# Impacts of animal science research on U.S. sheep production and predictions for the future

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# Background

- How many people in this room turned down this assignment before Dave Thomas found me??

- You were very wise!!
- Probably got some research done this Spring.

# Disclaimer

- Prepared for the Centennial of ASAS.
- Emphasis on U.S. science that was reported in JAS.
- Apologies to overseas scientists and anyone else whose work was overlooked.

# Materials and Methods

- Contacted current and past colleagues (n=43) to obtain their perspectives on what research had produced the greatest impact.
- Obtained statistics from National Agricultural Statistics Service, USDA.
- Searched the literature.

# Results

- **Respondents: n=21 (49%). Generated a collective opinion.**
- **Searched JAS from Jan. 1910 to April 2008 using the search criteria: key words; sheep, wool, lamb, ewe, ram, ovine, fleece; any of these words in Title or Abstract.**
- **3917 titles listed (most *bona fide* sheep articles)**

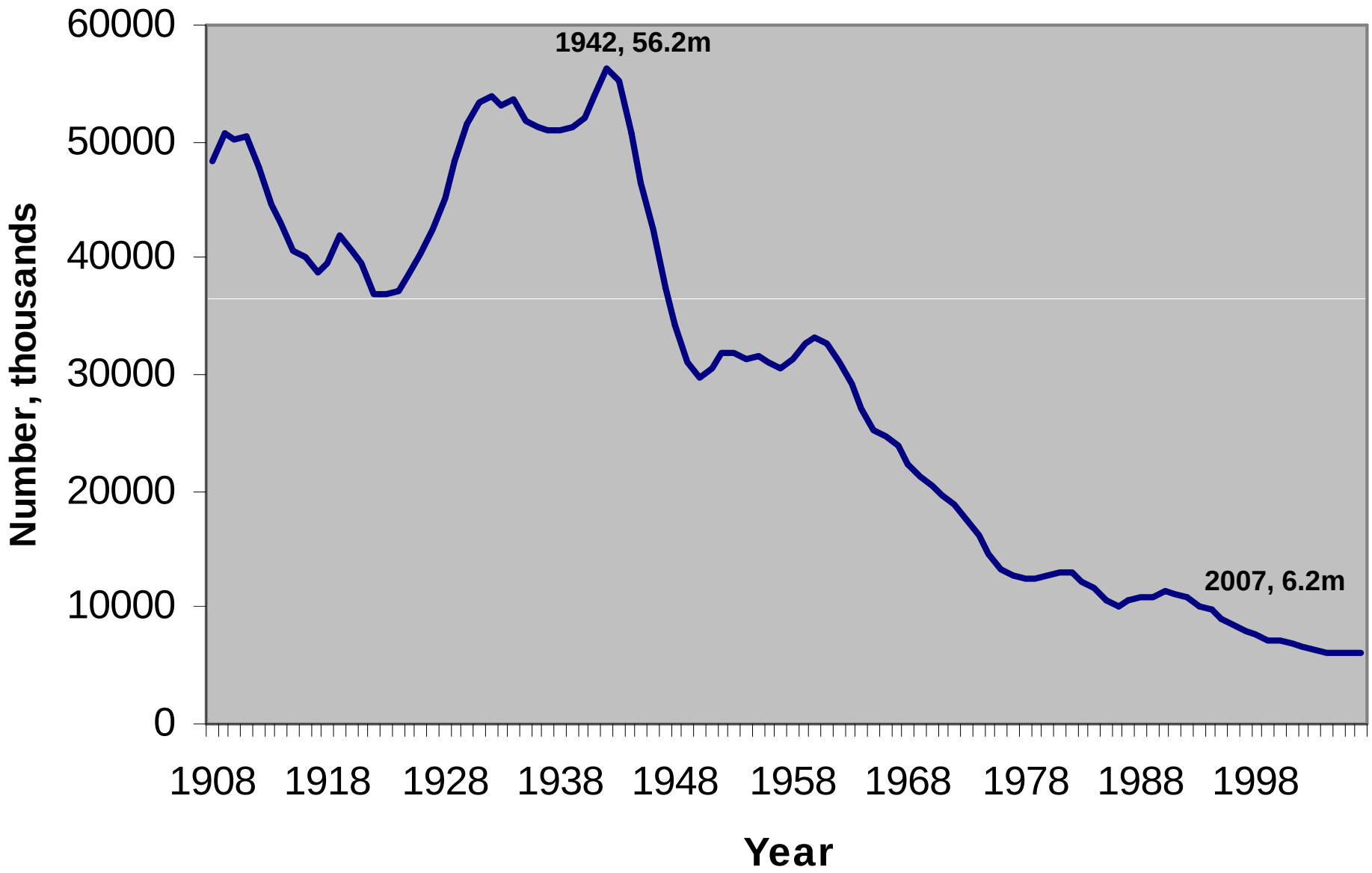
# Manuscript

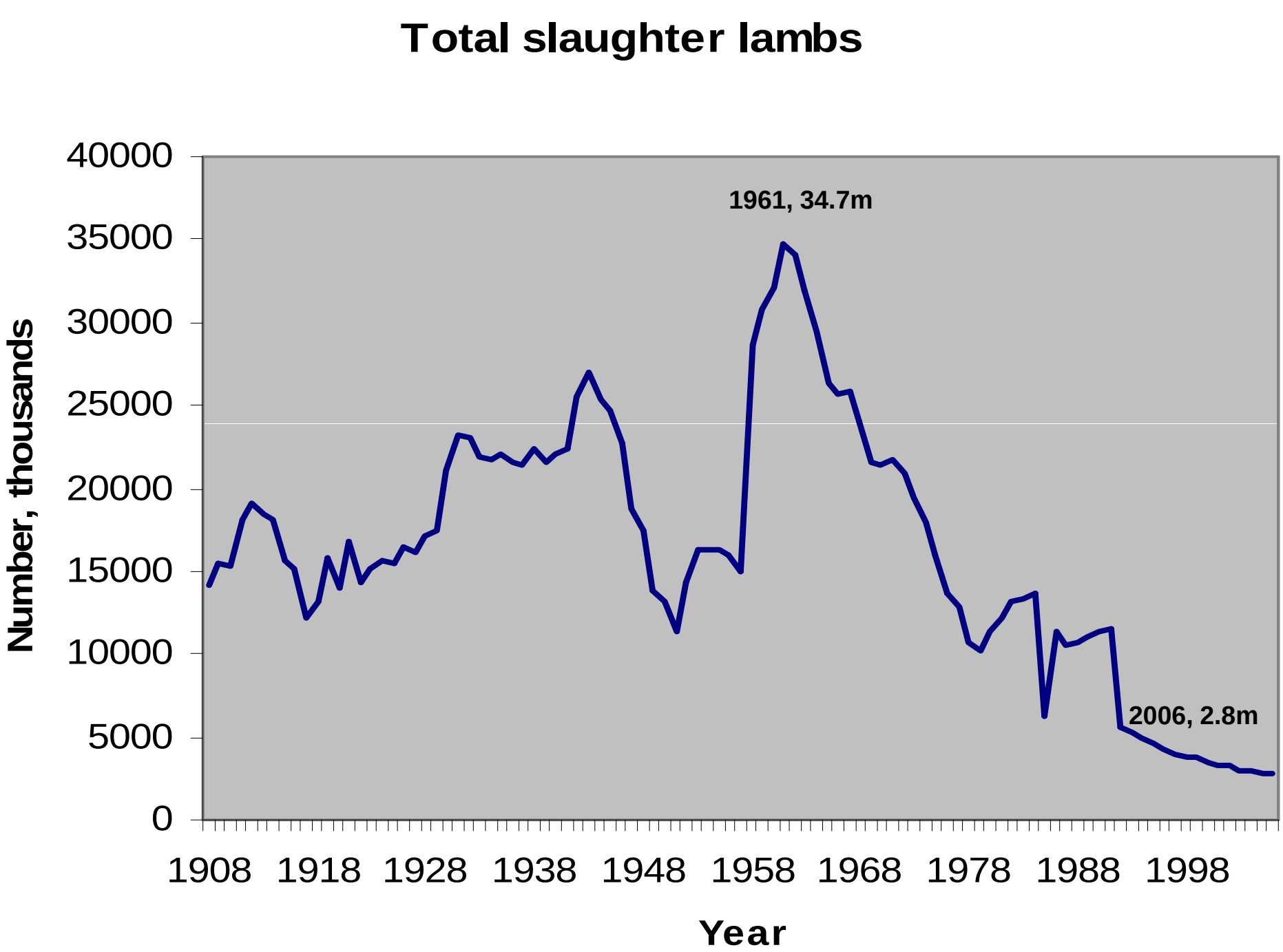
- Submitted May 1, 2008.
- Reviews returned June 5, 2008.
- Have 6 weeks to respond to review.
- Biggest problem, too long (probably like this presentation).
- Will be available on-line as a Special Topics, Perspectives paper.

# Presentation - 30 minutes

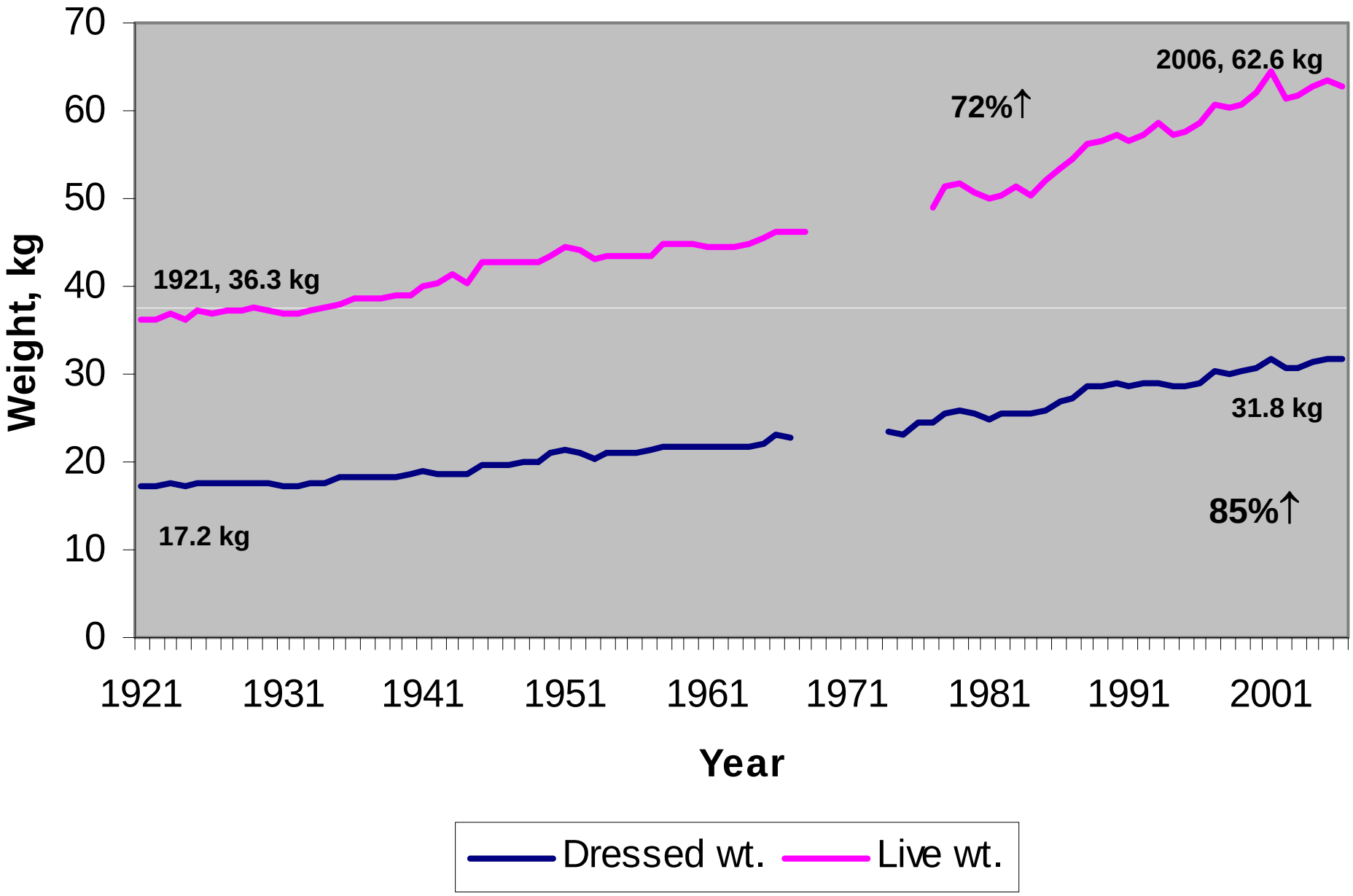
# U.S. sheep industry trends

# Total sheep and lambs, 1908 to 2007

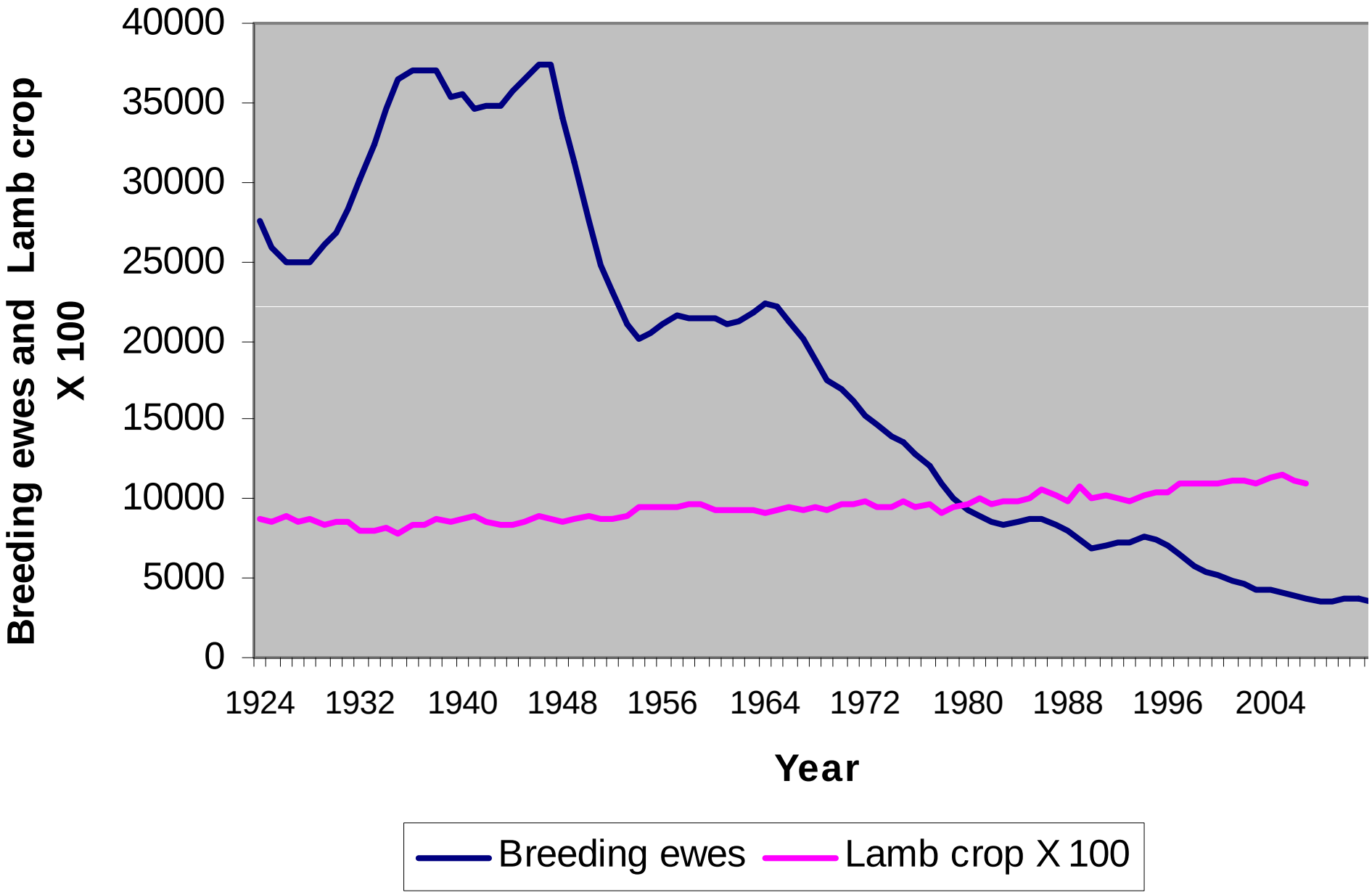



Total slaughter lambs
Number, thousands
40000
35000
30000
25000
20000
15000
10000
5000
0
1908
1918
1928
1938
1948
1958
1968
1978
1988
1998
Year
1961, 34.7m
2006, 2.8m

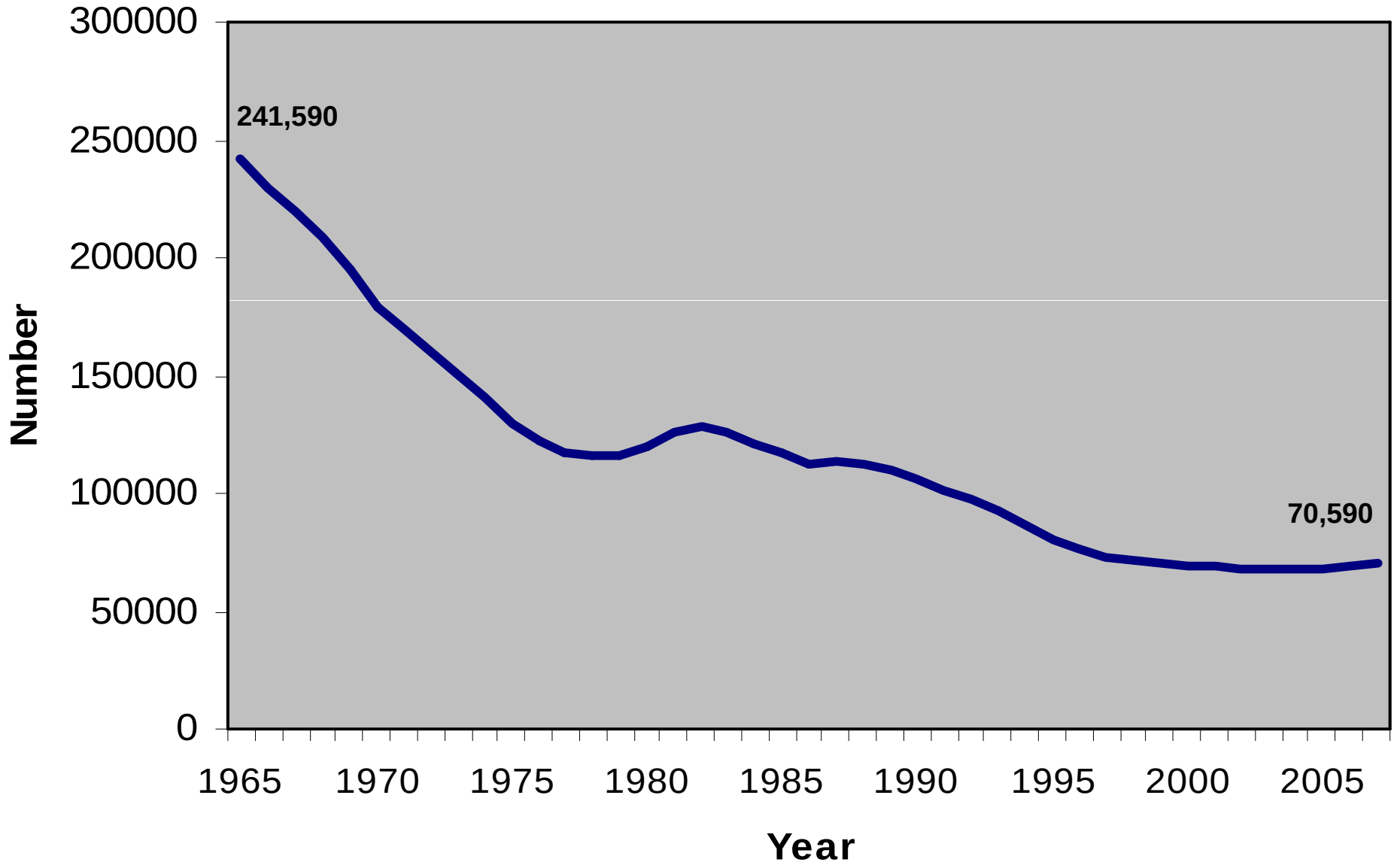
# Live and dressed slaughter lamb weights

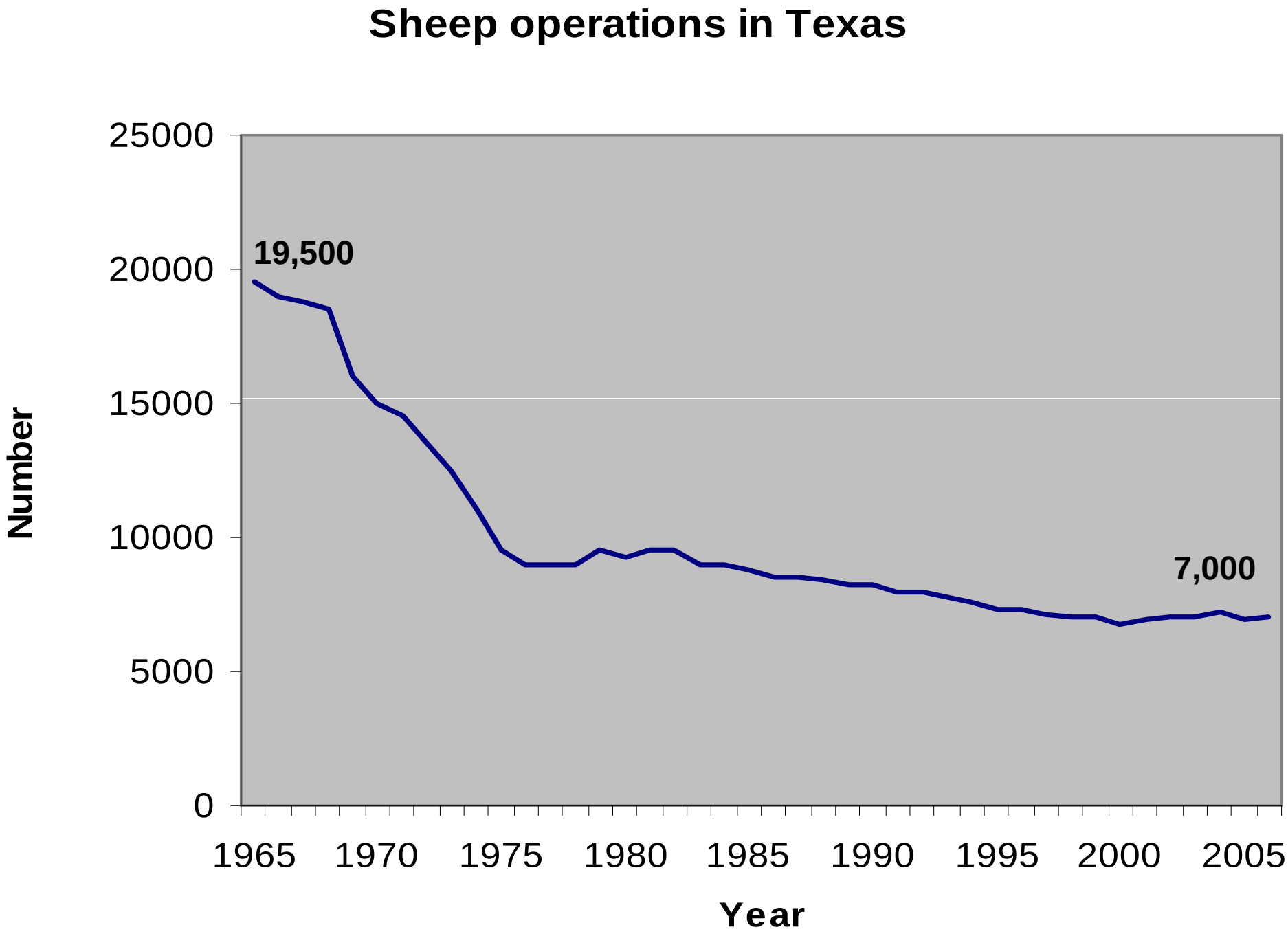


# Breeding ewes (1+ yr and older) and lamb crop

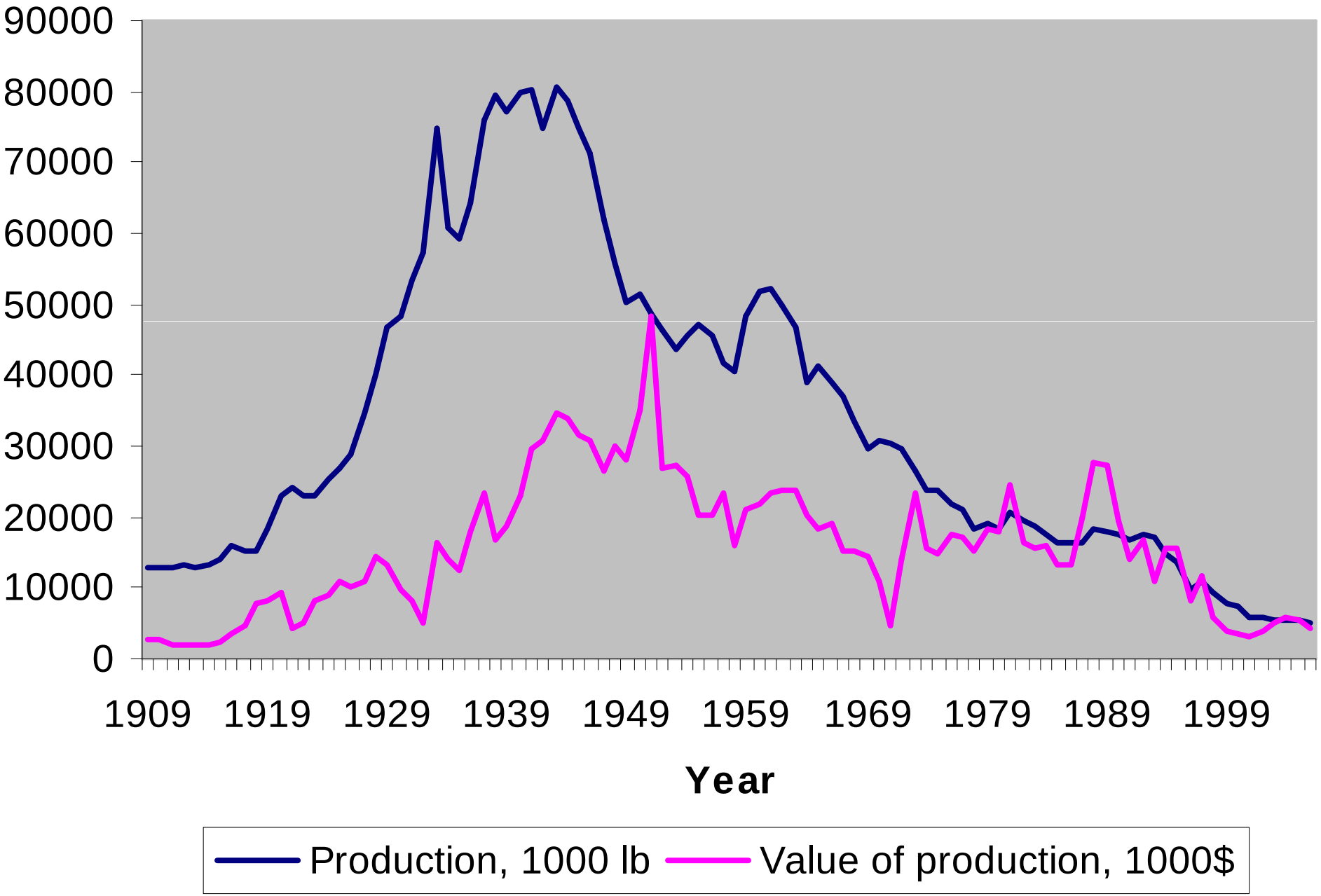


# Number of operations with sheep

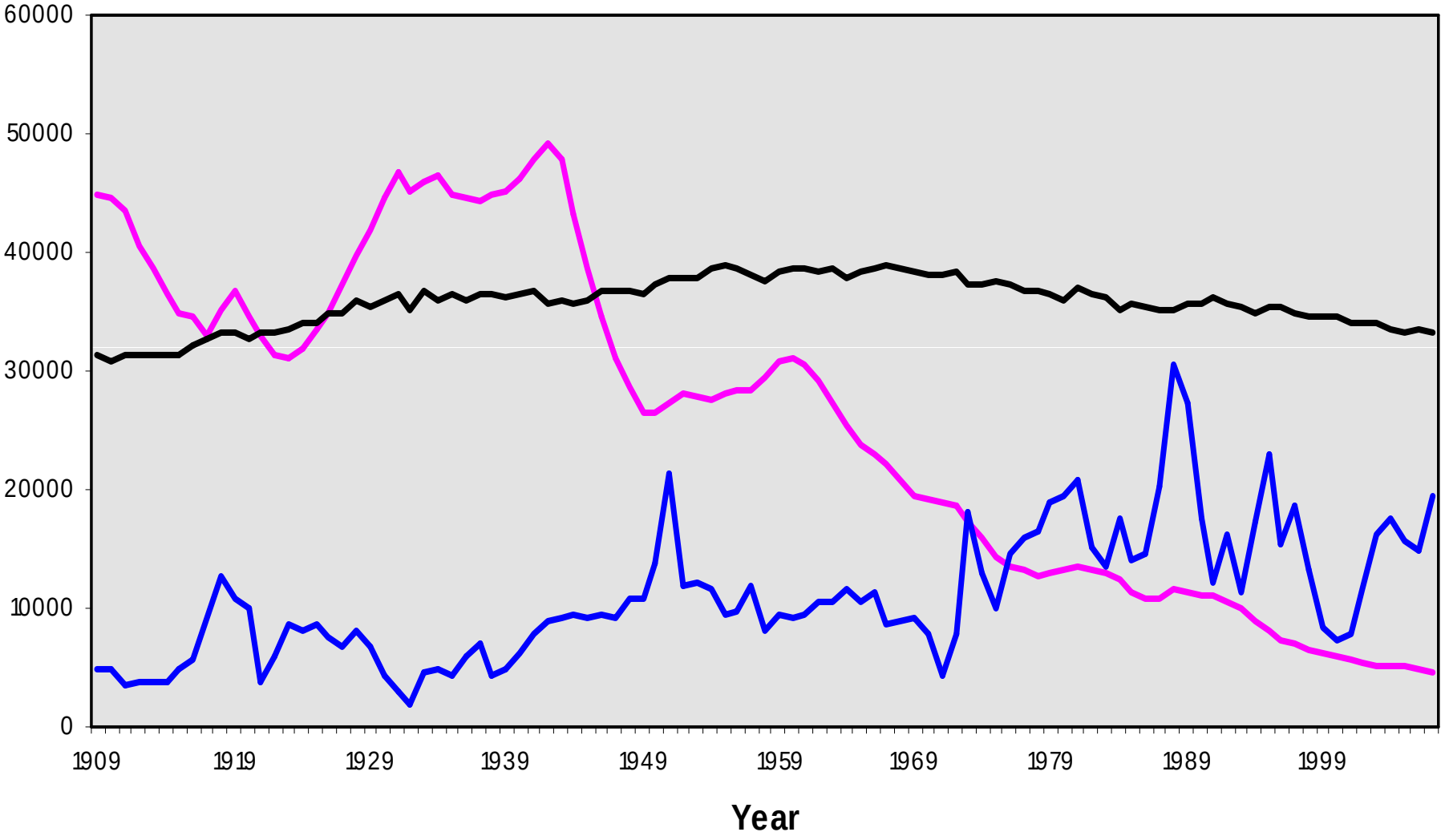



Sheep operations in Texas
Number
25000
20000
15000
10000
5000
0
19,500
7,000
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

# Wool production and value, 1909 to 2007



# Wool production and value, 1909 to 2007

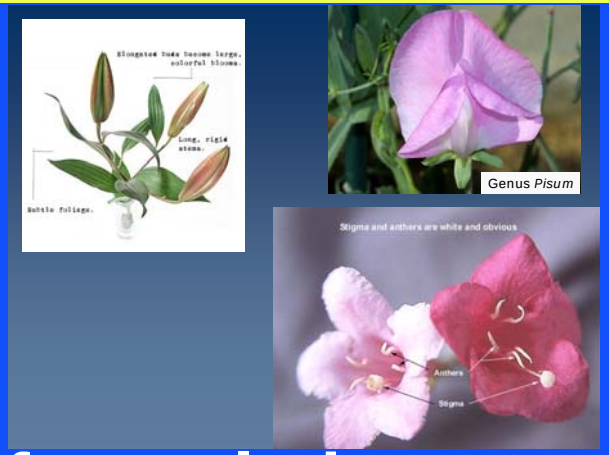


# Genetics - quantitative and population

- Estimates of genetic parameters and genetic merit of individuals.
- Breed improvement.
- Breed development.
- Evaluation of breeds and crosses.
- Analysis of Quantitative Trait Loci.

# Animal breeding

- **Foundation …Mendel (1865)**




- **Wright (1921)……principles of population genetics established with guinea pigs.**
- **Lush and students applied principles to farm animals.**
- **Animal Breeding Plans, 1937**

# Animal breeding

- Lush's concepts espoused by:
- Hazel, Terrill, Shelton (1940's and 1950's).
- Developed breeding objectives.
- Genetic improvement programs that included selection indexes.
- New breeds (to replace *ad hoc* crosses being made by producers).

# Animal breeding

- Genetic improvement programs required accurate estimates of :
- Phenotypic variation
- Heritability
- Repeatability
- Genetic and phenotypic correlations
- Values for economically important traits

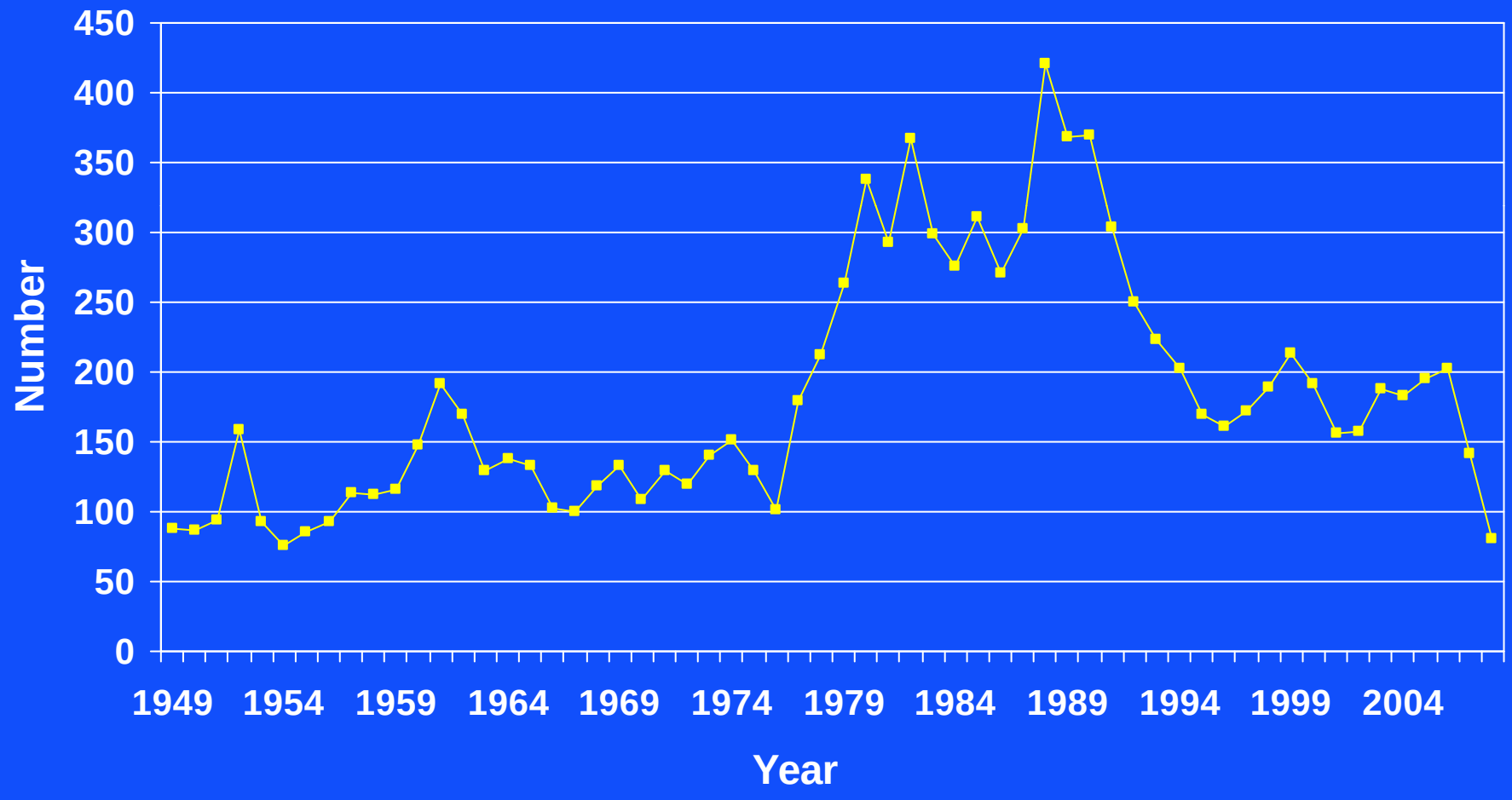
# Genetic parameters

- Reviews by Fogarty (1995) and Safari and Fogarty (2003).
- LAMBPLAN
- MERINOSELECT
- NSIP, USA implemented in 1987.
- Provided genetic evaluations for 11 breeds in 2007 (Notter).

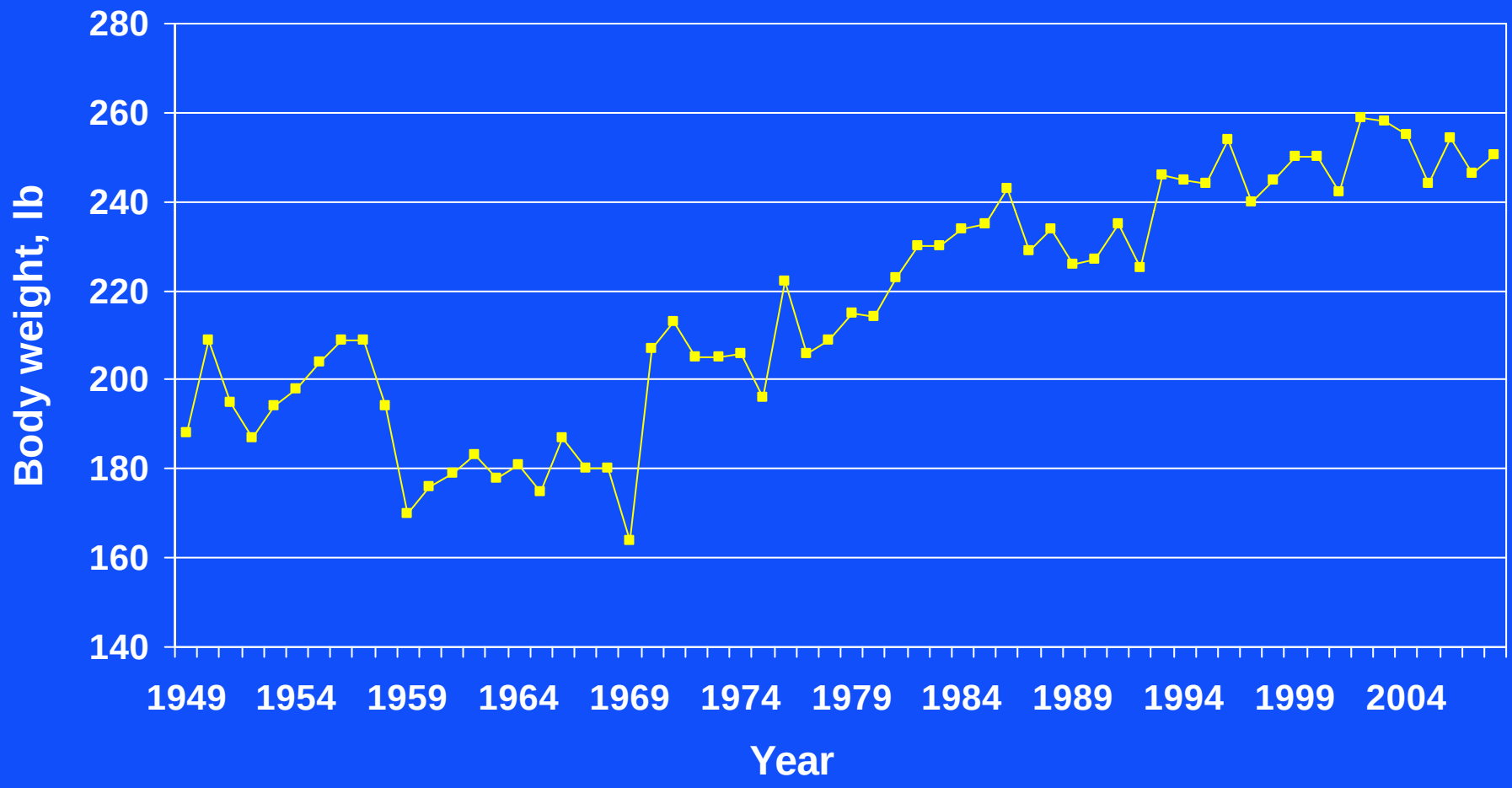
# Ram evaluation

- Central Ram Performance Tests.
- Gain and wool evaluation, ~140 d: ND-SD, MT, TX, WY.
- Gain tests only, ~60 d: IA, IL, IN, OH, OK, PA, VA, WI, WV, ….++??

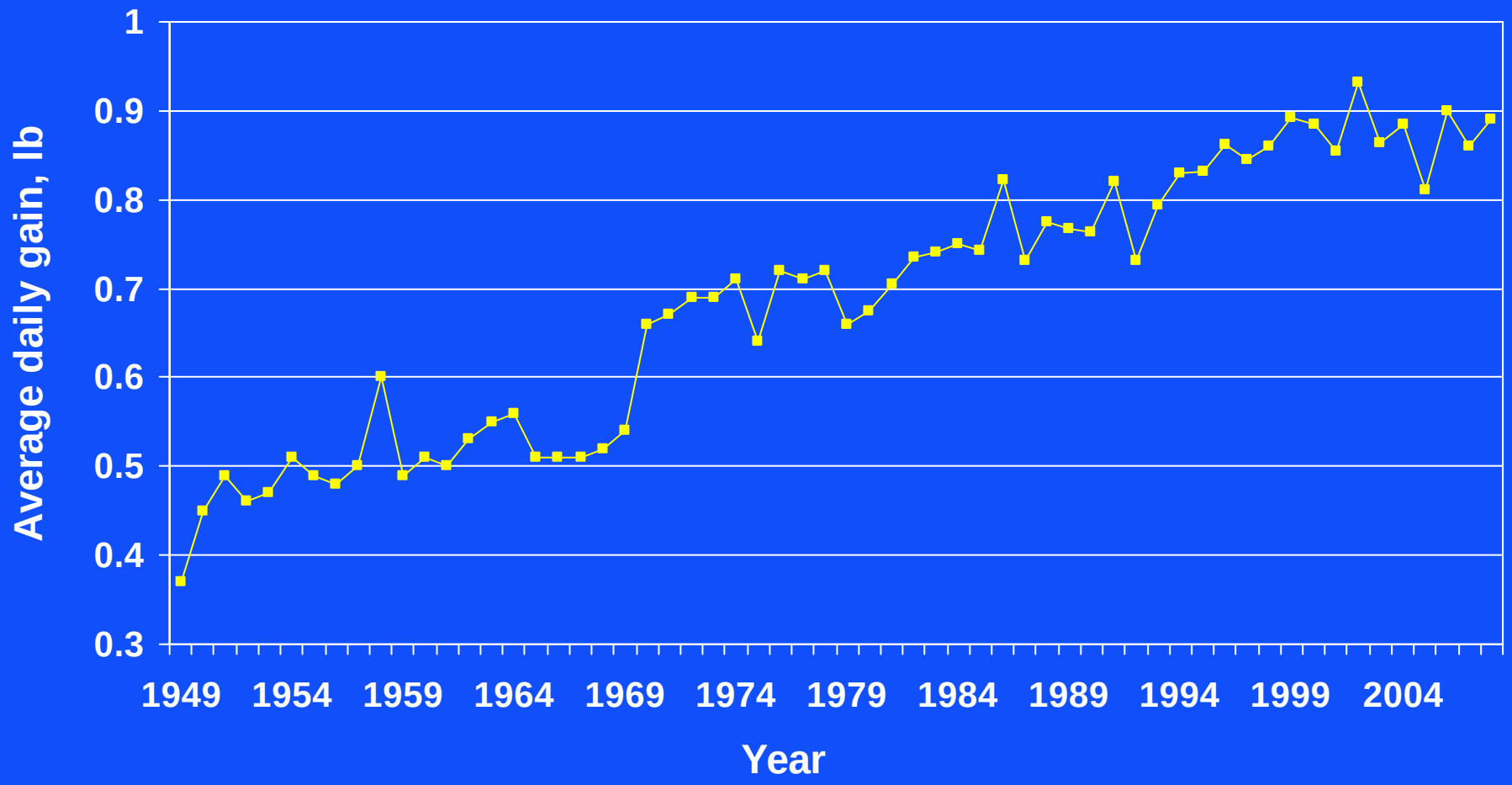
# Sonora Ram Test, 1949 to 2008



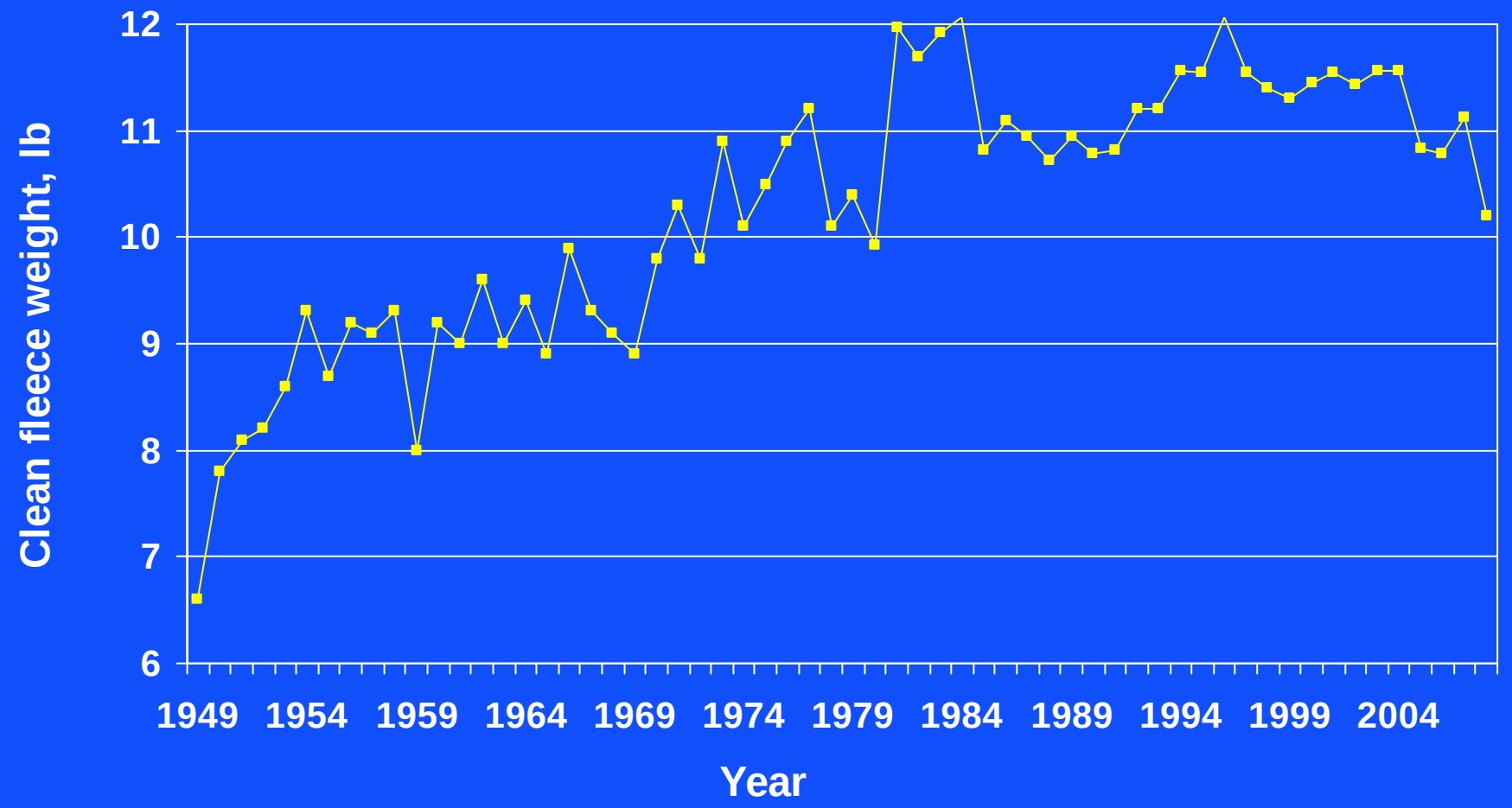
# Final Body Weight, 1949 to 2008



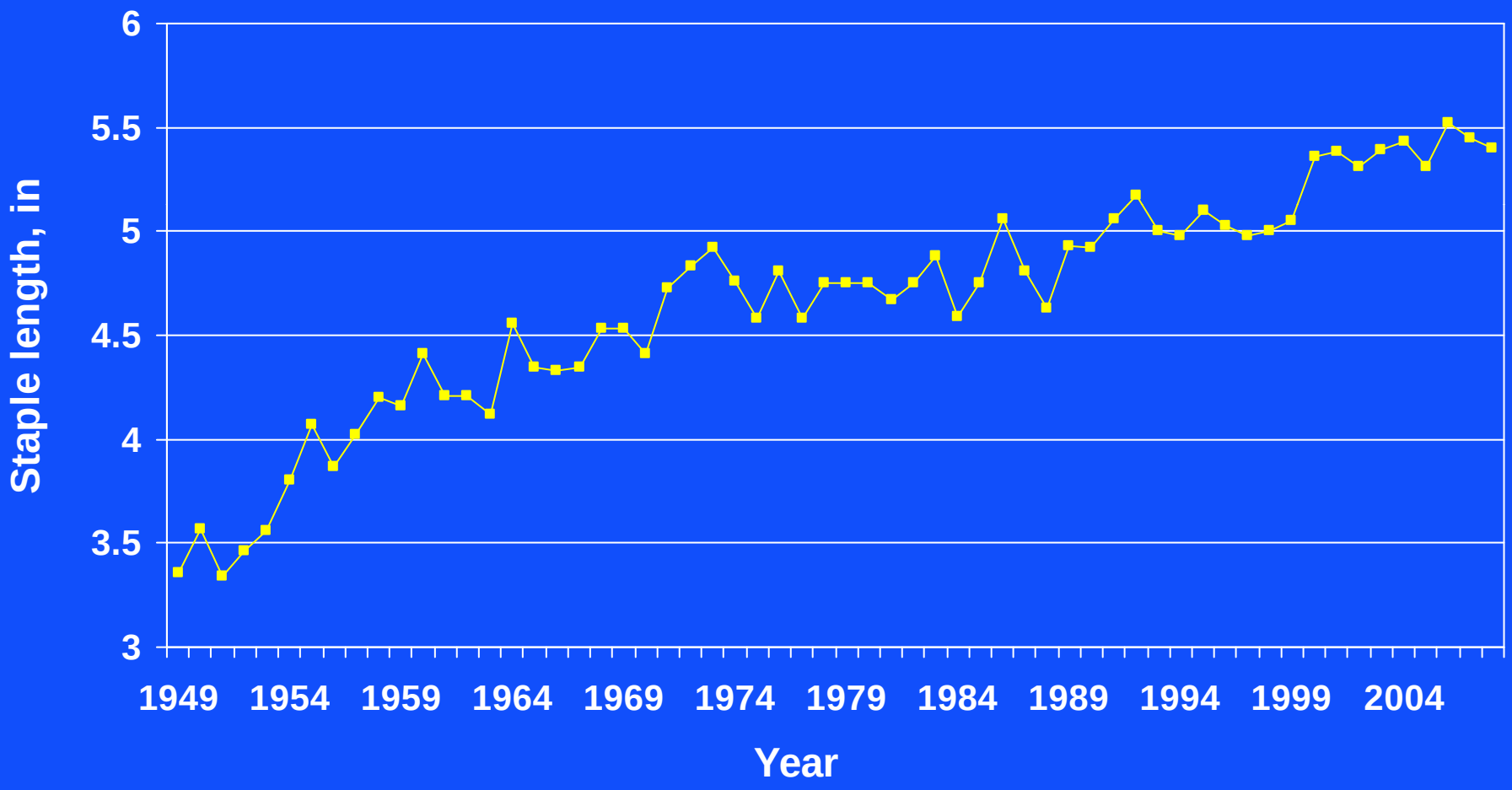
# Average Daily Gain, 1949 to 2008



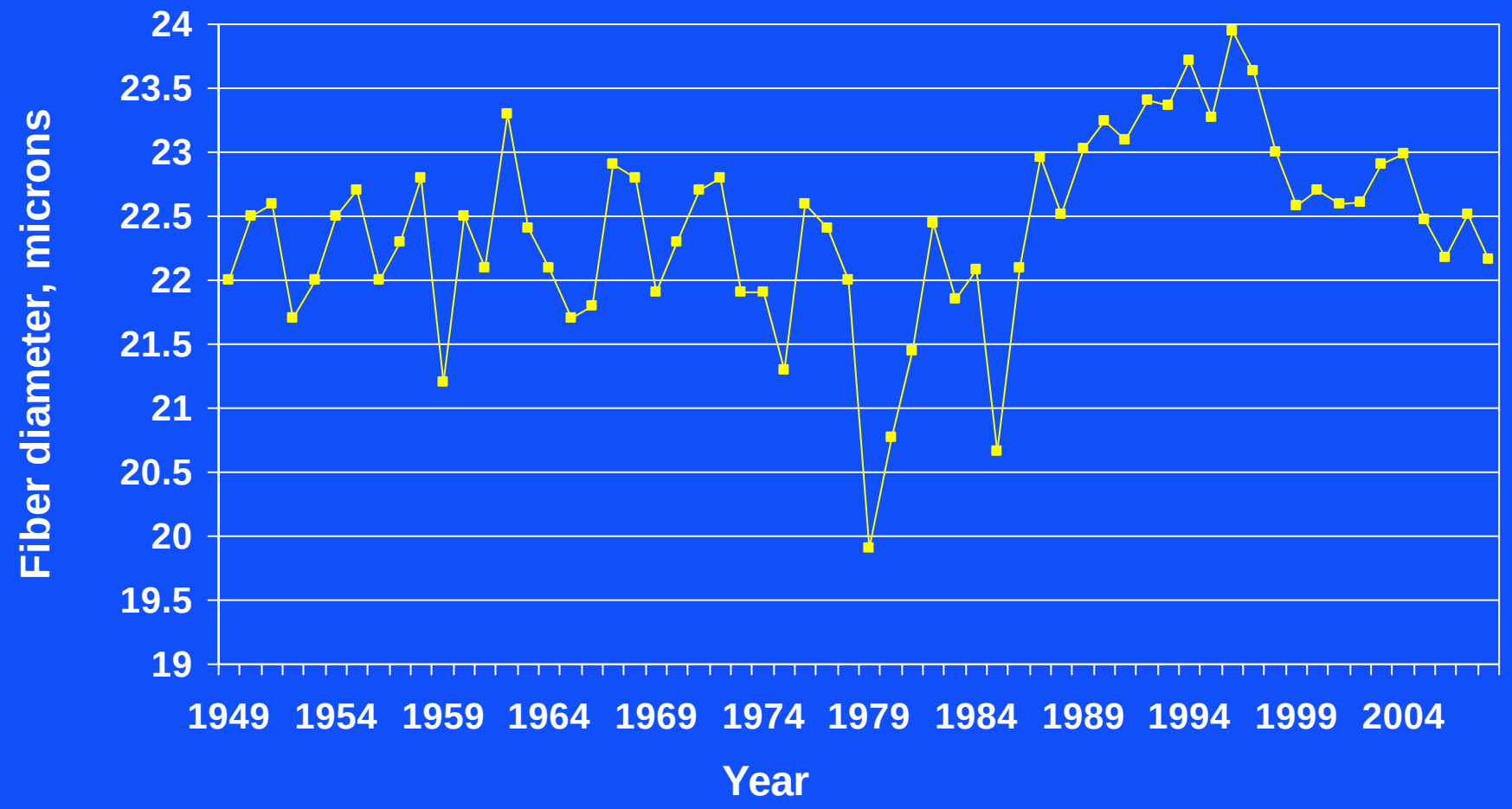
# Clean Fleece Weight, 1949 to 2008



# Staple Length, 1949 to 2008



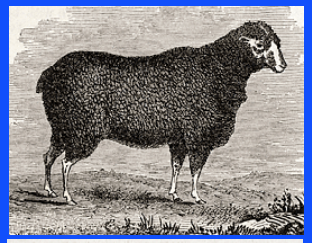
# Fiber Diameter, mid-side, 1949 to 2008

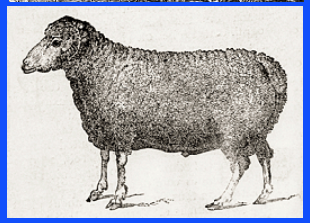


# Ram evaluation

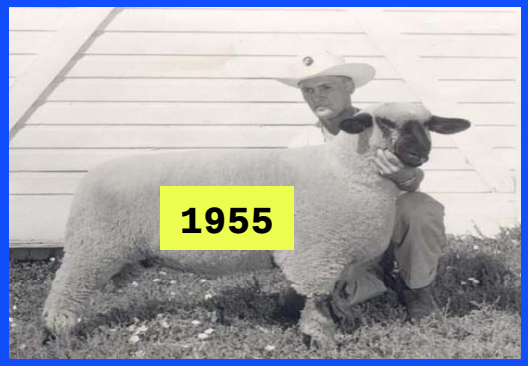
- Efficiency of gain ????
- West Virginia measures **Residual Feed Intake** on gain-tested rams.
- In 2006, RFI ranged from 57 (least efficient ram) to –33 (most efficient ram) kg during the 63-d test.
- With this much variability in a moderately heritable trait, progress should be possible.

# Breed improvement





# Breed improvement




Courtesy Suffolk Sheep Society

Courtesy Donner Trail Ranch

# Sheep breeding

- Terrill's 50-yr review (1958; 336 references)
- Columbia (Lincoln x Rambouillet) 1912, USDA.
- Panama (Rambouillet x Lincoln) private group.
- Romeldale (Romney x Rambouillet) A.T. Spencer

# U.S. sheep breeds

- **Columbia (Lincoln x Rambouillet) 1912, USDA**
- **Large, dual purpose, range sheep, medium wool**

Courtesy South Dakota State University

Courtesy Encyclopedia Britannica

# U.S. sheep breeds

- **Panama (Rambouillet x Lincoln)**
- **Dual purpose, medium sized, range sheep, medium wool**

Courtesy Dave Casebolt, University of Idaho

# U.S. sheep breeds

- Romeldale.  Initial crosses made by A.T. Spencer in 1915 (Romney x Rambouillet).
- 1960's, G. Eidman kept some multicolored lambs from his purebred (white) Romeldale flock, selected for many years
- Produced the

  California Variegated Mutant

# U.S. sheep breeds

- **Targhee, 1928, USDA (Rambouillet x Lincoln-Rambouillet, Corriedale-Lincoln-Rambouillet, Corriedale, Columbia).**
- **Dual purpose, range sheep, fine/medium wool.**

Courtesy of Bob Padula

provided by Jack McRae

# U.S. sheep breeds

- **Montadale, 1940's, E. H. Mattingley (Columbia x Cheviot)**
- **Dual purpose, medium size, low maintenance, medium wool**


**Courtesy Montadale Sheep Breeders Association**

# U.S. sheep breeds

- **Katahdin, 1950's, M. Piel in Maine. Crosses of British meat breeds (esp. Suffolk) with African hair sheep (esp. St. Croix imported from the Caribbean) and later Wiltshire Horn.**
- **Medium sized, prolific, parasite resistant, hair sheep.**

Provided by Katahdin Hair Sheep International

# U.S. sheep breeds

- **Polypay, 1975, USDA-Hulet et al. (and independent breeders; 4-breed composite with Targhee, Rambouillet, Dorset, Finnsheep).**
- **Dual purpose, medium sized, prolific, extended breeding season, medium wool.**

Courtesy of the Polypay Sheep Association

Courtesy of the University of Kentucky

# U.S. sheep breeds

- Royal White, 21st Century. Bill Hoag (Dorper x St. Croix)
- Medium sized, low maintenance, hair sheep.

Courtesy Bill Hoag

# Breed and crossbreed evaluations

- Too numerous to list.
- Immense impact on the sheep industry.

- **Objectives:**
- 1. Determine appropriate roles (e.g., maternal, paternal, general purpose) of the numerous breeds and crossbreeds.
- 2. Establish productivity and quality attributes in different production systems.

# Breed and crossbreed evaluations

- Suffolk is the dominant terminal sire breed.
- Finnsheep has had major and lasting influence.
- USDA-Clay Center, 5-sire breed evaluation-concluded use of Romanov crossbred ewes would improve commercial lamb production.
- Dorper currently receiving a lot of attention from researchers and breeders….easy care, hair/wool shedding sheep.
- Some sire evaluations completed. Maternal evaluation in extensive production system in progress.

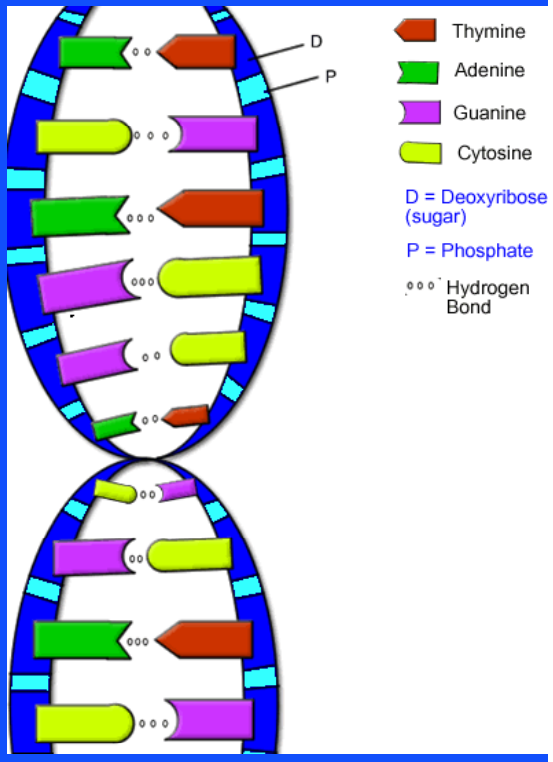
# Breed and crossbreed evaluations

- In the past 30 yr, most crossbreeding research has been concerned with increasing lamb production.
- One multi-institution study (Snowder et al., 1997) was concerned with increasing wool production using Merinos. Little impact on the U.S. sheep industry to date.
- In contrast, studies involving the East Friesian (Thomas et al., 2004) for milk and cheese production are having an impact in the Upper Midwest and New England.

# Molecular genetics

- This field promises to have the greatest impact on sheep production (and a lot of other things!!) in future.

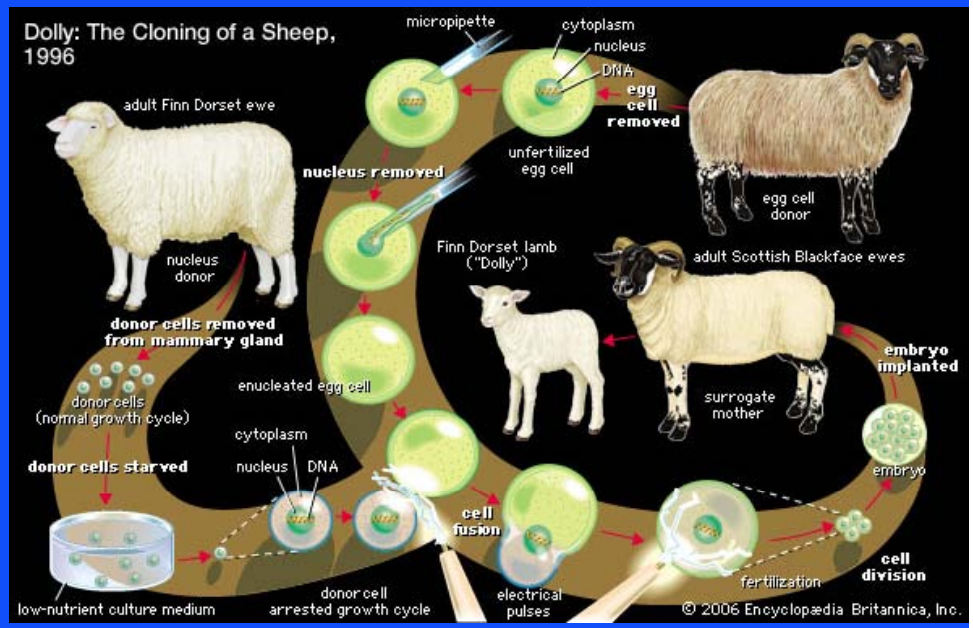
- Recognized more than a decade ago that genetic marker technologies could be applied to livestock selection programs:
- Marker-assisted selection.
- Parentage identification.
- Gene introgression.



# Molecular genetics

- Perhaps the most publicly recognizable event in this field involving sheep was the cloning of Dolly (7/5/1996 to 2/14/2003).

- The first animal to be cloned from an adult somatic cell using the process of nuclear transfer.



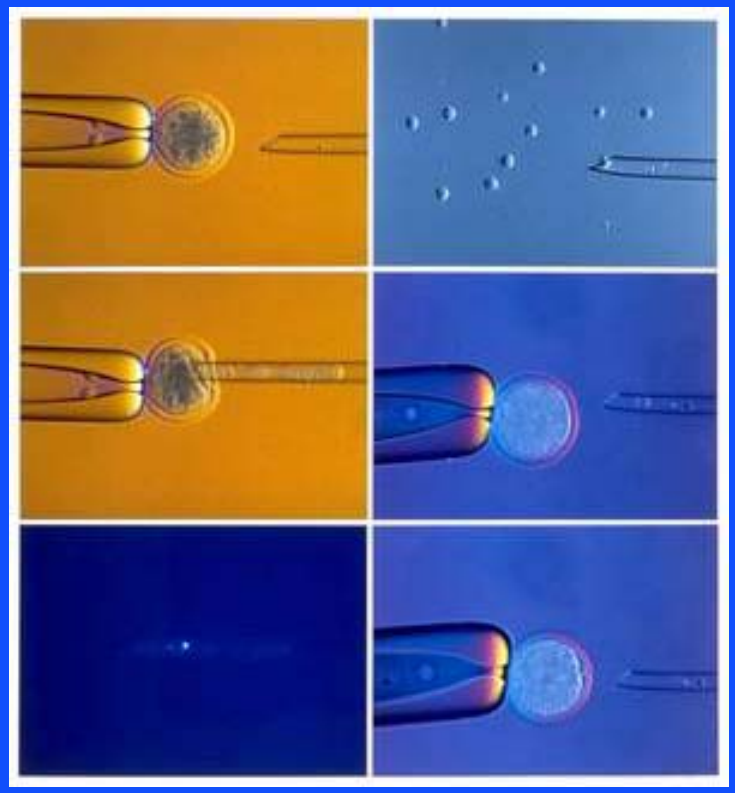
# Why was Dolly the sheep named Dolly?

# Molecular genetics

- Next major milestone occurred in November, 2006 when the International Sheep Genomics Consortium released a virtual map of the sheep genome (using information from the cow, dog, and human genomes).
- http://www.marc.usda.gov/genome/sheep/sheep.html
- This resource will improve the efficiency of sheep research into gene function.

# Molecular genetics

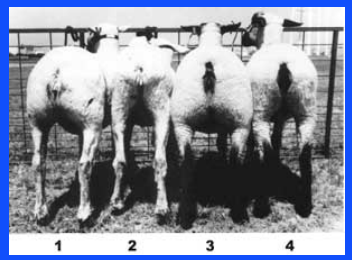
- **Transgenesis approaches are being investigated to enhance:**
- **Prolificacy**
- **Reproductive performance**
- **Feed utilization**
- **Growth rate**
- **Carcass composition**
- **Milk production**
- **Resistance to disease**
- **Wool properties and growth**



# Molecular genetics

- **Major achievements to date:**
- **DNA test for Spider lamb syndrome carriers (Cockett et al., 1999).**

- **Callipyge gene (Freking et al., 1998).**




- **Booroola gene (Wilson et al., 2001; McNatty et al., 2007).**

- **DNA test for scrapie susceptibility (Baylis and Goldmann, 2004).**

- **Woodlands gene (Feary et al., 2007)**

# Reproduction

- Reproductive efficiency
- “Weight of lamb weaned or marketed per ewe exposed”.
- Is THE major factor affecting profitability of most commercial sheep operations.
- Therefore much research in this area.

# Reproduction

- **Main approaches have been:**
- **Increase ovulation rate.**
- **Reduce embryo wastage.**
- **Reduce lamb losses.**
- **Shortcut: Switch to more prolific breed.**

# Reproduction technology

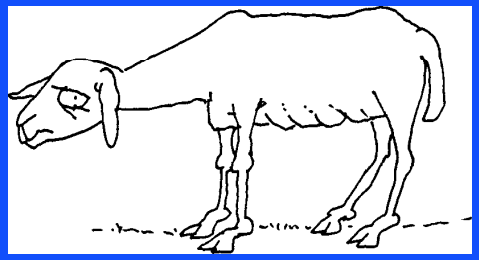
- Artificial insemination.
- Not as important in sheep as in other species (e.g., dairy cattle).
- Laparoscopic AI with frozen semen has permitted more rapid dissemination of new breeds in the U.S.

# Reproduction technology

- Ultrasound for detection of pregnancy (Lindahl, 1966).
- Detection of open, singles and multiples has permitted differential nutritional management.

# Reproduction- Prenatal losses

- ~30% of all fertilized eggs, most within 18 d of conception.
- Reasons not always obvious.
- Viability of fertilized egg has been shown to be sensitive to:
  - Poor nutrition
  - Overfeeding
  - Toxins
  - High temperatures
  - Other stressors
  - Certain diseases
  - Breed



# Reproduction

- **Perinatal losses**
- **Most occur within 3 d of parturition, ~12% of all live births in the U.S.**
- **Causes:**
- **Ringwomb**
- **Malpresentations**
- **Malformations of the lamb**
- **Birth injuries**
- **Infections**
- **Starvation**
- **Cold exposure**
- **Other factors: birth and breed type, age of ewe**

- **Improved (increased) management, jugs, etc. (Innskeep, 2002)**

# Reproduction

- **Other areas in which research has impacted the industry.**

- **Breeding soundness of ram (esp. Brucella ovis, leading source of infertility. Dr. Kimberling, CO).**
- **Breeding capacity, sperm viability, libido, serving capacity……..USDA, Dubois (Terrill, 1937; Stellflug et al., 2006).**
- **Ram effect**
- **Melatonin**
- **Estrus synchronization, hormones (none approved by FDA).**


Healthy ovine testicle

Brucellosis infected testicle

# Reproduction

- **Dichotomy exists for researchers and producers**

**INTENSIVE vs EASY CARE**

- **(e.g. Hogue, 1986) (e.g. Thonney et al., 2008)**
- **Major challenge: convince producers to use available technology.**

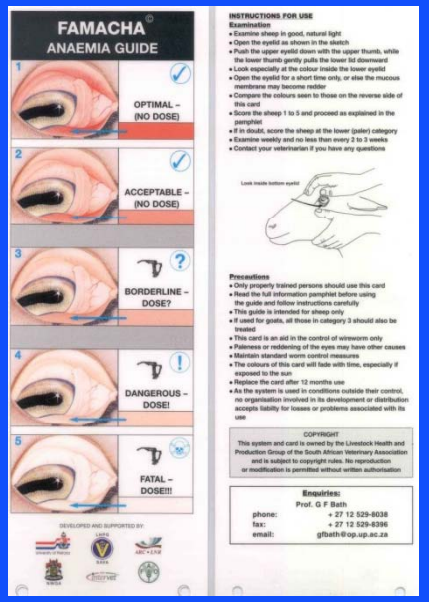
# Health

- In the past 100 yr, MANY vaccines, anthelmintics, coccidiastats, and antimicrobial agents brought to the market.
- Resulted in healthier animals for producers, researchers, and consumers.
- Usually, not discovered by animal scientists.
- But animal scientists heavily involved in the evaluation of new drugs.

# Health

- Stomach worms

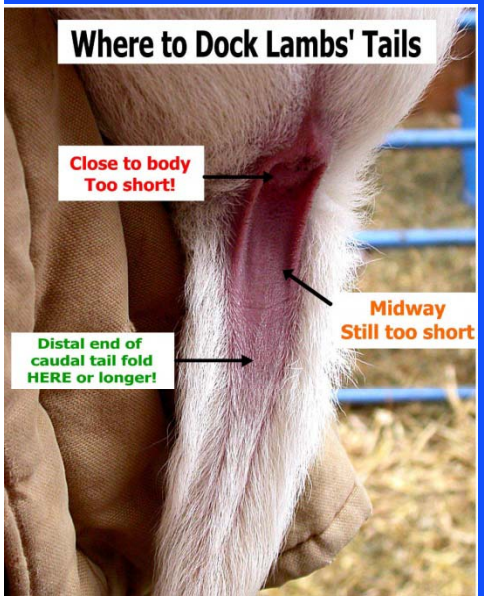
- 3 families of drenches…….very effective in the past.
- Multiple-anthelmintic resistance in *Haemonchus contortus* now major problem in many U.S. locations.
- Some practical recommendations.
- FAMACHA for detecting clinical anemia (Kaplan et al., 2004).
- EPD's for parasite resistance.



# Health

- Elimination of the screwworm in the South completed by 1966.
- Scrapie (1732 until today). USDA/APHIS Scrapie Eradication program:
- Third eyelid biopsy (O'Rourke et al., 2000).
- Rectal mucosa biopsy (USDA, 2008).

# Health


- Soremouth (orf; Boughton and Hardy, 1934). TAES vaccine.
- Rectal prolapse esp. in feeder lambs. (Thomas et al., 2003). Short docking strongly indicated.

# Nutrition

- A. L. Pope, 1958. 50-yr Review for ASAS.
- C. F. Parker and A. L. Pope, 1983. 75-yr Review.
- R. Jordan, 1979. 50-yr Review on lamb feeding.

# Nutrition

- 1908-1933. Many feeding trials to establish energy and protein requirements of sheep.
- First NRC published in 1945.
- 1933-1958. Many feeding trials to more accurately determine E and P requirements and also roles of minerals and vitamins.
- Discovery that 25 to 33% of protein could be replaced with urea (Harris and Mitchell, 1941).
- 10 essential amino acids synthesized in the rumen (Loosli et al., 1949).

# Nutrition

- Salt limiting protein supplements (Meyer and Weir, 1954).
- Cu, Co deficiency defined in Australia.
- Fl, Mo, Se toxicity described.
- Most vitamins known by 1933, but roles in sheep nutrition not determined.
- Vitamin E / Se deficiency research (1940's onwards) in relation to white muscle disease.

# Nutrition

- Mid 50's. Advantages of pelleted feed…….many studies (esp. NM).

- W. A. Henry. 1900 to 1956, 22 editions).

  "Feeds and Feeding: A Handbook for Student and Stockman."


# Nutrition

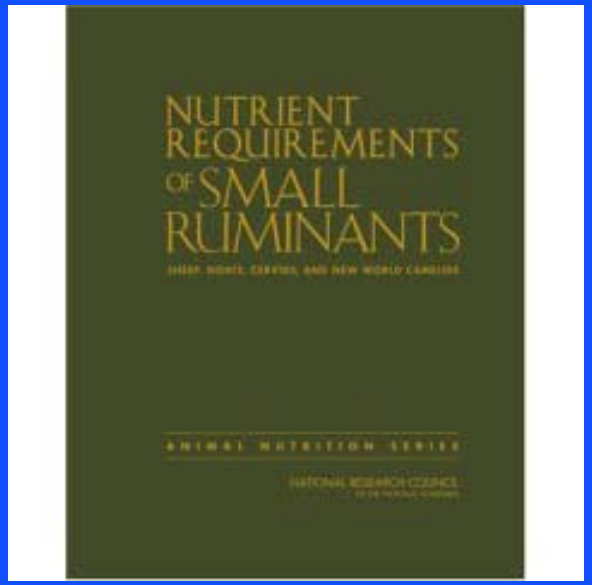
- 1960's. Ca/P ratios in high concentrate diets.
- $NH_4Cl$ to protect against urinary calculi.
- Diethylstilbestrol implants improved lamb gains (FDA prohibited in 1979).
- 1970's. Zeranol growth promoter, still available, little used.

# Nutrition

- Technologies refined in the ’60’s and 70’s (esp. Jordan et al.)
- Creep feeding of lambs on rangeland and farms.
- Feeding of early weaned lambs.
- Feeding of very early weaned or orphaned lambs.

# Nutrition

- 100 years of sheep nutrition research is summarized (with MANY refs) in the latest NRC.
- This information has had and will have a MAJOR impact on how sheep are fed and on profitability in the sheep industry.



# Nutrition

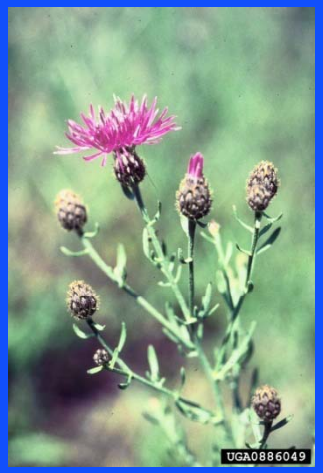
- Native and improved pastures are the major feed source for sheep. Historically underutilized. But have been over-utilized on occasions.

- Special issue of Sheep Res. J. 1994. Role of Sheep Grazing in Natural Resource Management. Included multispecies grazing, controlling rangeland weeds, etc.

# Nutrition

- **Targeted Grazing: A Natural Approach to Vegetation and Landscape Management.**

  **K. Launchbaugh and J. W. Walker, and R. Daines. Eds. 2007.**

# Nutrition

- **Range supplementation**
- **Maintain and sustain animal productivity throughout the year.**
- **Provide supplementary feed at critical times.**
- **When to start? How much to feed? Many studies conducted (e.g., TX, MT, NM. WY, etc.).**

**Protein supplementation effective when provided as infrequently as once per week (Huston et al., 1999).**

# Nutrition

- 20 years of productivity of F. D. Provenza et al. concerning behavior-based management of livestock
- Providing explanations for:
- Dietary preferences
- Aversions
- Manipulations
- Apparently random, unexplainable behavior of livestock.

# Management

- **Decrease lamb mortality caused by exposure, starvation or disease.**
- **Restraining ewes in jugs for 3 d after parturition.**
- **Fostering multiples or orphans using:**
- **Jugs (Price et al., 1984).**
- **Impregnated stockinette (Price et al., 1984).**
- **Vaginal stimulation (Keverne et al., 1983).**

# Management

- **Alternatively, wean at 2 or 3 days, raise on milk replacer, change to concentrates after 4 to 8 weeks (Large, 1965; Peters and Heaney, 1974).**

# Management

- Intensive sheep production systems.

- 3 lamb crops in 2 years
- 5 lamb crops in 3 years (Star System, Cornell).
- 2 lamb crops in 1 year (Oklahoma State University).

- Prairie Rose Lamb, Harlan IA. 8000 + ewes

# Management

- **Grazing management**
- **Manipulation of animal grazing in pursuit of a defined objective.**

- **Many studies.**
- **Mixed species grazing.**
- **In Texas, management for deer, quail, other wildlife is overshadowing management for domestic livestock.**

# Management

- Predation by canines, felines, foxes, wild and feral swine, bears, raptors, raccoons, etc.
- Possibly the biggest problem facing the sheep industry today.
- Special Issue, Sheep & Goat Res. J., 2004 was devoted to this subject (19 articles on predation management).

# Management

- **Predation solutions**

- **Lethal methods:**
  **Hunting, traps, snares, baits, etc.**

- **Non-lethal to predators:**
  **Night confinement, improved fences, early weaning of lambs, selective removal of offending animals, etc.**
- **Guardian animals: dogs, donkeys, llamas, alpacas, etc.**

- **<u>Bottom line. Sheep producers are losing ground.</u>**

# Lamb Marketing

- Typically lambs sold as feeders, then as slaughter lambs, then as carcasses, then as cuts, and finally to the customer.
- Many studies.
- Special Issue, Sheep & Goat Res. J., 1998, 12 articles by sheep research and extension personnel.
- It is difficult to estimate the impact of animal science research on lamb marketing in the past 100 years.

# Lamb Marketing

- Research has identified methods of producing more and larger lambs more efficiently.
- Many lambs slaughtered in over-fat condition (Tatum et al., 1989) because the marketing system rewarded this practice.
- Researchers and economists have devised value-based marketing systems that would pay for consumable meat and usable hides.
- Low adoption. Notable failures.
- Perhaps high feed prices will alter this situation.

# Wool Marketing

- Traditionally, U.S. grease wools sold as whole fleeces packaged in burlap bags.
- Numerous methods. Buyers purchase without the benefit of fiber measurements from producer, co-op, warehouse, etc.
- After World War II, efforts made to measure value determining wool characteristics prior to sale.
- Core sampling techniques developed by USDA, AMS researchers.

# Wool Marketing

- Research showed that skirting and classing fleeces and packaging different fleece parts in separate lines (i.e., as in Australia) was a value adding proposition particularly for fine wools (e.g., Lupton et al., 1992).

- Failure to perform these practices properly was shown to contribute to lower prices received for U.S. wools versus comparable Australian types (Hager, 2003).

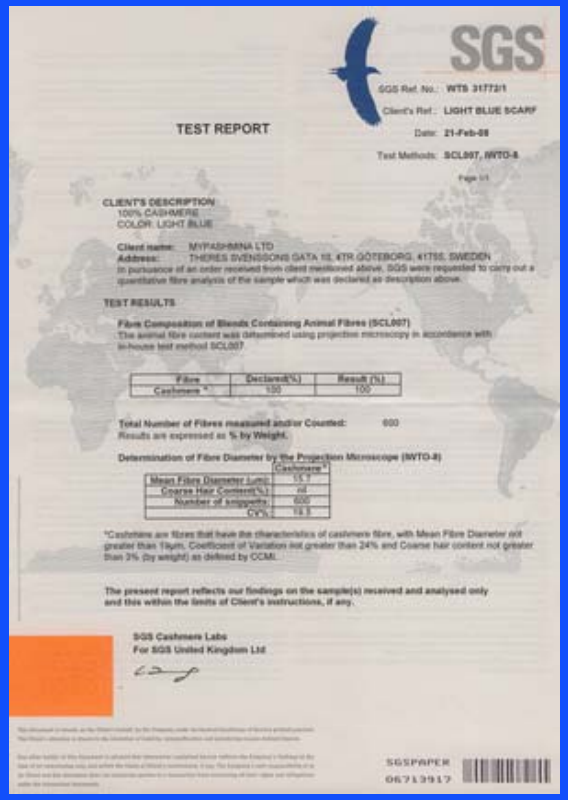
- Other issues included contamination with polypropylene and colored fibers.

# Wool Marketing

- Research also showed that providing **objectively measured fiber properties** (e.g., AFD, CV, clean yield, VM, SL, SS) to potential buyers at time of sale resulted in higher prices being paid (Lupton et al., 1994).

- Attempts have been made to sell U.S. wool in a central location using an open-bid auction.

- Not popular with U.S. buyers.



SGS

SGS Ref. No.: WTS 31772/1
Client's Ref.: LIGHT BLUE SCARF
Date: 21-Feb-08
Test Methods: SCL007, IWTO-8

TEST REPORT

CLIENT'S DESCRIPTION
100% CASHMERE
COLOR: LIGHT BLUE

Client name: MYFASHIMINA LTD
Address: THERES SVENSSONS GATA 10, 4TR GÖTEBORG, 41755, SWEDEN
In pursuance of an order received from client mentioned above, SGS were requested to carry out a quantitative fibre analysis of the sample which was declared as description above.

TEST RESULTS

Fibre Composition of Blends Containing Animal Fibres (SCL007)
The animal fibre content was determined using projective microscopy in accordance with in-house test method SCL007.

| Fibre | Declared(%) | Result (%) |
|---|---|---|
| Cashmere * | 100 | 100 |

Total Number of Fibres measured and/or Counted: 600
Results are expressed as % by Weight.

Determination of Fibre Diameter by the Projection Microscope (IWTO-8)

| | Cashmere * |
|---|---|
| Mean Fibre Diameter (um): | 15.7 |
| Coarse Hair Content(%): | nil |
| Number of snagged fibres: | 600 |
| CV%: | 19.3 |

*Cashmere are fibres that have the characteristics of cashmere fibre, with Mean Fibre Diameter not greater than 19µm, Coefficient of Variation not greater than 24% and Coarse hair content not greater than 3% (by weight) as defined by CCMI.

The present report reflects our findings on the sample(s) received and analysed only and this within the limits of Client's instructions, if any.

SGS Cashmere Labs
For SGS United Kingdom Ltd

SGSPAPER 06713917

# Wool Marketing

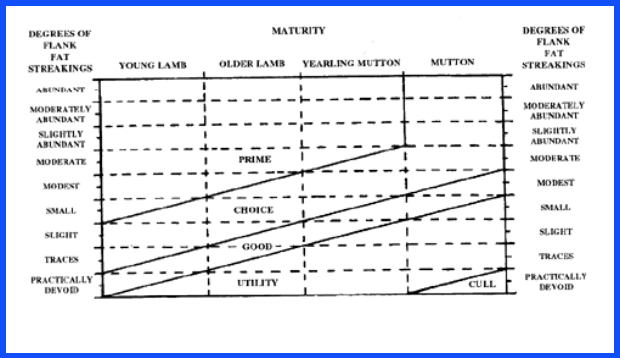
- Since then, many wool mill closures in the U.S. have caused 75% of domestic wool production to be exported.
- Central, open auction may be preferred by foreign buyers.

# Meat Research

- Animal and meat scientists have conducted many studies in which factors that affect **carcass characteristics, palatability,** and **chemical composition** of lamb meat have been evaluated.
- These variables are numerous:
- Breed, crossbreed, sex, age, slaughter weight, diet, feed additive, production system, stress, post slaughter treatments, etc.

# Meat Research

- Early advocates for a uniform system for describing lamb carcasses (e.g., Spencer, 1928).
- Official grade standards for lamb were changed at least 5 times before 1983, typically as a result of academic cutability studies (e.g., Breidenstein and Carpenter, 1983).



# Meat Research

- Target specs for “Consumer-preferred lamb” (1964) were produced by an industry-wide committee.
- Carpenter (1966) noted this would be difficult with all the different breeds, production systems, etc. used in the U.S.
- He suggested breeders and feeders emphasize a single trait: **“weight of edible meat per day of age”** (with palatability not being compromised).

# Meat Research

- **Researchers have demonstrated the advantages of feeding ram lambs compared to wethers in many studies (feed efficiency, gain, leaner carcasses).**
- **Question re. palatability usually present.**
- **Kemp et al. (1972) confirmed the lower palatability and increased toughness but noted that the ram lamb meat was still highly acceptable.**

# Meat Research

- Despite this and many subsequent studies with ram lambs, the impact on industry practice has been minimal.

- Why?
- Management problems in the feedlot.

- Some difficulty with hide removal.

# Meat Research

- Rarely a problem with toughness in lamb, but studies conducted to reduce toughness anyway (e.g. Carse, 1973).
- Temperature conditioning and electrical stimulation of the warm carcass.
- Very common in New Zealand in the 1980's. Not used in U.S.

# Meat Research

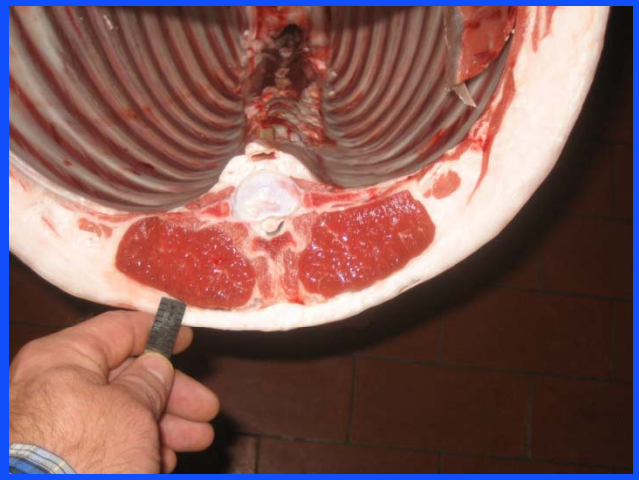
- Effects of feed on flavor of red meat including lamb (Melton, 1990).
- Rape, vetch, white clover, soybean meal all implicated in producing off-flavors.
- Barley implicated in other studies.
- In contrast, Hatfield (2000) reported no palatability problems with lambs fed barley at 80% of diet or with lambs finished on Montana rangeland.
- Important implications for present day feeding as prices escalate.





# Meat Research

- Consumers want less saturated fat, less cholesterol in their diets.
- The technology is available to produce leaner lambs (Parker and Pope, 1983).
- Little progress to date in improving lamb carcass composition (Beerman et al., 1995).
- Why? Same reasons.



# Meat Research

- Then the Callipyge was recognized (Shackleford et al., 1998).
- Was superior in several traits including yield of retail cuts.
- Not able to mitigate toughness.
- Not accepted.

# Meat Research

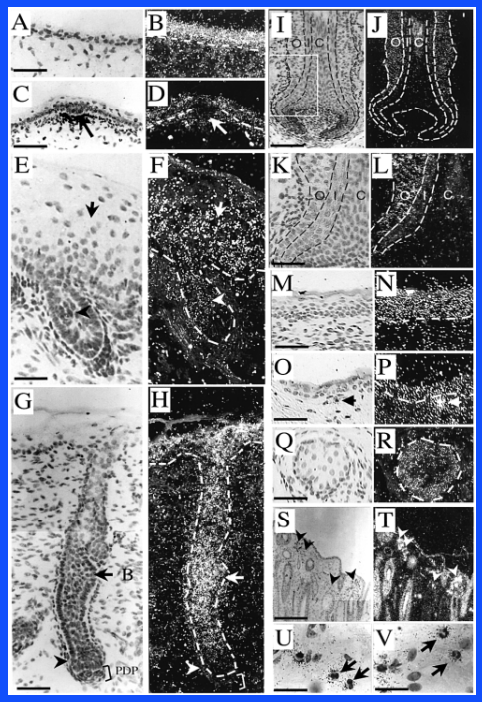
- **Healthier meat?**
- **Lambs supplemented with safflower oil (up to 6%, e.g., Boles et al., 2005).**
- **Increased levels of unsaturated fats and conjugated linoleic acid in the lean tissue.**

# WOOL RESEARCH !!

- JAS search on “wool,” 1910-2008, produced 330 articles.
- Early research concerned with estimating clean wool production of flock (Jones and Lush, 1927) and individual sheep (e.g., Hardy, 1933).

# WOOL RESEARCH

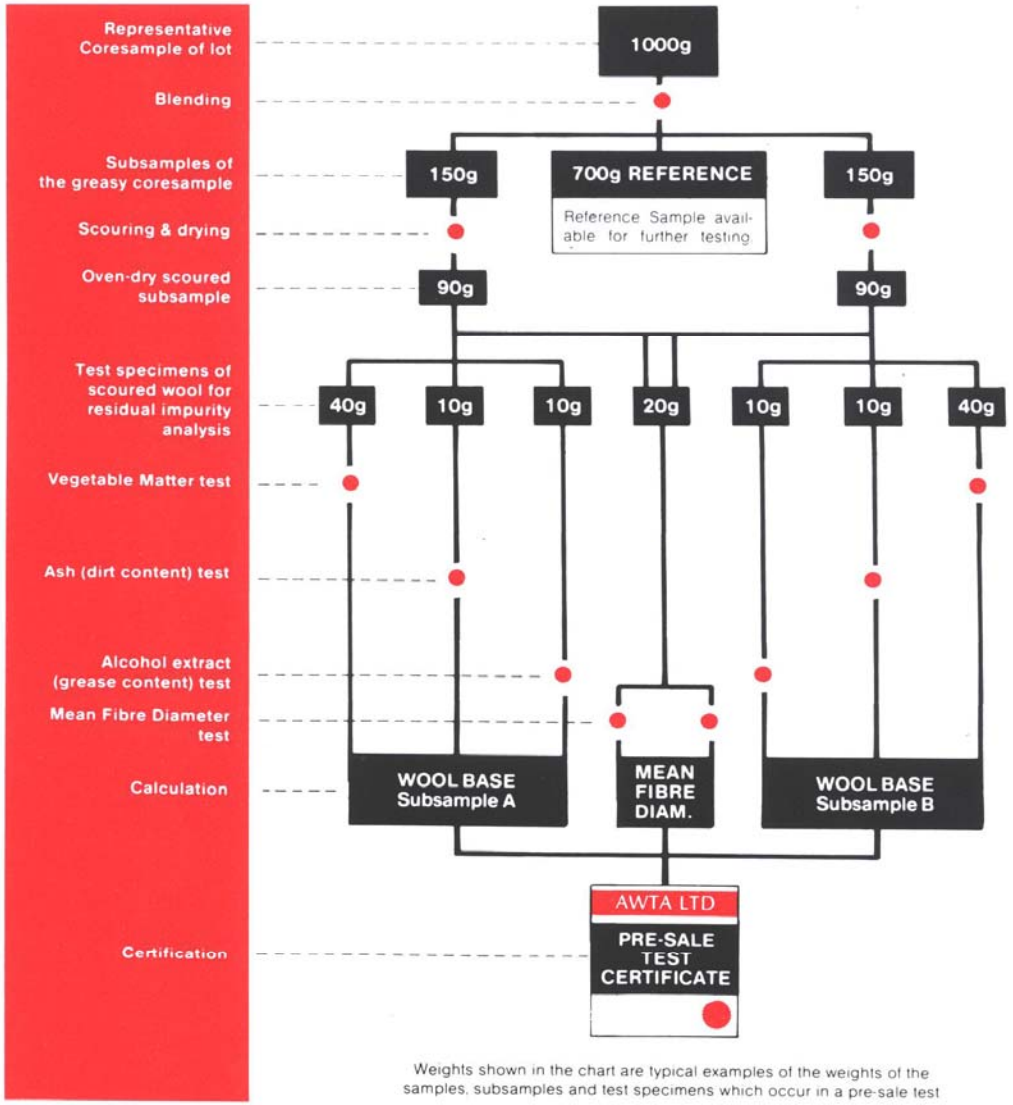
- Classic study by Reis and Schinckel (1961) showed abomasal infusion of casein or S-amino acids increased wool growth.
- Spawned many other studies with bypass protein, protein metabolism, etc.
- Minimal impact on sheep industry.
- Added immensely to our fundamental knowledge of wool and hair growth and protein metabolism.



# WOOL RESEARCH

- Clean yield work.
- Eventually led to today's most accepted method, coring of the whole fleece and making measurements on a representative sample (Johnson and Larsen, 1978).

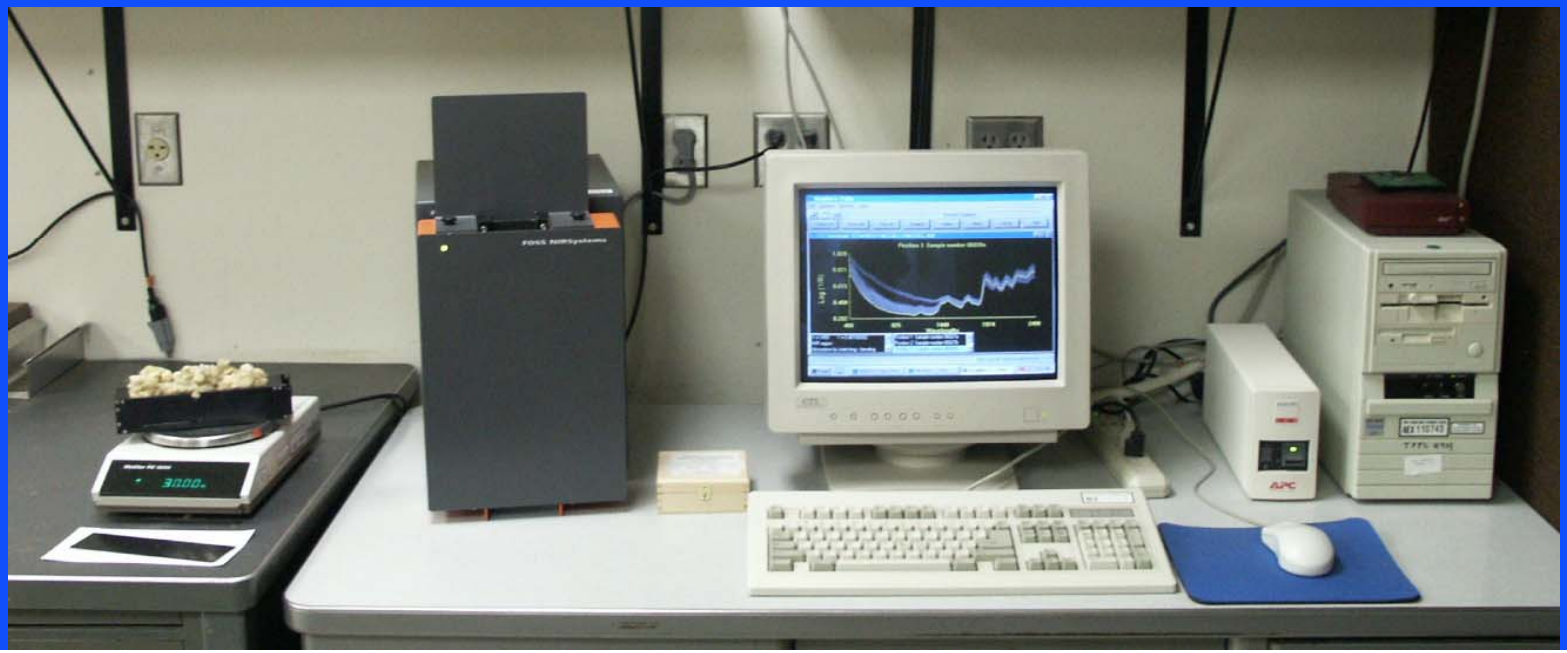
# Presale Measurement Procedure




Weights shown in the chart are typical examples of the weights of the samples, subsamples and test specimens which occur in a pre-sale test

# WOOL RESEARCH

- **Near-infrared reflectance spectroscopy has potential for estimating clean yield and fiber diameter (Sabbagh and Larsen, 1978).**
- **Still refining the method.**

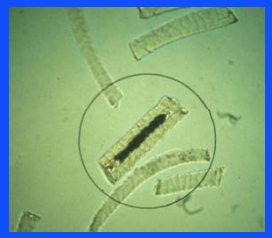


# WOOL RESEARCH

- Evolution of core sampling bags/bales of wool for clean yield and fiber diameter measurement.
- Grab sampling for length and strength.

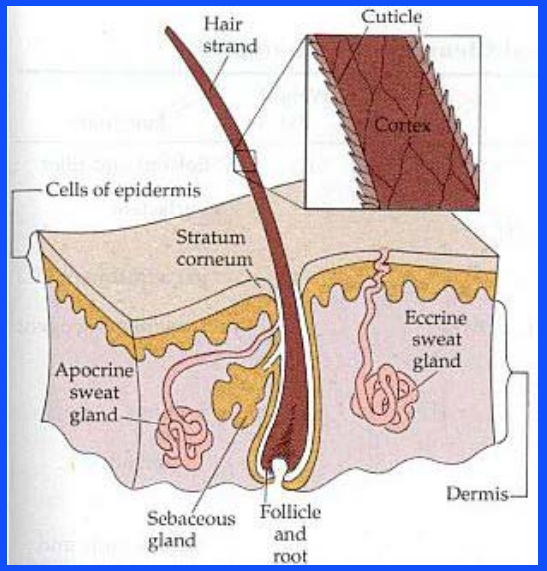
# WOOL RESEARCH

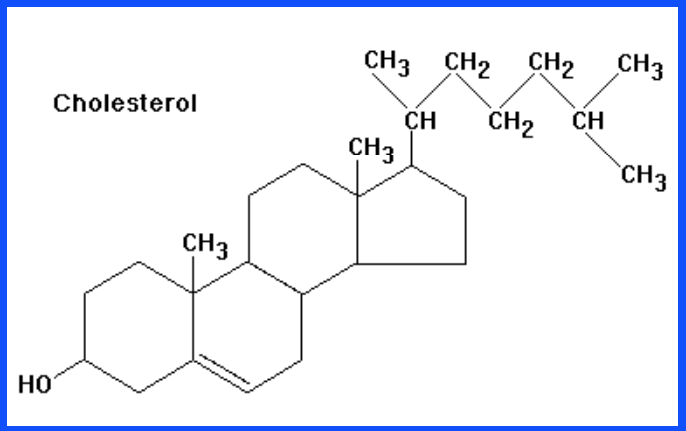
- Average fiber diameter. The most important value determining property.
- Evolution of fiber diameter measurement.



# WOOL RESEARCH

- **Studies on wool fibers, keratin protein, follicle development, wool wax (chemistry of auto-oxidation of sterols), were well funded.**
- **Because the results had implications for human hair growth and human health.**




# WOOL RESEARCH

- Australian TEAM trials 1985 to 2003.
- Major industrial-sized trials relating raw fiber properties with properties of processed fibers.
- Implications for all wool producers in terms of sheep management and preparation of wool for sale (skirting, classing, etc.).
- Necessities in today's wool market.

# The Future

- To quote a retired colleague after he had reviewed my Centennial paper:

  "It is becoming increasingly difficult to remain optimistic about the future of the sheep industry."

- But let's look at the facts.

# The Future

- After a very long decline, the rate of decline has decreased considerably and sheep numbers are actually increasing in some areas.

- I predict growth in smaller flocks due to popularity of hair sheep, dairy sheep, specialty wool breeds and good market for lamb meat (increasing ethnic population and young adults with expendable incomes).

# The Future

- I expect the number of large flocks will decrease unless we solve the problems of predation and labor (shortage, cost, lack of expertise) very quickly.

- I am not optimistic about expansion of high-input operations with increasing costs of feed.

- More people likely to turn to low-input operations using genetics to match the resource.

# The Future

- Many current constraints (several major ones not researchable) to profitable sheep production in the U.S.

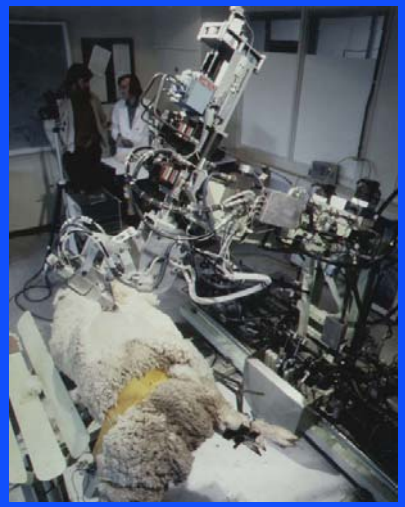
- Will not list here (read the review paper!).

# The Future

- Sheep can utilize a high proportion of renewable, lignocellulosics, often from non-competitive ecosystems, in their diet.
- At this time of increasing feed and fuel prices, this factor alone should endear the sheep to more producers.
- It did not help in the past 60 years, but perhaps now…….

# The Future

- **Wool technology**



- **Robotic shearing.**
- **Chemical de-fleecing (Bioclip).**
- **NIRS for yield testing.**
- **Washable, shrinkproof wool via genetics.**
- **Hair sheep: superior quality leather.**

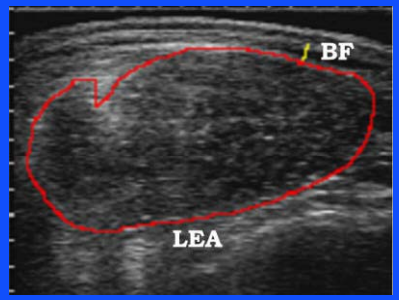
# The Future

- Short term.
- Nutrition research dominated with:
- Evaluations of by-products of bio-fuels industries.
- Production systems to produce lambs with no or shortened time in the feedlot.
- Lighter, less fat lambs

# The Future

- More use of sheep for vegetation management and targeted grazing.
- Real-time ultrasonography for evaluation of hot carcasses will (eventually) facilitate a value-based lamb marketing system.
- Tastier, reconstituted, pre-cooked, or easy-to-prepare lamb produ will help increase demand.






# The Future

- In the absence of a new family of superior anthelmintics being discovered and brought to the market, producers may realize that some areas of the country are no longer suitable for sheep production.
- Scrapie will be eliminated from the national flock.

# The Future

- **Finally, future profitability of the U.S. sheep industry will be dependent to a large degree upon the success of researchers who have received the lion's share of funding for the past 15 years…..molecular geneticists (no pressure guys!!).**

- **A lot has been promised, much has already been delivered, and much more is expected.**

# The Future

- **Sheep research programs are in progress around the world that will improve our understanding at the molecular level and result in improved:**

  **Fertility, reproduction, growth rate and efficiency, milk production, carcass composition, wool production, and resistance to parasites and diseases.**

# The Future

- I am optimistic that the expected benefits from the many ongoing molecular genetics investigations will be valuable to the industry and capable of being readily incorporated into selection programs and production systems.

# The Future

- The ultimate goal should be a profitable, globally competitive, sustainable sheep industry in the U.S.
- Researchers should continue to develop and producers should then use technology that will produce superior products while reducing U.S. production costs below those of the competition.
- Don’t think it’s possible?

- Read:
- Hudson Glimp, 1991. Can we produce lamb for 40 cents per pound?
- Fred Provenza, 2007. What does it mean to be locally adopted and who cares anyway?

# QUESTIONS ?

- **READ THE REVIEW ARTICLE !**
- **Thank you for listening.**