	0.67	140	144	104	182	106	130	806	1.44
Accelerated	Poor	0.93	0.90	0.35	140	144	54	228	64	82	714	1.28
Accelerated	Poor adjusted	0.93	0.90	0.35	140	144	54	150	135	58	681	1.22
Annual	Excellent			0.93			279			279	558	1.00

CEPOQ-photoperiod control

- Nearly continuous production (4 groups)
- Alternating 4 month light intervals (16L/8D; 8D/16L)
- Overlapping 8 month system
- Optimizes ovulation rate and conception
- Limited grazing, mostly confinement
- Maximum production (3.78 lambs per/ewe/year!!)

Cameron et al. 2010; Journal of Animal Science 88: 3280-3290

Accelerated lambing-historical perspective

- Extension of efforts started in the 1960's to try to increase the efficiency of production
- Efforts in the U.K., Canada and U.S.A. led to a number of systems designed to decrease lambing interval using various breed combinations
- The Polypay breed evolved out of these efforts
- Brian Magee and Doug Hogue from Cornell studied a variety of systems and fixed on the STAR system in the early 80's.