



# Anaesthesia and humane killing

Tor E. Horsberg  
Norwegian School of  
Veterinary Science





# ”Anaesthetic” agents for fish

- Waterborne administration
  - metacaine (MS-222)
  - benzocaine
  - CO<sub>2</sub>
  - 2-phenoxyethanol
  - quinaldine
  - chlorbutanol
  - metomidate
  - etomidate
  - propoxate
  - isoeugenol
  - halothane
- Parenteral administration
  - alphaxalone/alphadolone
  - ketamine
  - pentobarbital Na
  - etorphine
  - xylazine
  - lidocaine (local analgesia)
- Hypothermia
- Electroanaesthesia



# Minimisation of stress

- Gentle netting
- Gentle handling – wet latex gloves (avoid rubber gloves)
- Use a wet chamois leather on the bench
- Constant temperature – irrigation of skin
- Protect from sound and light





# Why do we need to anaesthetise fish?

## Need for immobilisation

- \* weighing
- \* grading
- \* artificial spawning
- \* injections (e.g. vaccination)
- \* sampling (e.g. blood)

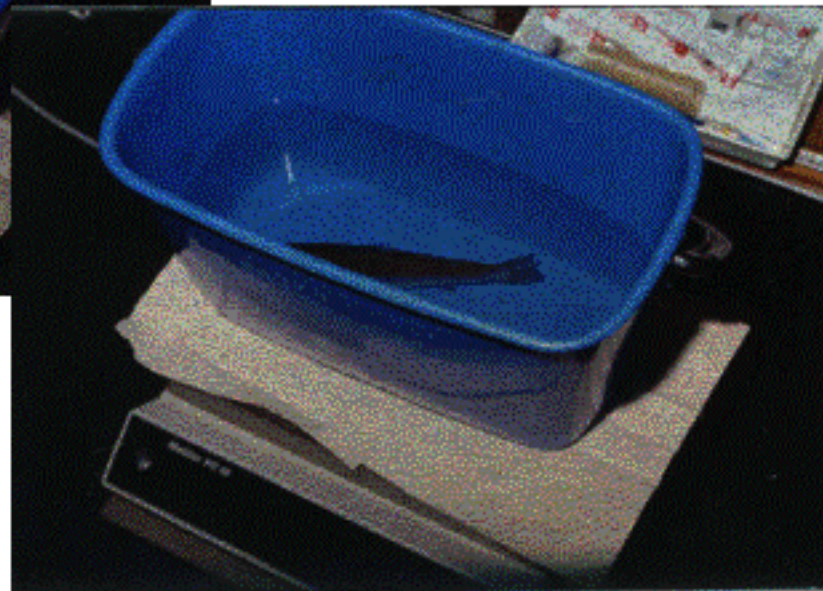
## Need for relief of pain

- \* cannulation
- \* operations





# Weighing





# Gavaging







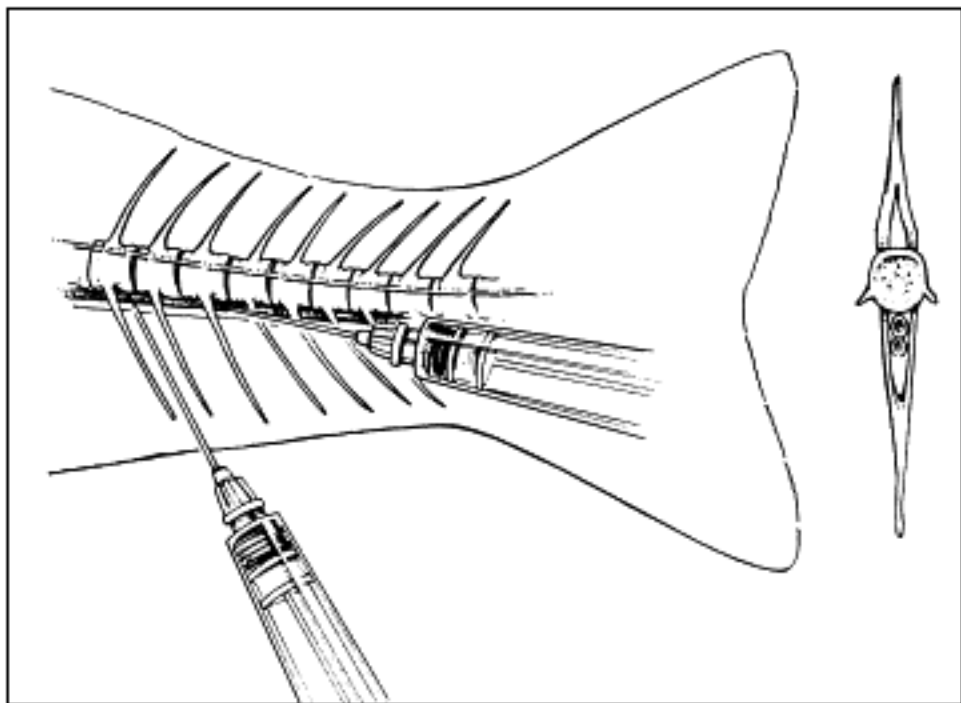
# Vaccination





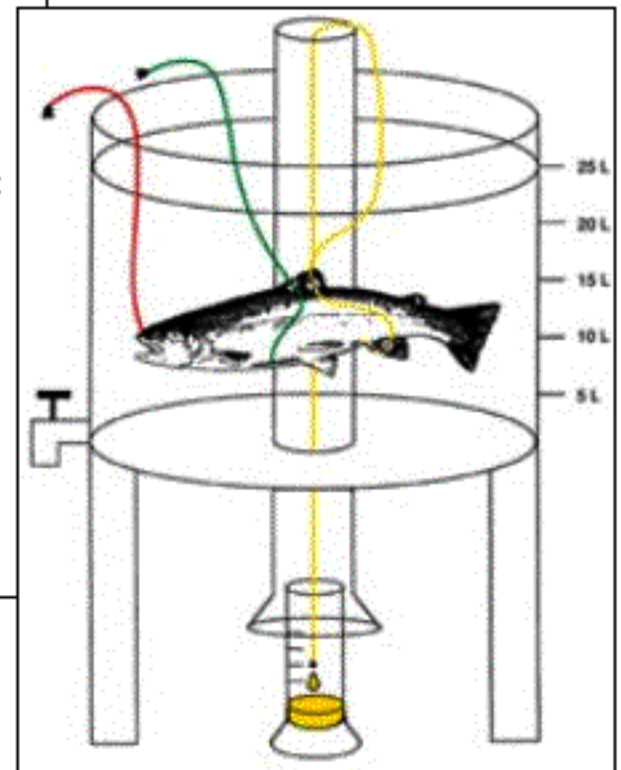
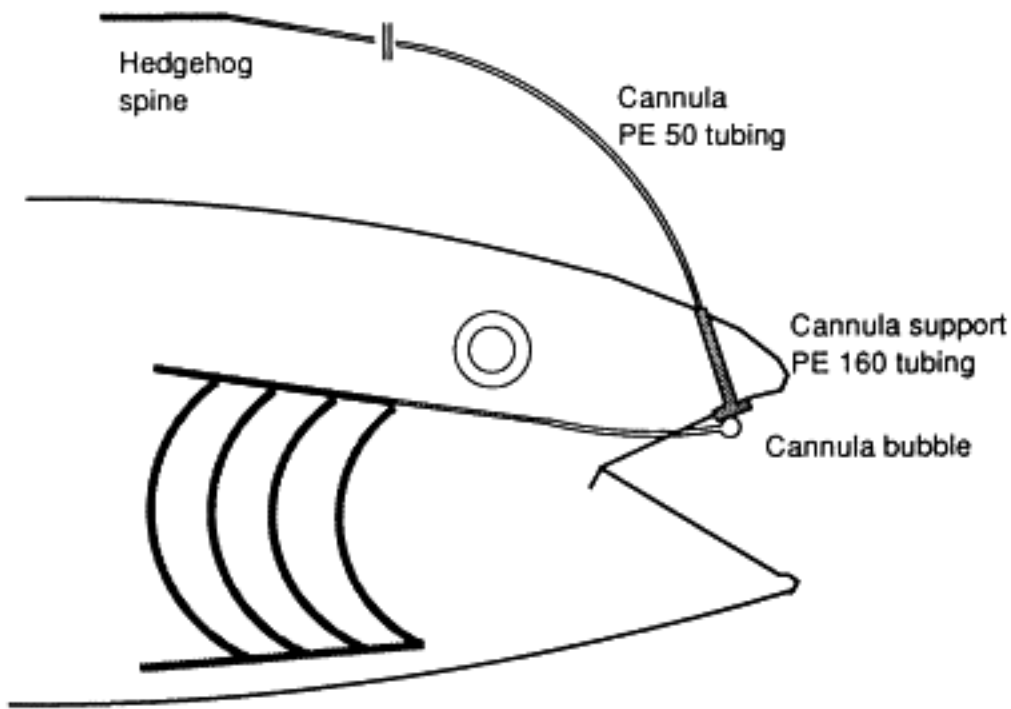


# Bloodsampling / iv. injections



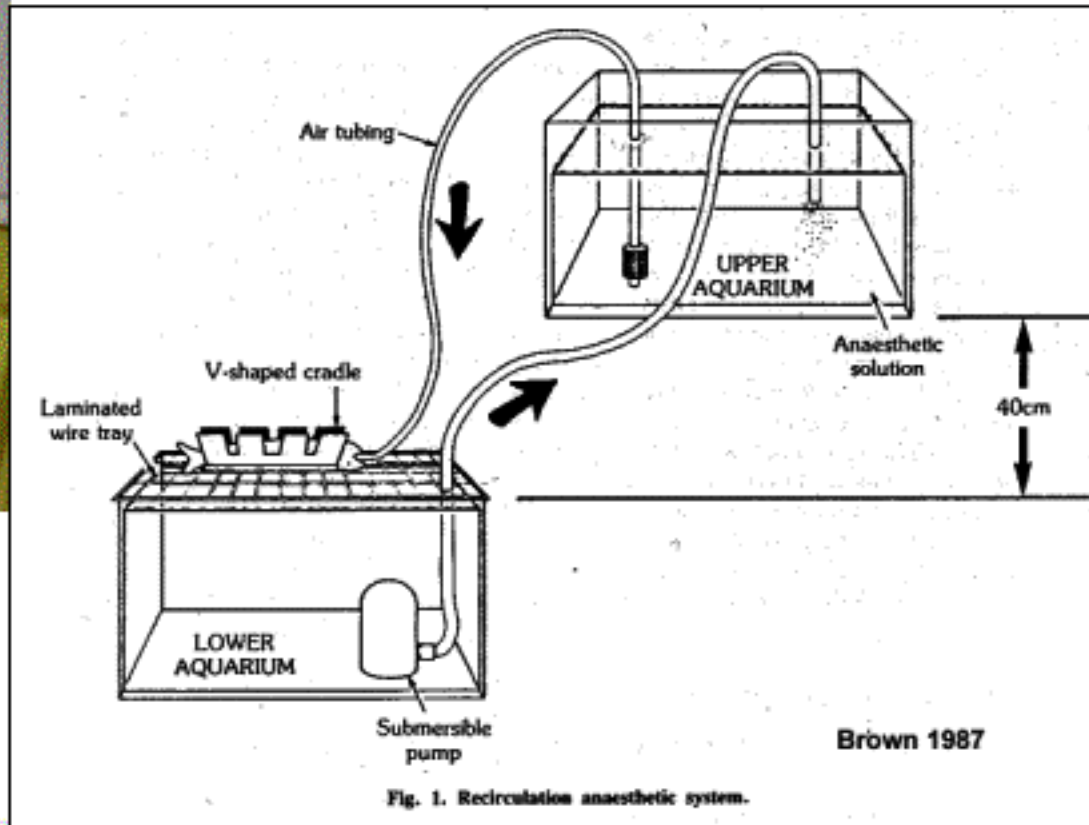


# Cannulation





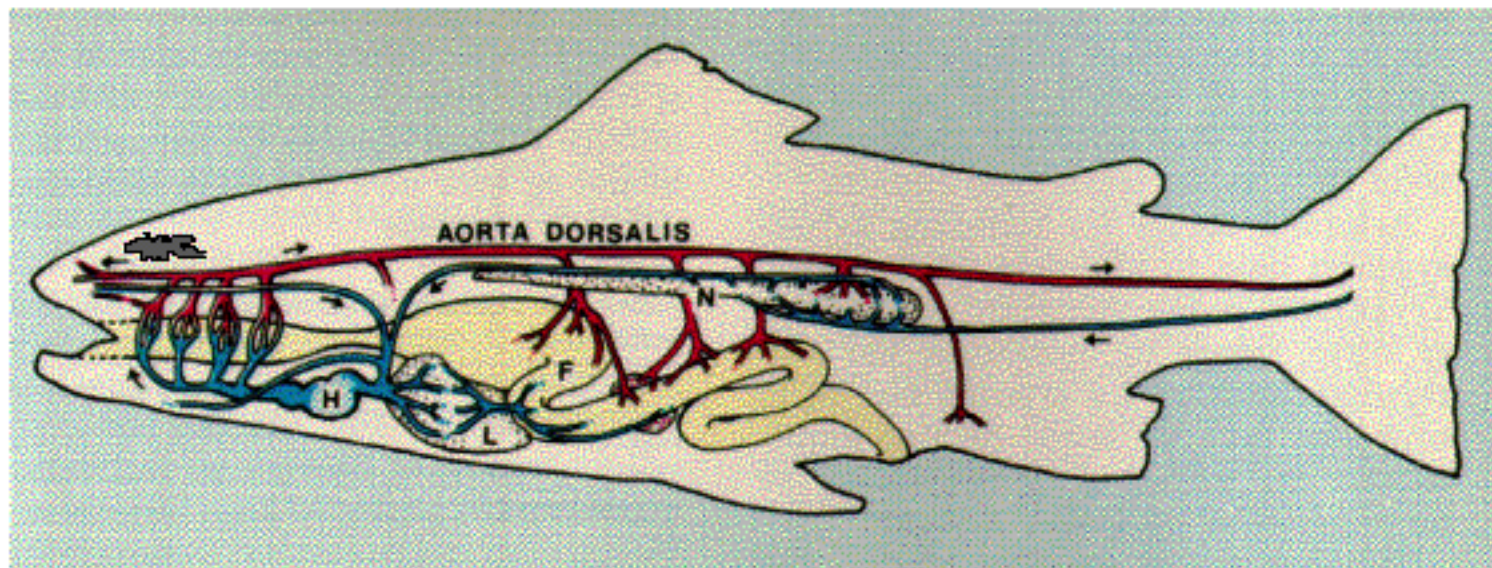
# Anaesthetics in the water - “inhalation anaesthesia”







# Pharmacokinetic properties





# Important factors

- Species
  - Gill surface
  - Basic metabolism
- Size
- Nutritional status
- Environmental parameters
  - temperature
  - pH
  - oxygen
  - water pressure?



# Different stages of anaesthesia

TABLE 1.

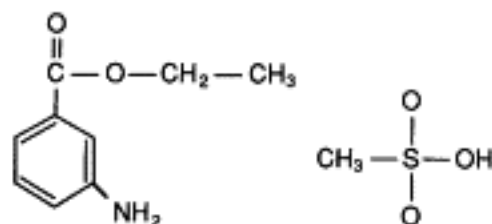
Classification of the Behavioral Changes That Occur in Fishes During Anesthesia  
(Levels of anesthesia considered valuable to fisheries work are in bold face type)

Definable levels of anesthesia			Behavioral responses of fish
<i>Stage</i>	<i>Plane</i>	<i>Word equivalents</i>	
0		Normal	Reactive to external stimuli, equilibrium and muscle tone normal
I	— 1	Light sedation	Slight loss reactivity to external stimuli (visual and tactile)
I	— 2	Deep sedation	Total loss reactivity to external stimuli except strong pressure, slight decrease opercular rate
II	— 1	Partial loss equilibrium	Partial loss muscle tone, react only to very strong tactile and vibrational stimuli, rheotaxis present, but swimming capabilities seriously disrupted, increase opercular rate
II	— 2	Total loss equilibrium	Total loss muscle tone, react only to deep pressure stimuli, decrease opercular rate below normal
III		Loss of reflex reactivity	Total loss of reactivity, respiratory rate very slow, heart rate slow
IV		Medullary collapse	Respiratory movements cease, followed several minutes later by cardiac arrest



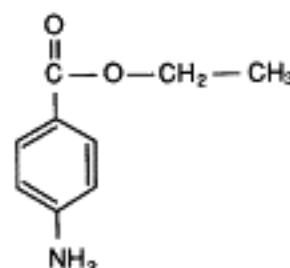


# Metacaine and benzocaine



metacaine (MS 222™, tricaine)

m.w. 261.3



benzocaine

m.w. 165.2

- introduced as a fish anaesthetic in 1932!
- derivatives of local anaesthetics
- blocking sodium-channels
- excellent immobilisation and muscle relaxation
- general stabilising effect on membranes
- good analgesic effect (?)



# Metacaine – dosage examples

SPECIES	CONCENTRATION	DURATION	NOTES
<i>Rainbow trout</i> quick procedures	265 mg/l	30 sec.	max. 1 min.
<i>Rainbow trout</i> normal procedures	80 mg/l	15 min.	mortalities after longer exposures
<i>Rainbow trout</i> transportation	25 mg/l	up to 8 hours	
<i>Salmon fingerlings</i> fin-clipping	60 mg/l	10 min.	
<i>Goldfish</i>	250 mg/l	4 - 10 min.	
<i>Frogs</i> adults	350 mg/l	10 - 15 min.	
<i>Frogs</i> juveniles	80 mg/l	10 - 15 min.	



# Benzocaine: dosage - salmonids

Duration	Dosage	Induction time	Max. exponation time	Recovery time
Short lasting	50 mg/l	about 3 min	15 min	about 5 min
	100 mg/l	about 1 min	5 min	about 3 min
Long lasting	20 mg/l		> 1 time	about 7 min



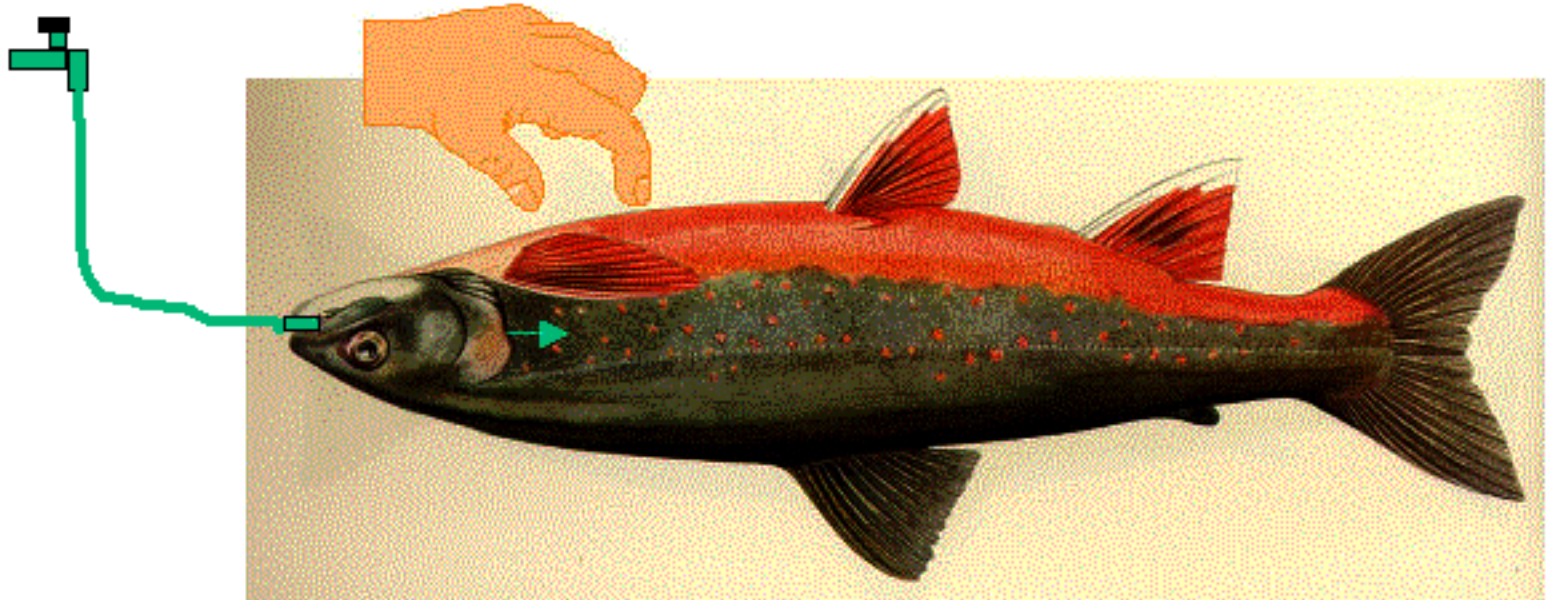


# Side effects, benzocaine

- Hypoxia
    - Increased hematocrit
    - Increased levels of
      - cortisol
      - glucose
      - lactate
      - potassium, magnesium
  - Little margin of safety for
    - flatfish
    - marine whitefish (cod, coalfish etc.)
- } NB!  
oxygenation

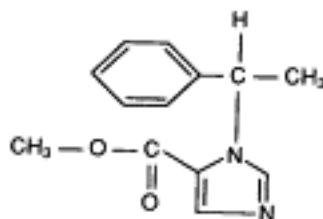


# First aid

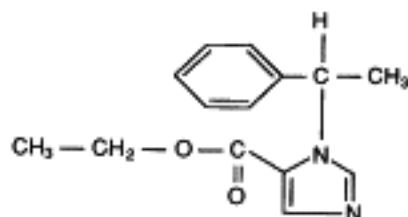




# Metomidate and etomidate



metomidate



etomidate

- Hypnotic agents (inducing sleep)
- No analgesia! Combination with local analgesics (e.g. lidocaine) for putative painful procedures
- Little depression of respiration
- Suppression of cortisol release
- Good margin of safety for marine species
- Not for food-producing animals



# Dosages of metomidate

Effect	Dosage	Induction time	Max.expo- nation	Recovery
Sedation	0.5 - 3 mg/l	about 10 min.	hours	?
Immobilisation	5 - 10 mg/l	about 3 min.	15 min.	about 15 min.

***NB! Not for putative painful procedures unless in combination with local analgesics***



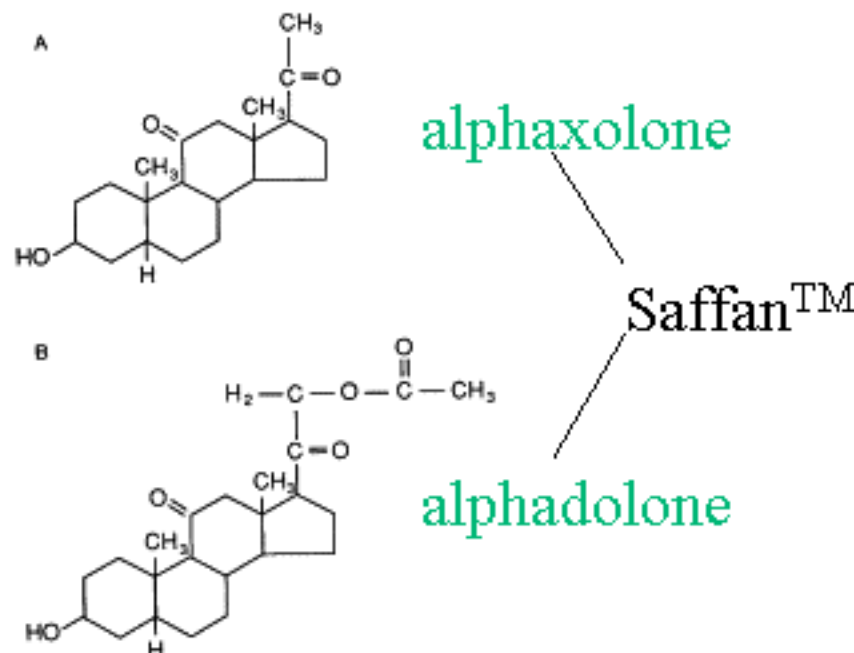


# Other bath agents

- CO<sub>2</sub> gas
  - general anaesthesia
  - panic-like reactions during induction
  - slaughtering (often combined with *in-vivo* chilling)
- Isoeugenol (Aqui-S™)
  - clove oil
  - sedation and anaesthesia
  - handling procedures
  - slaughtering (New Zealand and Australia)
  - not for food-producing animals in Europe (yet)



# Injection anaesthetics



- Steroid
- Increased respiration
- Dosage, salmon:
  - 12 mg/kg i.p. (= 1 ml Saffan pr. kg)
  - Effect after about 15 min.
  - Duration: about 2 h

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Ketamine 15 - 20 mg / kg i.m.



# Euthanasia

- **Slaughtering**
  - CO<sub>2</sub> gas (combined with chilling) + bleeding
  - Electroanaesthesia + bleeding
- **Destructive sampling**
  - Blow to the head (combined with spinal severance)
- **Destruction of larger quantities of fish**
  - Overdose of anaesthetic (e.g. 200 mg/l benzocaine for a minimum of 10 min.)
  - CO<sub>2</sub> gas

