COURSE #EVS-3120
ENVIRONMENTAL MICROBIOLOGY

SECTION 3

PATHOGENS IN THE ENVIRONMENT

PART 5:

A) IMPACT OF THE ENVIRONMENT

ON PATHOGENS

B) IMPACT OF PATHOGENS ON THE ENVIRONMENT

WINTER, 2000

THE EFFECT OF THE ENVIRONMENT ON PATHOGENS

- VECTOR CONTROL (MALARIA)
- CHANGES IN VECTOR HABITAT (DENGUE FEVER)
- CHANGES IN SECONDARY HOST HABITAT (LYME DISEASE)
- CHANGES IN PRIMARY HOST HABITAT (TB)
- INFLUENCE OF OTHER FLORA & FAUNA (CHOLERA)
- LIFE-STYLE & OPPORTUNISTIC PATHOGENS (LEGIONELLOSIS)

ENVIRONMENTAL CHANGES & MALARIA

- KILLS >1 MILLION/YEAR WORLDWIDE
- INCREASED EXPOSURE WHEN BUILDING DAMS & CANALS
- NO VACCINE
- PARASITE ALSO RESISTANT TO MANY DRUGS
- CHANGING THE ENVIRONMENT TO ELIMINATE MOSQUITO-BREEDING AREAS ONLY SUCCESSFUL MEASURE THUS FAR
- MALARIA, WHICH WAS ENDEMIC IN MANY PARTS OF CANADA & THE U.S., HAS BEEN VIRTUALLY ELIMINATED MAINLY THROUGH MOSQUITO CONTROL

THE EFFECT OF PATHOGENS ON THE ENVIRONMENT

- RABBITS IN AUSTRALIA (MYXOMAVIRUS)
- BSE IN CATTLE IN BRITAIN (PRIONS)
- URBANIZATION (CRYPTOSPORIDIOSIS)

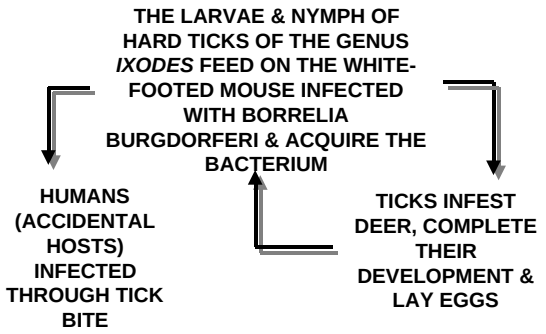
TICKS-DEER-MICE & LYME DISEASE

- MOST COMMON INSECT-BORNE DISEASE IN U.S.
- >10,000 CASES EACH YEAR IN THE U.S. ALONE
- AN ILLNESS DUE TO SPIROCHETE *BORRELIA BURGDORFERI*
- MISTAKEN FOR JUVENILE ARTHRITIS
- STARTS WITH A RASH & MAY BECOME DEBILITATING
- RARELY FATAL BUT DIFFICULT TO DIAGNOSE
- NO VACCINE, BUT ANTIBIOTICS EFFECTIVE
- PREVENTION BY AVOIDING EXPOSURE TO TICKS

THE CYCLE OF LYME DISEASE

- CHANGES IN LAND-USE MAIN CAUSE OF ITS EMERGENCE; REFORESTATION OF AREAS INITIALLY CLEARED FOR FARMING
- HIKING/HUNTING & EXPOSURE TO TICKS
- COMPLEX TWO-YEAR CYCLE INVOLVING A TICK (E.G., IXODES DAMMINI), DEER & MICE
- AS A LARVA, TICK FEEDS ON WHITE-FOOTED MOUSE & PICKS UP THE PATHOGEN; NYMPH MORE NONSPECIFIC & FEED ON ANY VERTEBRATE INCLUDING HUMANS
- THE TICK'S REPRODUCTIVE CYCLE REQUIRES THE WHITE TAILED DEER

CYCLE OF LYME DISEASE



HOW DID LYME DISEASE COME TO LIGHT?

- THE LINK BETWEEN PERIODIC BOUTS OF ARTHRITIS IN YOUNG & OLD FOLLOWING A TICK BITES WAS FIRST NOTED BY A MOTHER IN OLD LYME (CONNECTICUT)
- MEDICAL AUTHORITIES INITIALLY REJECTED HER FINDING, BUT HER OWN LITERATURE SEARCH & OBSERVATIONS OF OTHERS IN THE COMMUNITY FINALLY CONVINCED A RHEUMATOLOGIST OF THE LINK WITH TICK BITES
- EVENTUALLY, A BACTERIUM WAS FOUND TO BE THE CAUSE OF THE DISEASE

LIFE-STYLE & LEGIONELLOSIS

- CAUSATIVE AGENT *LEGIONELLA* SP.
- MAIN HABITAT IS WATER; THERMOTOLERANT
- COOLING TOWERS, AIR-CONDITIONERS, WATER HEATERS
- AIRBORNE; NO PERSON-TO-PERSON SPREAD KNOWN
- OUTBREAKS IN HOSPITALS, HOTELS & ON CRUISE SHIPS
- OPPORTUNISTIC PATHOGEN CAUSING PNEUMONIA MAINLY IN OLDER (>50 YEARS), DEBILITATED & IMMUNOCOMPROMISED
- SUPER-CHLORINATION OF WATER FOR ENVIRONMENTAL CONTROL

LEGIONELLA & OTHER ORGANISMS

- *LEGIONELLA* GROWTH NEEDS ALGAE & AMOEBAE
- MANY OF THE NUTRIENTS MAY BE OBTAINED FROM ALGAE (E.G., *CYANOBACTERIUM*)
- *LEGIONELLA* CAN MULTIPLY INSIDE AMOEBAE & ARE ALSO PROTECTED FROM ENVIRONMENTAL FACTORS & DISINFECTANTS
- ASSOCIATION WITH ALGAE & AMOEBAE MAY HELP IN THE AIRBORNE SPREAD OF *LEGIONELLA*

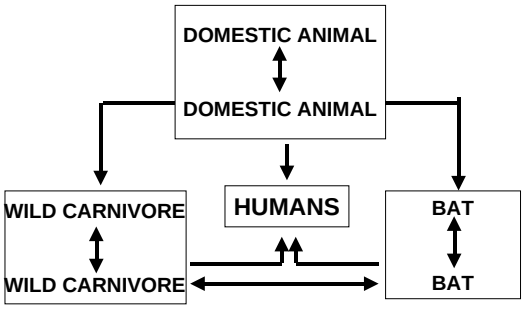
ALGAL BLOOMS & CHOLERA

- *VIBRIO CHOLERAE* HAS A VIABLE BUT NON-CULTIVABLE FORM (SOMNICELL) IN WATER
- SUCH CELLS HAVE BEEN DETECTED IN MANY AQUATIC PLANTS AND ANIMALS INCLUDING CYANOBACTERIA
- SEASONALITY OF ALGAL BLOOMS & CHOLERA OUTBREAKS IN BANGLADESH
- *V. CHOLERAE* REACHED THE PACIFIC COAST OF S. AMERICA IN THE BILGE OF A CHINESE SHIP
- BUILT-UP IN ALGAE & WENT UP THE FOOD CHAIN TO CAUSE OUTBREAKS OF CHOLERA
  - EPSTEIN, BIOSYSTEMS, 31: 209-221, 1993

ANIMALS & RABIES

- A VIRAL INFECTION OF WARM-BLOODED ANIMALS
- HUMANS ARE ACCIDENTAL HOSTS (ZOONOSIS)
- ALMOST ALWAYS FATAL
- SPREAD THROUGH ANIMAL BITES/SCRATCHES, AEROSOLS, TISSUE TRANSPLANTS, INGESTION
- URBAN & SYLVAN CYCLES
- RABIES IN WILDLIFE IN CANADA (FOXES, SKUNKS); ONTARIO HAS >80% OF CASES
- CONTROL (ELIMINATION OF STRAYS, VACCINATION OF PETS, QUARANTINE, BAT CONTROL)
- VACCINATION OF WILDLIFE!

RABIES CYCLE IN NATURE



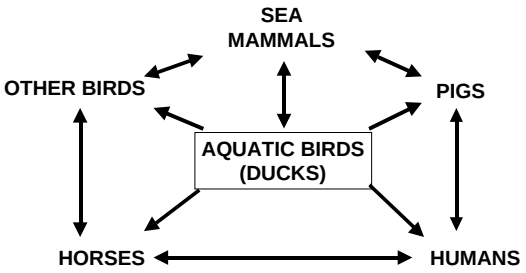
WILDLIFE VACCINATION AGAINST RABIES

- THE CAPTURE-VACCINATE-RELEASE APPROACH IS VERY EXPENSIVE & USEFUL ONLY IN SUBURBS
- ORAL IMMUNIZATION OF WILDLIFE IS POSSIBLE USING VACCINE IN BAIT
- RECOMBINANT VIRUSES WITH RABIES GLYCOPROTEIN GENE
- A UNIQUE EXPERIMENT IN ECOLOGY & INTERRUPTION OF DISEASE SPREAD
- VACCINE DROPS FROM LOW-FLYING AIRCRAFT
- TETRACYCLINE A TRACER FOR VACCINE INGESTION
- RABIES ELIMINATED FROM CERTAIN COUNTRIES

WATER FOWL & INFLUENZA

- A VIRAL INFECTION OF HUMANS & ANIMALS
- EPIDEMICS & PANDEMICS
- COMPLEX ECOLOGY; AQUATIC BIRDS AS MAIN RESERVOIRS
- WILD DUCKS EXCRETE VIRUS IN THEIR FECES
- VIRUS SURVIVES IN WATER FOR SEVERAL MONTHS
- PIGS IN SOUTHERN CHINA MAY BE THE REASSORTMENT VESSELS
- MIGRATORY BIRDS FROM CANADA MAY CARRY VIRUS SOUTH
- NO SATISFACTORY MEANS OF CONTROL
  - Webster et al., ***Microbiol. Rev.***, 56: 152-179, 1992

HOSTS FOR INFLUENZA A VIRUSES



- Webster et al., *Microbiol. Rev.,* 56: 152-179, 1992

MYXOMAVIRUS & RABBIT CONTROL

- EXPLOSIVE INCREASE IN RABBIT POPULATION IN AUSTRALIA
- SEVERE ECONOMIC & ENVIRONMENTAL DAMAGE
- CONVENTIONAL CONTROL MEASURES UNSUCCESSFUL
- ARTIFICIAL INTRODUCTION OF MYXOMAVIRUS LED TO HIGH RATES OF MORTALITY & REDUCED NUMBERS
- HOST-PARASITE ADAPTATION
- NEED FOR A MORE POTENT VIRUS STRAIN
- AN ENVIRONMENTALLY- & ECOLOGICALLY-SAFE APPROACH
- A CALICIVIRUS INTRODUCED RECENTLY

DEER MICE & HANTAVIRUSES

- VIRUS GROUP FIRST DISCOVERED DURING KOREAN WAR; LATER ISOLATED IN OTHER PARTS
- LUNG INFECTION, HEMORRHAGE, KIDNEY FAILURE
- DISCOVERY OF SIN NOMBRE VIRUS IN SOUTH-WEST U.S.
- AIR-BORNE TRANSMISSION
- SPREAD IN ANIMAL CARE FACILITIES & LABORATORIES
- FIELD MICE & OTHER RODENTS BELIEVED TO BE THE MAIN RESERVOIR
- CHANGING HABITAT OF THE DEER MOUSE
- CARE IN CLEANING RODENT-INFESTED AREAS

URBANIZATION & CRYPTOSPORIDIOSIS

- PROTOZOAN PARASITE CAUSING ACUTE GASTROENTERITIS
- KNOWN PATHOGEN OF CATTLE AND OTHER ANIMALS
- ALSO INFECTS HUMANS
- WATERBORNE OUTBREAKS IN URBAN AREAS
- DIFFICULT TO ELIMINATE DURING DRINKING WATER TREATMENT
- FATALITIES IN DEBILITATED & IMMUNOCOMPROMISED
- CATTLE & POLLUTION OF RECEIVING WATERS
- BIOLOGICAL ANTAGONISM IN AQUATIC ENVIRONMENT

BOVINE SPONGIFORM ENCEPHALOPATHY (BSE)

- BSE OR 'MAD COW DISEASE'
- DISCOVERED IN THE U.K. IN 1986; OUTBREAK START 1981?
- MORE THAN 160,000 CASES IN CATTLE, MOSTLY IN THE U.K.
- CASES OUTSIDE U.K. FROM EXPORTED FEED & CATTLE
- SOURCE SCRAPIE-CONTAINING MEAT & BONE MEAL IN CATTLE FEED; OUTLAWED IN JULY, 1988

BSE (cont'd.)

- CHANGE IN CATTLE FEED PREPARATION (AN ORGANIC SOLVENT AND ITS STEAM EXTRACTION ELIMINATED)
- EXPERIMENTALLY TRANSMITTED TO SHEEP, GOATS, MICE & MONKEYS
- CASES IN DOMESTIC CATS & ZOO ANIMALS
- CASES IN HUMANS??

CREUTZFELDT-JAKOB DISEASE (CJD)

- A HUMAN DISEASE CAUSED BY PRIONS WHICH ARE HIGHLY RESISTANT TO CHEMICAL & PHYSICAL AGENTS
- RARE (1:1 MILLION) BUT HIGH IMPACT DISEASE
- CASES DUE TO IMPROPERLY DECONTAMINATED SURGICAL EQUIPMENT, TRANSPLANTS & INJECTED HORMONES
- NEARLY 50 RECENT CASES OF CJD IN U.K.; ALL IN YOUNGER PERSONS
- RELATIONSHIP WITH BSE?

THE SPREAD OF *GIARDIA LAMBLIA*

- AN INTESTINAL PROTOZOAN WHICH CAUSES DIARRHEA
- MANY WILD & DOMESTIC ANIMALS ARE HOSTS
- WATER & FOOD ARE COMMON VEHICLES
- FOUND IN FECALLY-POLLUTED WATERS & EVEN IN PRISTINE MOUNTAIN STREAKS
- TRAVELERS & HIKERS ARE OFTEN INFECTED
- NO VACCINE BUT TREATMENT AVAILABLE
- ENVIRONMENTAL CONTROL THROUGH PROPER FOOD & WATER TREATMENT (POINT-OF-USE DEVICES)
- INCREASE IN NUMBER OF CASES DUE TO TRAVEL

TOXOPLASMOSIS

- CAUSED BY THE PROTOZOAN *TOXOPLASMA GONDII*
- WIDELY DISTRIBUTED IN NATURE
- MILD OR SUBCLINICAL INFECTION IN MOST CASES
- SEVERE INFECTION IN DEVELOPING FETUS (BIRTH DEFECTS) & THE IMMUNOSUPPRESSED
- 33% CHANCE OF FETUS BECOMING INFECTED ON INFECTION OF PREGNANT MOTHER
- CAN INFECT 200 SPECIES OF ANIMALS & BIRDS, BUT MAIN SOURCE FOR HUMANS ARE CATS
- CAN SPREAD BY A VARIETY OF MEANS (DIAGRAM)
- ENVIRONMENTAL CONTROL OF UTMOST IMPORTANCE

SPREAD OF *TOXOPLASMA GONDII*