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Advances in Invertebrate Zoology Page 9



Time

Platyhelminthes

02 November 2015 10:12

Size

- Affects locomotion/osmoregulation
- Weight Is proportional to volume is proportional to length³ • Animal the same shape but 2x as big has 8x the weight
- Surface area or CSA is proportional to length²
 - 2x size. 4x the SA or CSA
- Limitations of size
 - Transportation/heat exchange
 - Circumvent?
 - Change shape
 - Circular cross-section to flattened ellipse
 - □ Keep SA:Vol constant

Body Form and Structure

- Bilateral symmetry
- Definite anterior end
 - Sensory and motor nerve elements
 - Highly differentiated (eyes)
 - Prey detection
- 1mm-5m
- Body more than 2 cell layers thick
- Acoelomate animals triploblastic
- Parenchymal she e o
- Parenchyma
 Reproductive organs
 Musculature
 Parenchymal streach
 Accentass of fibres
 Cells of varying types
 Functional/storage
 Myocvtors '

 - Myocytons (non-contractile)
- Intestinal organs embedded
 - Dissection impossible
- No circulatory system
- Nervous system simple
 - Brain cerebral ganglion
 - Longitudinal cords
 - Simple sensory organs
- Trematodes (flukes)
 - Range of sizes
 - Stoma mouths (taxonomic)
 - Mono-: oral sucker only
 - Amphi-: oral sucker, posterior acetabulum
 - Di-: oral sucker, acetabulum on ventral surface
 - Echino-: collar with spine
 - Holo-: ventral surface modified
 - Gastero-: mouth on ventral surface

- Target viral processes and structures
 - Musculature
 - Surface
- Benzimidazoles
 - Tubulin
- Imidathiazoles/tetrahydropyrimidines
 - Acetyl choline mimic
 - Spastic paralysis
- Macrocyclic lactones (avermextus/milbemycins)
 - Glutamate gated chloride channels
 - Flaccid paralysis
- Problems with chemotherapeutics
 - Resistance
 - Failure
 - Access
 - Drug residues

Vaccine development

- Acquired immunity
 - Antigens seen by host
 - Surface antigens and ES antigens
- Successive immunisations
 - Follow protective moieties
- Damaged worms
 - Algh AB titre in blood
 Disrupts metanalism
 Facility in pact
 A protection against 'blood alker'
 Aminopeptidase
 Gut glycoprotein contraction
- Extracts and homogenates
- Dissected organs/tracts
- High AB titre in blood
- Pitfalls?
 - Immunity not reinforced by natural infection
 - Successive vaccines
- Target biological systems
 - Feeding and/or digestion
 - Migration
 - Reproduction
- Generation of cDNA libraries
 - Recombinant screening
 - NGS (next generation screening)
 - Traditional methods
 - Mabs and serum
 - Directed using bioinformatics
 - Localisation
 - Surface expression
- Vaccine at present
 - Dictyocaulus vivparus
 - Dictyocaulus filaria
 - Irradiated larvae
- One GI tract vaccine

- Ca²⁺, troponin/tropomyosin
- Fast guick and sudden actions
- Mvofibrils 60%
 - Mitochondria 4%
 - Fast contraction, don't need constant aerobic respiration
 - Sarcoplasmic reticulum 21%

Motor Neurons

- Multiterminal, polyneural innervation
 - Multiple contact points between neuron and muscle fibre
 - Multiple neurons acting on the same muscle



- L-glutamate neurotransmitter
- Inhibitory (stop muscle from contracting) and neuromodality (change the way the muscle reacts to the neuron)
- Locust limb
 - Fast extensor tibiae MN (FETi)
 - 68% of fibres activated
 - Slow extensor tibiae MN (SETi)
 - 8% exclusively
 - In vertebrate motor units give fine control
 - In invertebrates separate motor neurons have different effects
 - FETi greater neurotransmitter volume, great post synaptic potential
 - Frequency of motor neuron potential gives control each action potential causes small movement - cumulative effect of multiple potentials
 - <5Hz no response, 15-20Hz contracted to tonus (rigid but not acting on skeleton)</p>

Self-organised movement

- Group coordination
 Phase change change in behaviour. E.g. Mormon cricket sy amos
 Protein and salt deprivation area exhausted of food
 Cannibalism (Simpson et al. 2006):

 alternative source of redeinand salt
 Pursue other incorducits

 Sen on a oll turns, Bazazi et al. 21 08
 If they cannot cord Orientation (Bazazi et al. 2001)
 - o Travel in the same direction to maintain distance between 'lanes' of pursuing crickets
- Running away from those chasing
 - Simple local processes contribute to coordinated group movement

Developmental Changes

- Holometabolous (complete metamorphosis) and Hemimetabolous (partial metamorphosis)
- Muscles for moulting
- Massive changes
 - Caterpillar hydrostatic movement
 - Butterfly rigid exoskeleton and wings
 - Levine and Trueman (1985)
 - Caterpillar lots of internal muscles
 - Butterfly many internal muscles and associated motor neurons degenerate
 - Adult lots of external (relatively) muscles important
 - Completely rewired
 - Muscles degenerate and are replaced, same MN
 - Dendrites remodel
 - □ Larva side-side bending
 - Adult coordination for dorso-ventral flexion
- Teneral period
 - o Period after moult neural circuits not fully matured
- Autotomy and degeneration
 - o Can lose limbs muscles and MN degenerate

- Semi-lunar processes
 - □ Knee joint
 - □ Resilin

• Jump Sequence

- Cocking
 - Tibia held against femur while flexor contracts
 - Small flexor vs huge extensor
 - Lump deflects tendon, like pulley for flexor
 - Tendon has small pouch locks over Lump



Amphipods

27 November 2015 13:56

- Crustaceans
 - But no carapace
- Class Melacostraca
- Superorder peracarida
 - Young develop directly, no larval stage
- Order amphipoda
 - Young brooded by mother
 - Marsupium/pouch
- Distributed worldwide
- Mostly marine
- Some aquatic and terrestrial

Ecology

- Diverse feeding habits
 - Herbivores
 - Detritivores
 - Carnivores
 - Omnivores
- Critical role in food webs

Antarctic Giants

- uphic levels
 up to 10cm long
 Up to 10cm long
 Polar seas high Churk tration of O2
 Polar seas high Churk tration of O2
 And high Churk tration of O2
 Can circulate around larger body

 Ergiants

 28-34cm long
 Kermadic Trench, north of Mt.
 6.9-9.9km⁻¹

Supergiants

Silk Spinners

- Crassicorophium bonelli
 - Spin silk
 - Strong as spider silk
 - Adhesive as barnacle adhesive
 - Used to make tube out of sediment
 - Possible medical application

Terrestrial Species

- Family talitridae
 - Marine, semi-terrestrial, and terrestrial species
- Sand-hoppers
 - Semi-terrestrial
 - Feed on rotting vegetation along tide line
- Land-hoppers
 - Full terrestrial damp habitats

Abundant in soil habitats of NZ

Subterranean Species

- Stygobites
 - Restricted to subterranean habitats
 - Many amphipod families
- Troglomorphy
 - Loss or severe reduction of
 - Eyes
 - Pigment
 - Body appendages

Gammarus duebeni

- Generalist feeders
 - Detritivore and opportunistic predator
- Found in brackish and freshwater habitats
 - Europe and North America
- Wide salinity tolerance
 - Rockpools above high tide mark
 - Freshwater lakes and rivers
 - Ireland, west wales, western Scotland, Cornwall, Brittany, Isle of Man
- G. duebeni celticus
 - Physiological subspecies
 - Freshwater
 - Physiological subspecies
 - Reduced permeability
 - Copious dilute urine produced
 - Reabsorption of salts in antennal glands
- esale.co.uk Associated morphological feature Menus section of 5th walking leg thinner ther the brackish individuals 2000
 - Sutcliffe 2000
 - Testing for ubspecies
 - Physic ogical and morrho carfeatures not in clusters
 - □ Clines coord end vith salinity
 - □ Selection within species
 - Artificial selection for salinity
 - □ Freshwater adaptations within 4 generations
 - □ Rapid adaptations
- Molecular phylogenetics
 - Analysis of Mitochondrial Cytochrome Oxidase 1 gene
 - 2 major clades
 - Both with freshwater and brackish individuals
 - Clade I
 - Wales, Ireland, Scotland
 - Suggested pre-glacial divergence
 - Freshwater refuge during sea-level fluctuation
 - Clade II
 - Widely distributed
 - Little genetic divergence on East and West sides of Atlantic
 - Recolonisation from European refuge

Invasions

- G. duebeni
 - Very tolerant of stress
 - Change in salinity
 - Aerial exposure
 - Hypoxia

- Some females produce only female offspring regardless of environment
- Associated with parasitic infection

Transovarially Transmitted Parasites

- Infect oocyte cytoplasm
 - Transmitted from mother to offspring
 - Not from father to offspring males are dead end in parasite cycle
- Benefit from distorting sex ratio in favour of females
 - Infected produce more female offspring
- Nosema granulosis in Gammarus duebeni
 - Microsporidian parasite
 - Transovarially transmitted with high efficiency
 - No obvious horizontal transition routes
 - Spores
 - Thin walls
 - Short polar filament (internal transmission)
 - Effective feminiser
 - Almost all transovarially infected embryos develop as females
- Dictocoela duebenum in Gammarus duebeni
 - Microsporidian
 - Transovarially transmitted
 - Effective feminiser
 - In same populations as *N. granulosis*
 - Occasionally produces severe muscle infection
 - Large quantity of tough spores
 - Suggest horizontal transmission
- Can 2 feminisers co-exist?
 - Mathematical models suggest that they cannot
- n ley cannot jon and the isation ability displaces the other Parasite with highest transmise 61 completely
 - Horizontal transmission
 - Cap allow existence
 - b tter feminiser has a ter horizontal transmission

Co-evolution of Amphipods and Feminisers

- If feminisers are transmitted solely transovarially they should be inherited with mitochondrial genes
- N. granulosis
 - Co-inherited with mitochondrial CO1
- D. duobenum
 - Not coinherited with CO1
 - Present in many amphipod species, no evidence for co-evolution

Interactions of Feminisers and Environment

- Low temperatures
 - Inhibit parasite replication in embryo
 - Reduces effectiveness of feminisation
 - Can result in incomplete feminisation intersexuality

Paramyxea in Orchestia

- Paramyxea parasite
 - Vertically transmitted, mother to offspring
- Causes feminisation
 - In Orchestia gammarellus semi-terrestrial talitrid amphipod
- Microsporidium Dictyocoela gammarellum
 - Present in some host species

Invasive Species

11 December 2015 12:01

Freshwater Ecosystems

- Extensively disturbed by human activity
- Vulnerable to invaders
- Transport of invaders enhanced
 - Construction of canals
 - Transport of ballast water

Aquatic Invasive Species

- 3rd greatest cause of decline in aquatic ecosystems
- In Britain
 - >100 non-native species
 - £26 million of damage each year

Crustaceans

- Most important group of aquatic invaders
- >53% of invaders in European freshwater

Amphipods

- Major group of invasive crustaceans
 - Especially in Europe and north America

- - Broad dietary range
 - Broad habitat preferences

Ecological Impact

- Displacement of native amphipods by invaders
- Reduced flow of nutrients through food webs
- Destabilised ecosystem
 - Vulnerable to further invasions
 - Positive interactions between invaders

Ponto-Caspian Region

- Main source of amphipod invaders
 - At least 10 species have invade Europe and North Africa
- Complex geological history
 - Highly variable
 - Highly instable
- Pont-Caspian species
 - Pre-adapted to disturbed habitats

Dikrogammarus villosus

• Amphipod crustacean