



Department of
Primary Industries

Anaesthesia and Analgesia of fish

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Marine fish production and enhancement

Plan of talk

- Who uses anaesthetics for fish
- Why anaesthetics are used
- When anaesthetics are used
- How anaesthetics are used
- What types of drugs are used
- Preparation and monitoring needed
- Euthanasia
- Analgesia



Who uses anaesthetics on fish

- Aquaculture (range of procedures)
- Fish research (e.g. zebra fish, 600 labs globally)
- Public zoos and aquaria wanting to provide improved veterinary care of their fish



Do fish feel pain?



Contentious!

Both sides of the argument set the same requirements for pain reception but opinions differ on where the criteria appear phylogenetically and whether or not parallel systems have evolved in different classes and species.

Nevertheless,

Fish display robust neuroendocrine and physiologic stress responses to noxious stimuli



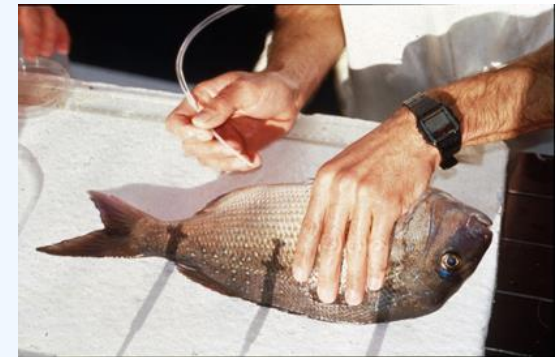
Why is chemical restraint needed

- Increase safety for fish and handler
- Procedures can be done out of water
- Reduces movement and physiologic changes in response to pain stimuli
- Reduces excitement and hyperactivity related trauma that can occur in routine handling = lowers mortality and morbidity
- Decreased movement minimises integument damage and osmoregulatory disturbances,
- Reduces metabolism and oxygen demand and produces less waste (CO₂ and ammonia)



When is anaesthesia used

- fish handling
- post-harvest transportation
- diagnostic procedures
- surgery/gavage
- artificial breeding
broodfish anaesthetised to enable gamete sampling, hormone injection, and egg and milt stripping
- euthanasia.



How are anaesthetics administered

- Immersion = inhalation
 - drug ventilated in solution
 - enters bloodstream via gills/skin
 - passes rapidly to CNS

Most common method

- Parenteral

oral (metomidate only one?)

intravaenous injection

Intracoelomic injection

Intramuscular injection (hand syringe, pole syringe, darting)



Drugs used for IMMERSION anaesthesia

- Tricaine methane sulphonate (MS-222)
- Benzocaine
- Clove Oil, Eugenol, Isoeugenol, AQUI-S
- Metomidate
- 2-Phenoxyethanol
- Quinaldine & Quinaldine sulphate
- Azaperone
- Medetomidine (atipamezole 6x dose for recovery)
- Isoflurane and Halthane
- Oxygen (for some sharks)



Drugs used for PARENTERAL anaesthesia

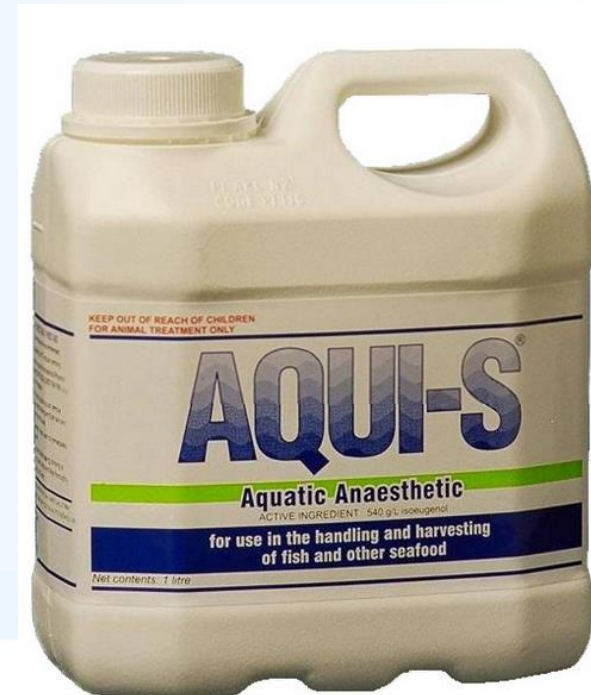
- Ketamine (IM, IV)
- Medetomidine + ketamine (IM; atipamezole for recovery in some sharks)
- Xylazine + ketamine (IM)
- Propofol (IV)
- Alfaxolone/Alfadolone (for sensory physiology)



Why select a particular anaesthetic

- **Efficacy** (rate of induction/recovery, margin of safety, adverse responses)
- **Ease of use – administration** (mixing, water solubility, pH)
disposal
- **Toxicity to users**
- **Cost**

Most widely used immersion anaesthetic (isoeugenol)



Aqui-S advantages



- Approved in Australia, NZ, Norway, Korea, Costa Rica, Honduras with Zero withholding period
- Soluble in freshwater and seawater
- Effective at low concentration 5-20mg/L
- Sedative effects detected at low concentrations
- Wide margin of safety – fish can remain in treatment for long periods of time
- Limited adverse response
- Fast recovery
- Cost effective



Levels of anaesthesia in fish

5.2 Levels of anaesthesia

Level	Description	Signs displayed
0	Normal behaviour	Reactive to stimuli. Good muscle tone, normal equilibrium and operculum rate.
1	Sedation	Equilibrium maintained. At lighter levels there is some reaction to external stimuli and normal opercular rates. Deeper levels show no reactivity to mild external stimuli and reduced opercular rates.
2	Light anaesthesia	Opercular rate increases initially, then decreases as anaesthesia deepens. Progressive loss of equilibrium. Reacts to only deep pressure stimuli. Colour changes may be seen.
3	Surgical anaesthesia	No reaction to any stimuli. Slow opercular rate, with operculum spread. No muscle tone, no equilibrium control.
4	Medullary collapse	Cessation of operculum movements, followed some time later by cardiac arrest.



Essential preanaesthetic preparation

1. **Baseline behavioural parameters** (ventilation, caudal fin stroke rate, overall activity level, schooling behaviour)
2. **No food for 12-24 h – limits regurgitation** (clogs gills / nitrogenous waste)
3. **Containers with adequate water for transportation, induction, maintenance, recovery, possible water changes**
4. **Water quality same as source water** (DO, pH, temp, salinity)
5. **Out of water plan to prevent drying** (skin, fins, eyes)
6. **PPE** (masks for powders, gloves)



Monitoring



Anaesthetic depth (e.g. activity, reaction to stimuli, equilibrium, jaw tone, muscle tone, caudal fin strokes, swimming, respiratory rate)

- Usually occurs within 5-10 minutes
- often a short excitement phase during immersion; coughing reflex

Cardiopulmonary Activity (can be monitored with cardiac ultrasonography, Doppler flow probes, ECG; blood gas sampling for O₂, CO₂ and pH)

Water Quality (DO, pH, temp, ammonia)

Recovery (occurs when fish returned to aerated, anaesthetic-free water; often 5-10min; might show excitement phase – protect fish and handler)

Resuscitation (may require forward movement through water or irrigation of gills)





Sedation
(5 ppm Aqui-S)





Light anaesthesia
(10 ppm Aqui-S)



Heavy (surgical) anaesthesia
(20 ppm Aqui-S)



Gavaging medicated feed

Euthanasia

- Overdose of immobilization drug is usually acceptable
- Mostly use Immersion drugs MS-222 and benzocaine at 5 -10x anaesthetic concentration
 - Large fish - poured onto gills
 - Maintaining fish in solution 5-10 mins after cessation of opercular movement = expired
 - Cardiac asystole lags behind brain death (myocardial cells use local glycogen stores)
 - Or cranial concussion, pithing, spinal transection, exsanguination used in deeply anaesthetised fish



Analgesia

Limited information is available about the use of analgesics in fish

- Drugs listed as anaesthetics are often assumed to provide analgaesia if they result in complete immobilisation of the fish but depends on drug property – caution needed!
- Some studies with morphine (rainbow trout) and butorphanol (koi carp) have shown some analgaesic or at least antinociceptive action



ACEC Guideline NSW Fisheries



A Guide to Acceptable Procedures and Practices for Aquaculture and Fisheries Research

3rd Edition



**Barker, D., Allan, G.L., Rowland, S.J., Kennedy, J.D.
and Pickles, J.M.**

for the
Primary Industries (Fisheries) Animal Care and Ethics Committee

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