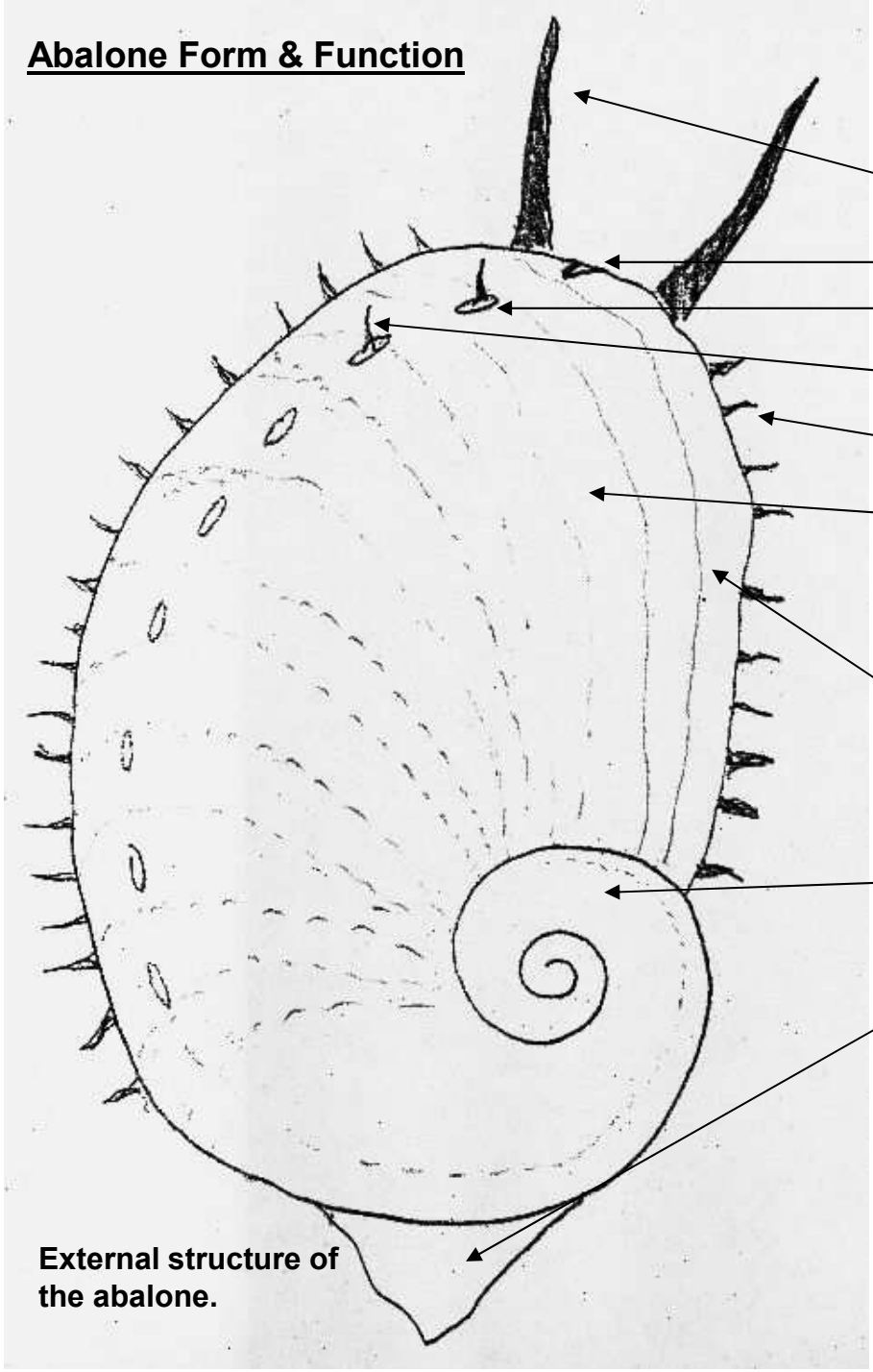
Abalone Form & Function



External structure of the abalone.

- **Cephalic tentacle**
- **Notch**
- **Respiratory pore** allows outflow of water carrying used water, faeces, urine, gametes.
- **Respiratory/Palial tentacles** occupy the respiratory apertures keeping them open.
- **Epipodial tentacles,** sensory function.
- **Shell**

Periostracum
organic layer
Outer prismatic layer
Calcite crystals
Inner nacreous layer
aragonite

- **Growth rings** brought about by changes in growth due to water temperature and food availability.
- **Spire**
- **Epipodium**, a skirt-like extension of the foot.
- **Foot**

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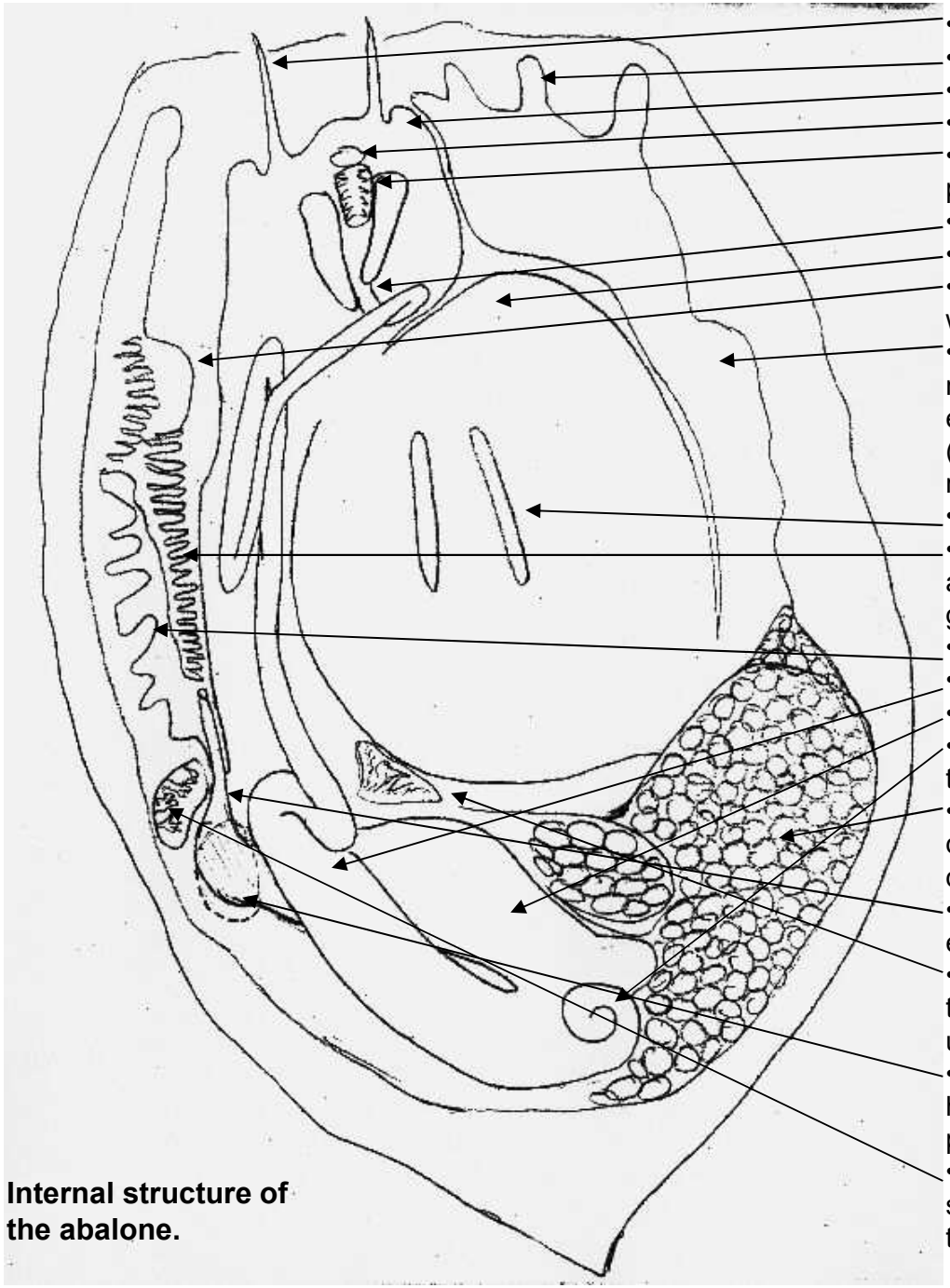

Internal structure of the abalone.

- **Cephalic tentacle**
- **Epipodium & epipodial tentacle**
- **Eye**
- **Snout & mouth**
- **Radula** composed of a chitinous ribbon supported by a pair of cartilaginous
- **Oesophagus**
- **Shell muscle**
- **Osphradia** tests water quality (smells and tastes), sensing when to shut off the respiratory chamber**.**
- **Mantle** a sheet of loose connective tissue containing muscle fibres and rich supply of nervous an vascular elements covered by epithelium, produces the periostracum (organic layer of the shell). Also functions as an accessory respiratory organ.
- **Pedal nerve**
- **Gills (ctenidia),** the bilateral leaflets (lamellae) arise from a central axis (rachis). They function to transport blood, for gaseous exchange and water movement.
- **Hypobranchial gland** produces mucus.
- **Crop** stores ingested food awaiting digestion.
- **Stomach**
- **Spiral caecum** receives secretions from the digestive tubules.
- **Digestive tubules** consists of a mass of blind-ending digestive tubules joined by ducts produce enzymes to digest proteins, lipids & carbohydrates.
- **Rectum** empties faeces into the respiratory chamber for expulsion.
- **Right kidney** has a filtering function - similar to the terrestrial kidney. Gametes also pass through this organ upon exit.
- **Heart** wraps around the rectum. Mechanically pumps the haemolymph and also has a filtration function for urine production.
- **Left kidney** located next to heart & rectum has a bag-like structure and play a role in defence - similar to the terrestrial spleen.

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Abalone Biology & Culture Requirements

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Species

Haliotis rubra = Blacklip abalone

Haliotis laevigata = Greenlip abalone

Haliotis roei = Roe's abalone

Haliotis conicopora = Brownlip abalone

Haliotis scalaris = Staircase abalone

Survival

Larvae 30-40% (up to 90% if antibiotics used)

Settlement 20-40% (up 60% in some instances)

Grow to 100mm in 12-18 months

Diet

Larvae: First 2 weeks on diatoms & then *Uvella lens.*

4-5 mm: Navicula diatom

>5 mm: Pelleted diet

Water movement

Water flow optimal between 3-15 L/min (higher in hatchery, ~3.5L/min in growout).

Feed intake increases with higher water movement (in the wild, this is when abalone "catch" fragmented algae).

Suspended solids

Faecal wastes are mildly acidic, anoxic and chemically reduced. Decreasing fibre in food will decrease solid wastes.

Temperature

Optimal for Greenlip	18.3^{o}C with range 17-19^{o}C
Optimal for Blacklip	17.0^{o}C with range 17-24^{o}C

Diurnal variations may also impact growth rates.

pH

Greenlip	7.78-8.77 (optimal
Blacklip	7.93-8.46
Hazardous if	<7.16 or >9.01

Haemolymph calcium begins to be mobilised at pH 7.76.

Salinity

Optimal	35 ppt
Greenlip & Blacklip	25-40 ppt

Better recovery from low salinity rather than high salinity.

Stocking density

No more than	40 kg/m^2
Average commercially	10 kg/m^2

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Diagnostic techniques

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Oxygen

Low DO for 24h → lowered immunity.

DO <80% → ciliate infestation.

DO <4.3mg/L (>56% saturation) → increased mucus cells in gills.

Ammonia

Chronic exposure is detrimental and its effect depends on the interaction with dissolved oxygen.

>0.073 mg/L FAN → decreased growth.

>0.188 mg/L FAN → histological changes in right kidney.

Nitrite

Even low concentrations can be detrimental.

>0.43 mg/L → decreased growth.

>7.8 mg/L → histological changes.

Refuge

Increases productivity at high density.

Anaesthetics

All have depressive effects on growth rates. Moving abs is a real stressor and especially at higher temperatures.

Magnesium sulfate appears to have the least side-effects, followed by benzocaine.

Iodine

Use iodine to visualise abscesses grossly (stains up the carbohydrates).

Mudworm – Vermifuge

50% ethanol + 50% seawater

Phenyl solution

Incubate shells at room temperature overnight and examine sieved material.

Haemocyte count

Draw haemolymph from the junction between the mouth and the foot with a 25G needle and syringe.

Bacteriology

Culture haemolymph and swabs from gill.

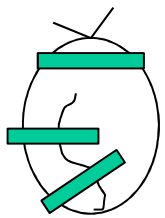
Perkinsus test

Incubate at room temperature, sections of foot muscle in Ray's fluid thioglycolate media for 5-7 days in the dark to encourage sporulation by parasite. Examine material microscopically.

Histology

Used to detect presence of any other diseases.

3 routine sections are sampled for testing.



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References:

Illustrations by R. Loh.

Abalone form & function summarised from:

Bevelander, G (1988) ***Abalone Gross and Fine Structure.*** Boxwood Press, U.S.A.

Abalone biology & culture requirements summarised from:

Burke, CM, Harris, JO, Hindrum, SM, Edwards SJ & Maguire GB (2001) ***Environmental requirements of abalone.*** University of Tasmania, Australia.

And other sources.

Diagnostic techniques based on personal experience.

The Fish Vet's Details:

Dr Richmond Loh

BSc, BVMS, MPhil (Pathology), MANZCVS (Aquatics), MANSCVS (Pathobiology)

Phone: +61 (0)4 2182 2383

Email : thefishvet@gmail.com

Web: http://www.thefishvet.com.au