Biting Midges
Order DIPTERA
Family Ceratopogonidae (1400 species)
- Leptoconops
- Forcipomyia
- Culicoides
  - C. variipennis
  - C. occidentalis
  - C. sonorensis
Vectors of ~35 pathogens, many are hemorrhagic viruses

DISTRIBUTION OF CULICOIDES SPECIES

Culicoides Life Cycle
Egg laying sites and larval habitats
**Culicoides Life Cycle**

**Larvae**
- Vermiform
- Serpentine motion
- 2-3 weeks development
- Overwintering stage

**Pupae**
- Non-feeding
- Dorsal respiratory horn
- 2-3 days development

**Culicoides Life Cycle**

- Adults emerge, swarm mating
- Female feed preferentially on ungulates
- Gonotrophic concordance
- *C. sonorensis* has up to 3 generations per year in MT.
**Veterinary Importance**

- Annoyance
- Hypersensitivity
  - Equine allergic dermatitis

- Arbovirus transmission
  - Bluetongue
  - Epizootic Hemorrhagic Disease (EHD)

- Filarial nematode
  - Equine onchocerciasis

**Queensland itch**

**Summer dermatitis**

- 1st reported in Australia
- Reaction to salivary fluids
- Local inflammation and pruritis
  - cosmetic blemishes
- One species in Montana
  - *Culicoides stelffer*
Bluetongue Virus

- Reoviridae (Orbivirus)

- Originated in Africa, 1930's
- 24 serotypes worldwide, 6 in US
- 1st reported in Texas in 1952 as "soremuzzle" in sheep
- OIE listed diseases (Office International Epizootics) World Organization for Animal Health
  [http://www.oie.int](http://www.oie.int)

Bluetongue Virus Transmission

- Primary vector C. sonorensis
- Virus acquired in bloodmeal
- Reservoir: cattle, sheep
- Replicates in midgut cells
- Moves to hemocoel
- Infects the salivary glands
- EIP 26 days @ 15°C; 15 days @ 25°C; 7 days @ 30°C
Bluetongue

SHEEP
- Kamiah, Idaho 2003, 04, 05
- Wyoming 2007
- Montana 1960's, 2007
  - 16 counties 30-day quarantine
  - BT serotypes 11, 13 and 17

Clinical symptoms
- Swelling of tongue
- Oral lesions
- Hemorrhage
- Lameness
- Pneumonia
- Reproductive deformities

Bluetongue

CATTLE
- <5% show clinical symptoms
- 1-2% seropositive in Montana
- Restricted trade to bluetongue-free countries
- Animals, animal products (embryos, sperm)
Bluetongue

BTV in other species

- Goats – minimal clinical signs
- White-tailed, mule deer – 80-90% mortality
- Antelope – 80-90% mortality
- Bighorn Sheep – 0-50% mortality
- Elk – subclinical (same as cattle)

Bluetongue in Europe

- Sporadic outbreaks prior to 1998
- 1 – 2 countries, single serotype
- 1998 – 2002
  - 5 serotypes, 12 countries
  - >1 million sheep died
- 2006 BTV-8 1st reported
  - More virulent strain
  - Established in northern Europe
  - Economic losses USD $1.5 million

Bluetongue in Europe

- 2007 epizootic intensified
  - BTV-8 more aggressive than 2006
  - Economic losses USD $204 million
- 2008-09 BTV-8 continued to spread
- Vaccination campaign in 2008
Bluetongue in Europe

- Speculate result of change/variability in European climate
  - *C. imicola* primary vector range has expanded
  - Other *Culicoides* species serve as vectors
  - Transmission over larger geographical region
  - Increased virus persistence during winter as evidenced by earlier detection and transmission

Bluetongue Management

- Midge control next to impossible
- Animal treatment
  - No antibiotics available
  - Supportive treatment
    - Feed, water, shade, rest
  - Modified-live vaccine
    - Sheep only, serotype 17
    - Wool Growers Vaccine – BLU 10, 11 and 17
      - Used only in rams in Calif.
      - Causes abortions in ewes

Repellents

Pour-ons
- RTU Sheep Insecticide (Y-TEX)
- CyLence (Bayer)
- Permectrin CDS (Bayer)

Low volume belly sprays
- GardStar 40 EC (Y-TEX)

Insecticide Ear Tag
- PYthon ear tag (Y-TEX)
Recommended for Biting Midges

- PYthon ear tag (Y-Tex)
- 9.5 g @ one tag per sheep
  - Status: MT 24c SLN
- Permethrin CDS (Bayer)
  - Registered for sheep but not as belly spray
- Protect sheep for 3 to 5 weeks, interrupt BT transmission
- Both are synergized pyrethroids

Epizootic Hemorrhagic Disease (EHD)
EHD

- Orbivirus closely related to BTv
- 10 serotypes worldwide, 2 in US.
  EHD-1 New Jersey strain
  EHD-2 Alberta strain (Isolated in 1962
  epizootic in Alberta, Can.)
- *Culicoides* only proven vector

EHD

- Clinical signs of illness in white-tailed deer:
  - Fever, inappetence, weakness, hanging of head,
    labored breathing, swelling around head and
    neck, internal hemorrhaging, oral bleeding, death
    (4-10 days)
- No age-preference.
- Most important infectious disease in wild
  deer in U.S., 90% mortality.

Epizootic Hemorrhagic Disease 2001
White-tailed Deer Mortality Rates

[Map showing white-tailed deer mortality rates across different states and provinces, color-coded to indicate severity of outbreak.]
EHD

- Other wild ruminants
  - Mule deer, antelope, elk, bison, and bighorn sheep
- Cattle and sheep are commonly seropositive
- Sheep may show clinical symptoms.

EHD

- Cyclical disease in WTD
- Susceptible population
- Persistent drought with high vector density
- Local or regional epizootic
- Vaccine for EHD

Cutaneous Equine Onchocerciasis

- Nematode *Onchocerca cervicalis*
- Horses only known host
- High prevalence in parts of US
  - NY, KY, Gulf Coast
- >85% older horses infected
- *C. varipennis* and *C. sonorensis* N.A. vector
Cutaneous Equine Onchocerciasis

- Microfilariae cause depigmentation and hair loss
- Skin biopsies to detect mf
- Ivermectin treatment
- Skin lesions resolved in few weeks

Cache Valley Virus
(Bunyaviridae: Bunyavirus)

- 1st isolated in 1956 from Cx. inornata in northern Utah (Holden and Hess 1959)
- Broadly distributed throughout NA, especially in mid-west and NGP, Canada, northern Mexico and Jamaica
- Detected in Argentina (Tauro et al. 2009)

CVV Insect Hosts

- North America
  - 29 species, 6 genera (Coles et al. 1986)
  - Culiseta, Psorophora, Anopheles, Coquillettidia, Aedes, Ochlerotatus
- Mid-west
  - Anopheles quadrimaculatus, An. punctipennis and Coquillettidia perturbans implicated as vectors (Blackmore & Grimsd 1998)
- Saskatchewan
  - Ae. versans, Cx. tarsalis, Cx. inornata, probable chief vector in Sask. (Jensen et al. 1979)
- North Dakota
  - Aedes, Cx. tarsalis and Cx. inornata (J. R. Anderson, pers. comm.)
CVV Mammals Infected

- CVV associated with livestock (cattle, horses, sheep, goats, swine) and wildlife
- White-tailed deer high CVV specific antibodies (IN, WI, MN); could serve as amplifying vertebrate host. (Blackmore & Grimstad 1998)
- Human infections have been reported, although rare (Campbell et al. 2006, Tauro et al. 2009)

CVV Transmission

- Transmission occurs in late summer into early fall
- Susceptible animals are females being bred in August/Sept.
- If CVV transmission occurs in bred ewes from:
  - Day 0 to 28 post-conception: fetal resorption
  - Day 28 – 45 post-conception: neonatal developmental abnormalities
  - Day 45 – birth: no significant disease in the fetus

CVV Pathology

- Causes neurological and skeletal malformations in fetus
  - Fused joints, spinal curvature, enlarged skulls
- Reproduction abnormalities
  - Increased stillbirths, abortions, poor conception rates, weak lambs and calves.
CVV 2011 Outbreak

- CVV-infected lambs reported in ND, SD, NE, MN, WI
- Increased stillbirths, poor conception rates, and deformed lambs in MN, ND, SD and WI.
- Farm flocks where ewes bred in August/Sept.
- Estimates of 20% loss of lamb crop and
  >75% of ewes failed to conceive
- Potential health impact(s) on the dam resulting from embryonic death