



INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET



Development of anaesthetic protocols for lumpfish (*Cyclopterus lumpus* L): Effect of concentration, temperature and body weight

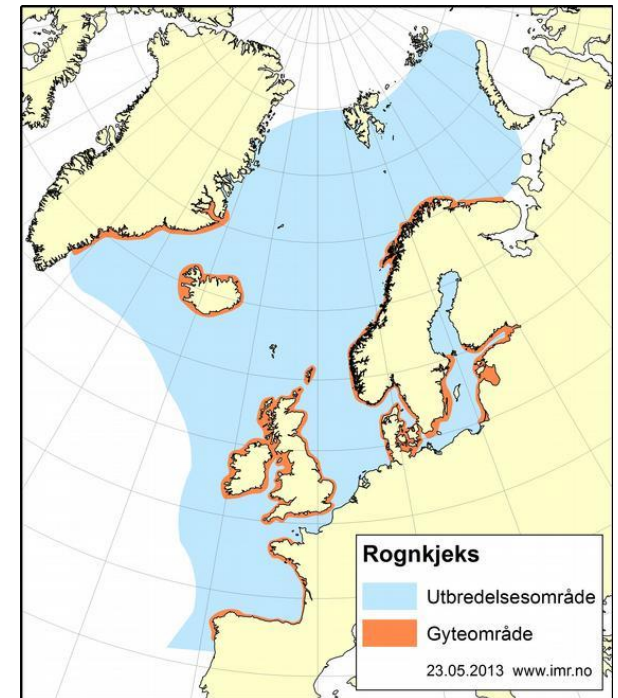
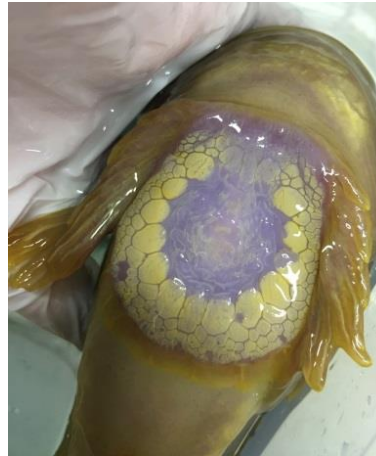
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Bergen, 06.03.18

Lumpfish – *Cyclopterus lumpus*

- Family *Cyclopteridae*
- Widespread from Biscaya to Island, Barent sea
- Common along the coast of Norway, tolerate low temperatures.



Consumption of salmon-lice drugs from 2007 to 2016

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Azametifos		66	1 884	3 346	2 437	4 059	3 037	4 630	3 904	1 269
Deltametrin	29	39	62	61	54	121	136	158	115	43
Cypermethrin	30	32	88	107	48	232	211	162	85	48
Hydrogen-peroksid (100%) tonn			308	3 071	3 144	2 538	8 262	31 577	43 246	26 597
Emamectinbenzoat	73	81	41	22	105	36	51	172	259	232
Diflubenzuron			1 413	1 839	704	1 611	3 264	5 016	5 896	4 824
Teflubenzuron			2 028	1 080	26	751	1 704	2 674	2 509	4 209

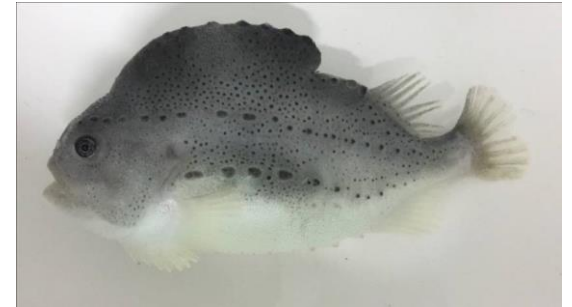
- Dramatic increase in consumption of anti sea-lice drugs from 2009.
- Reduced sensitivity/resistance.
- Alternative methods for de-licing



Alternative methods

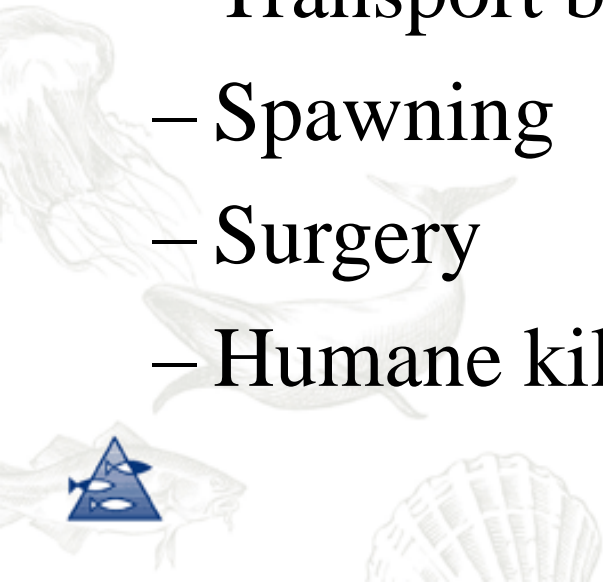
Use of cleanerfish

- Lumpfish eat salmon lice also at low temperatures
- Increased use of lumpfish in salmon farming
- Thirty manufacturers in 2016
- The goal is a total annual production of 55 millions cleanerfish

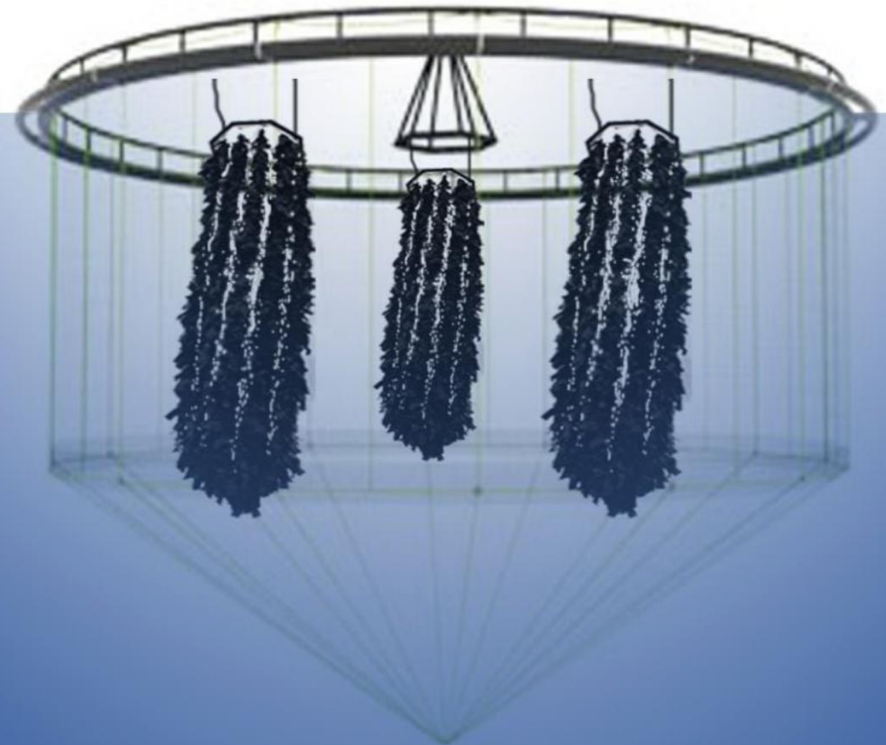


Lumpfish has become a farmed fish

- May be exposed to a number of treatments/procedures :
 - Vaccination
 - Blood sampling
 - Transport between destinations
 - Spawning
 - Surgery
 - Humane killing

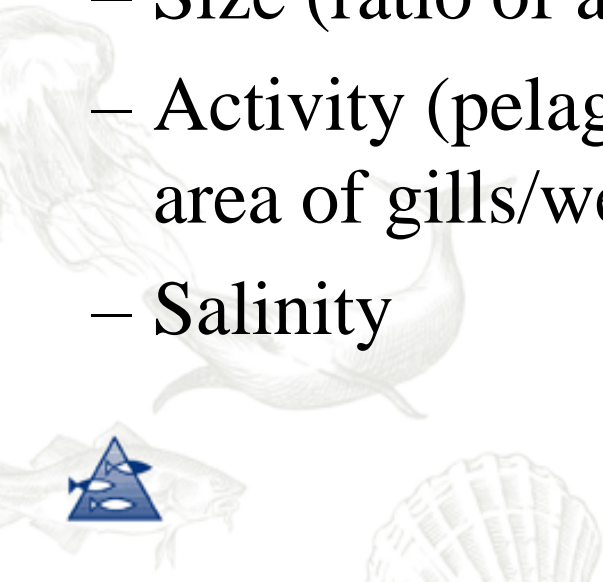


**Good welfare for
lumpfish in the cages.
«Dyrevelferdsloven»**



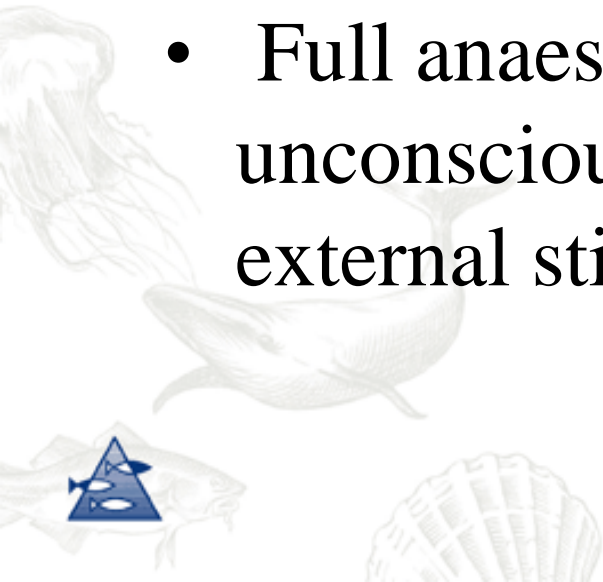
Need a protocol for anaesthesia of lumpfish

- Criteria to be considered when anaesthetising fish:
 - Main organ for absorption is the gill.
 - Temperature (metabolism, oxygen consumption, heart rate, gill movement)
 - Size (ratio of area of gills/ weight)
 - Activity (pelagic vs demersal fish, area of gills/weight)
 - Salinity



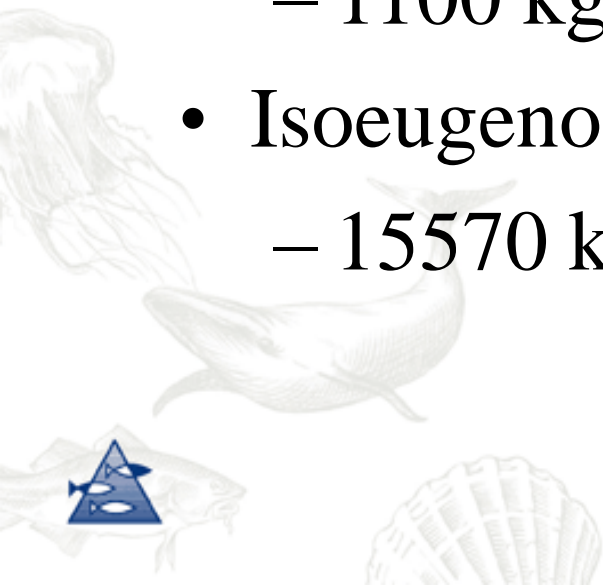
Anaesthetic levels

- Sedation. Calm the fish, reduced awareness, still in equilibrium. Reacts little to external stimuli and disturbances. Transport of the fish.
- Full anaesthesia, then the fish is unconscious and does not respond to external stimuli.



Most used anaesthetics in Norwegian fish farming

- Metacaine (Finquel, Tricaine Pharmaq)
 - 5440 kg active substance in 2015
- Benzocaine (Benzoak)
 - 1100 kg active substance in 2015
- Isoeugenol (Aqui-S aqua)
 - 15570 kg active substance in 2015



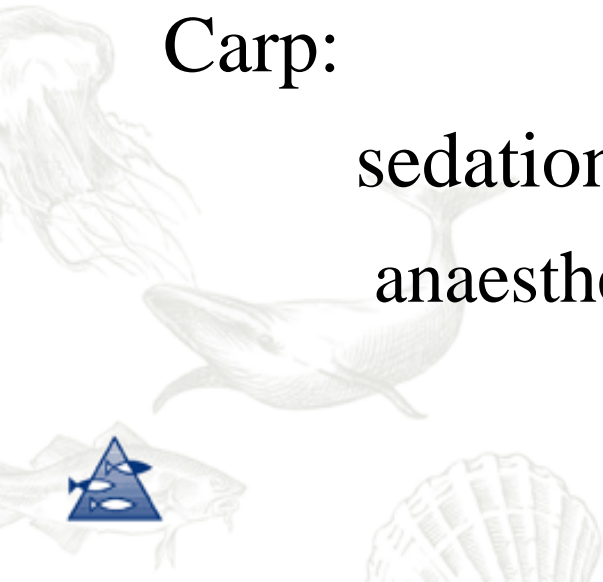
Metacaine: doses

Salmon:

sedation:	7-30 mg/L
light anaesthesia	30-80 mg/L
deep anaesthesia	80-100 mg/L

Carp:

sedation:	20-30 mg/L
anaesthesia	30-200 mg/L



Benzocaine: doses

- Salmonids:
 - Anaesthesia 30 - 40 mg/L



Isoeugenol: doses for salmonids

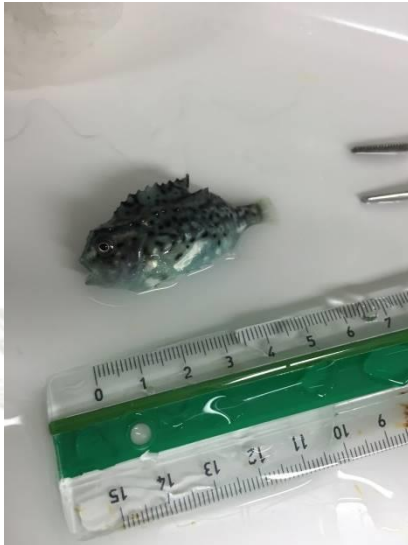
Sedation: 2-5 mg/L. Maximum exposure 5 hours.

Anaesthesia: 10-14 mg/L. Maximum exposure
15 minutes



Goal of the study

- Effects of temperature and size (weight)
- Dose optimization (induction and recovery time)
- What criteria to use to determine anaesthetic level
- Determine therapeutic window



Effects of temperature and size (weight)

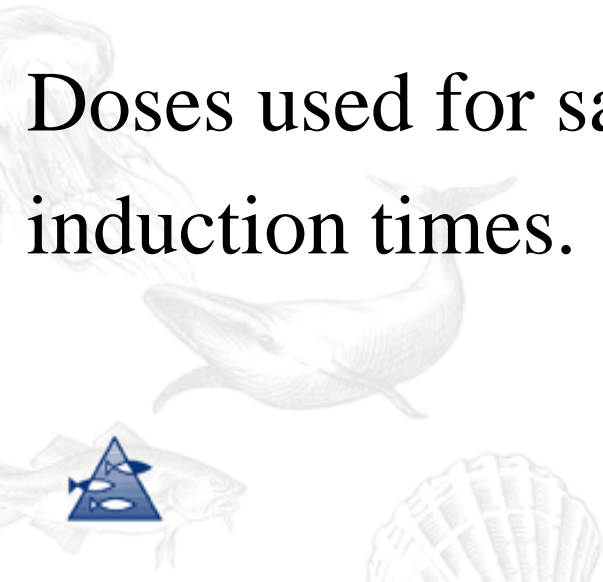
- Three sizes of fish
 - 10-20g
 - 200-400g
 - 600+g
- Two temperatures
 - 6°C
 - 12°C



Dose optimization

- Finquel vet 100, 200, 400, 800, 1600 mg/L (80-100 mg/L)
- Benzokain 100, 200, 400, 800 mg/L (30-40 mg/L)
- Aqui-S vet 10, 20, 40 mg/L (10-14 mg/L)

Doses used for salmonids gave long induction times.



What criteria to use?

- Measure “Induction time”:
 - Stop in respiration/gill movement
- Recovery
 - First respiration/gill movement
 - Normal respiration
 - Starts to swim, turns the right way if laid on the back



Response to external stimuli

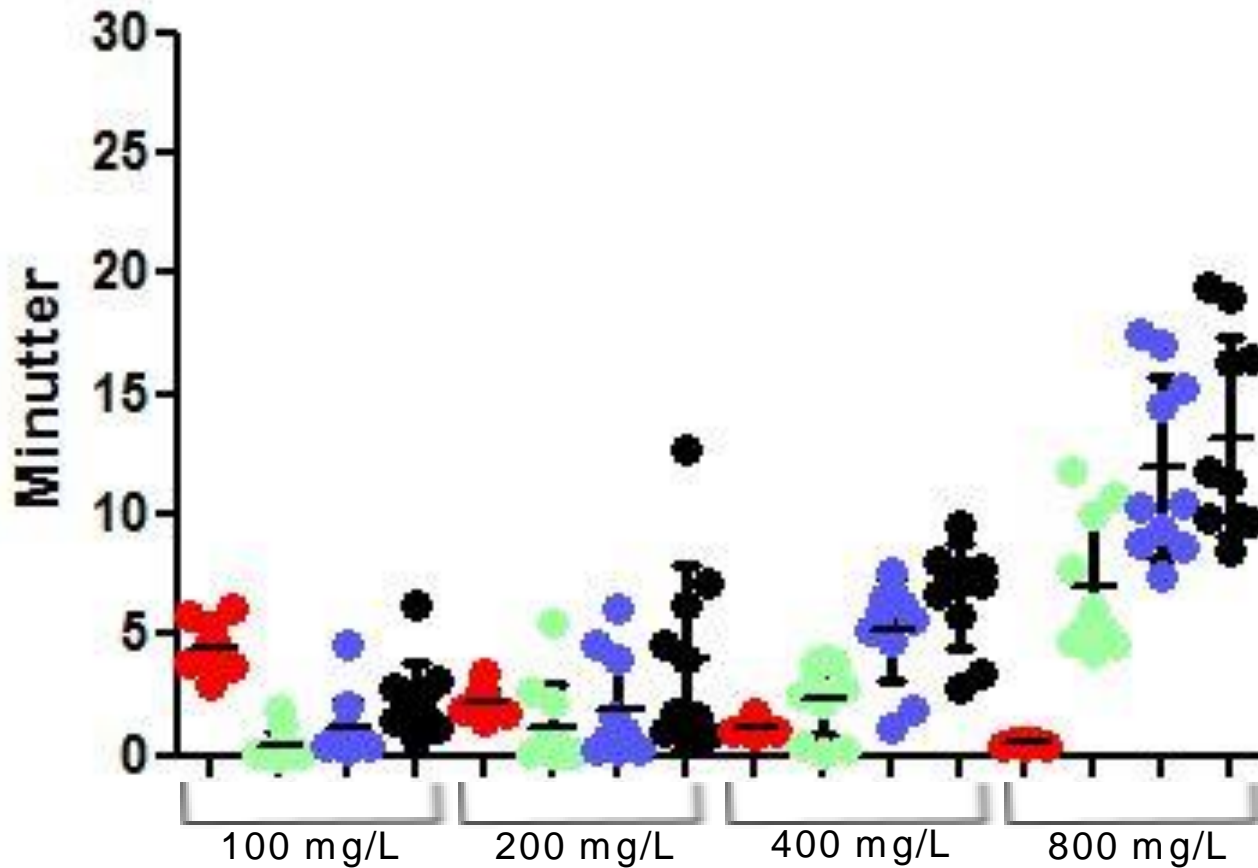
- Handling or pinching in the tail? **NO**
- Stab in the tail with a syringe needle? **NO**
- Pinch with a tweezers in the lip? **YES**



Induction and recovery

(10-20g, 6°C, n=10)

Benzocaine

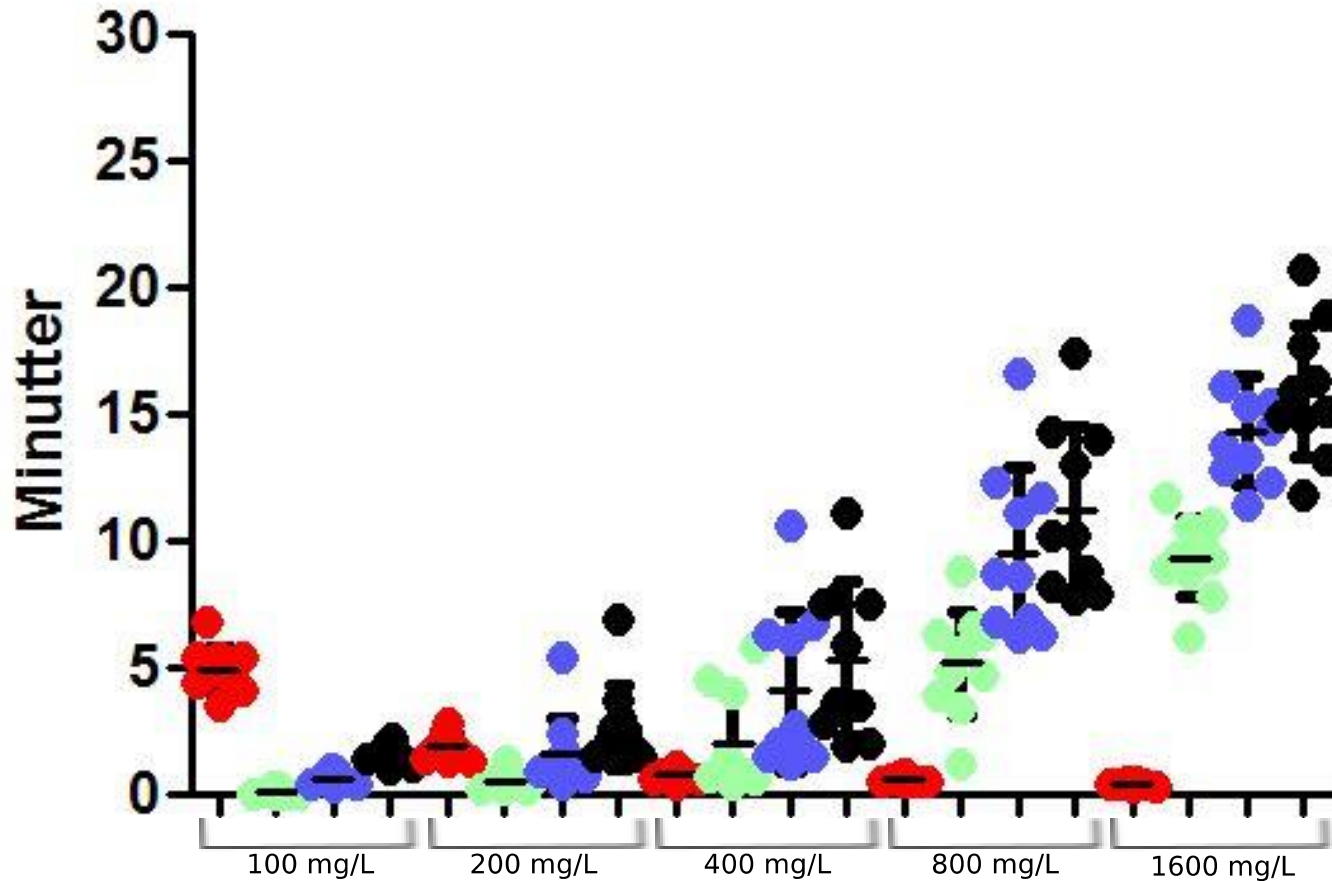


- Respiration stop
- Respiration start
- Normal respiration
- Starts swimming

Induction and recovery

(10-20g, 6°C, n=10)

Metcaine

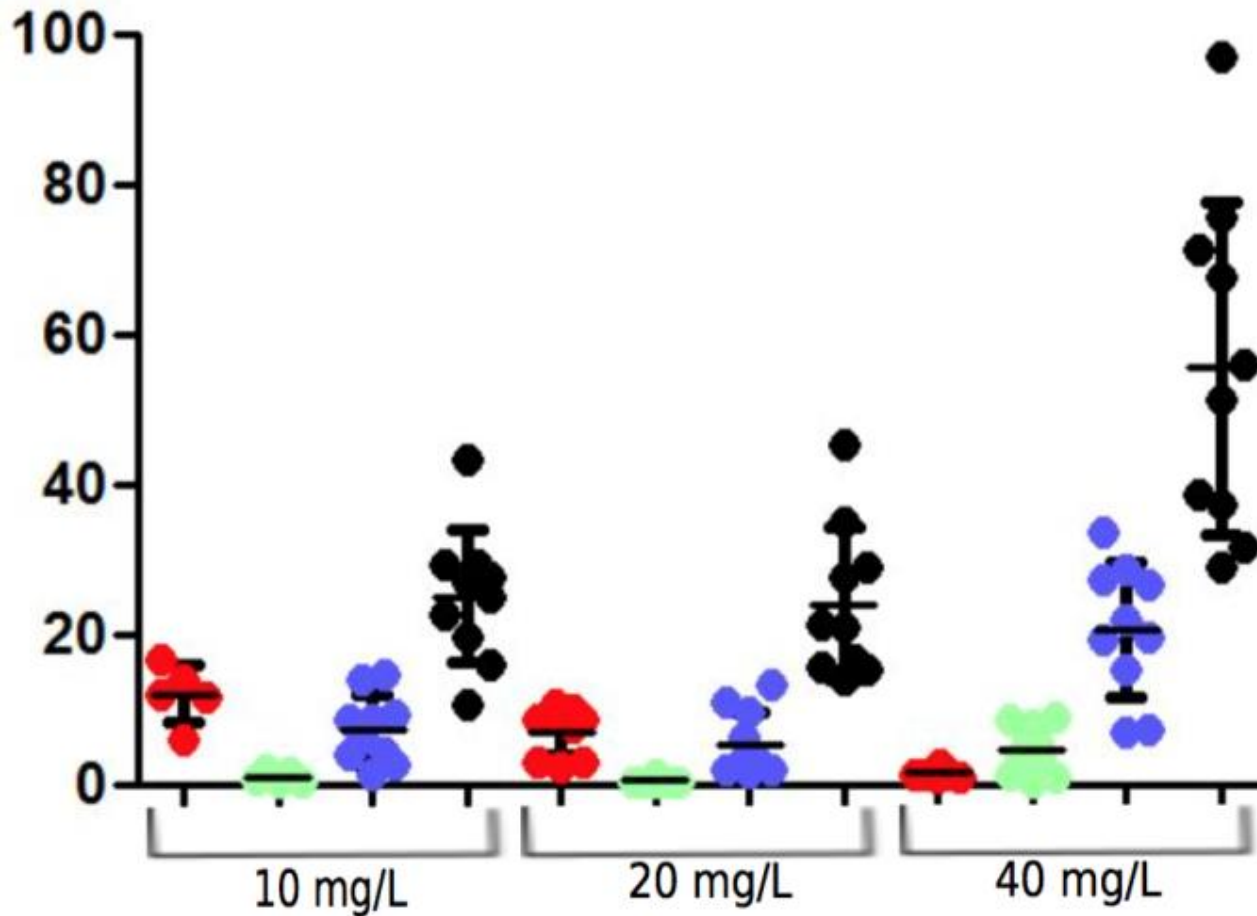


- Respiration stop
- Respiration start
- Normal respiration
- Starts swimming

Induction and recovery

Isoeugenol

(10-20g, 6°C, n=10)



- Respiration stop
- Respiration start

- Normal respiration
- Starts swimming

Therapeutic window



6°C and 10 g fish

Medikament		Benzokain				Isoeugenol			Metacain				
Dose		100	200	400	800	10	20	40	100	200	400	800	1600
Eksp.tid(min)	0	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
	10	0/5	0/5	0/5	5/5	-	0/5	3/5	0/5	0/5	0/5	3/5	5/5
	30	1/5	1/5	5/5		-	5/5	5/5	0/5	2/5	4/5	5/5	
	60	3/5	5/5			-			4/5	5/5	5/5		

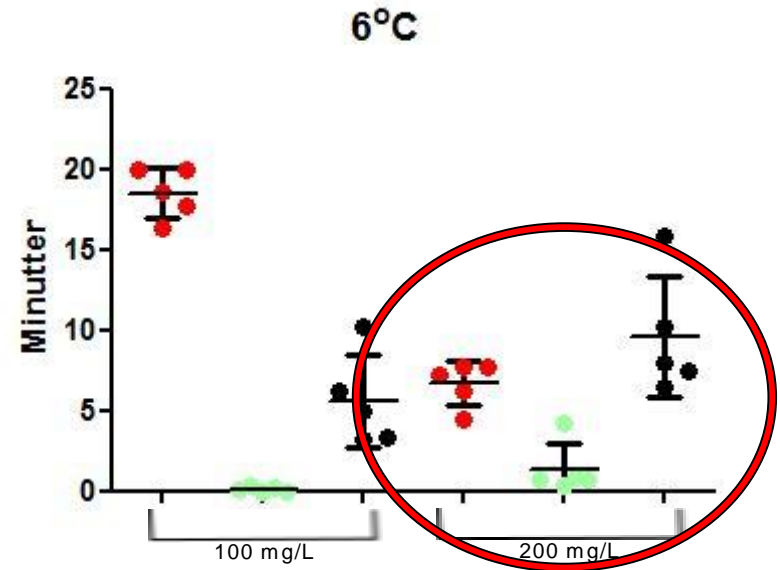
12°C and 10 gram fish

Medikament		Benzokain				Isoeugenol			Metacain				
Dose		100	200	400	800	10	20	40	100	200	400	800	1600
Eksp.tid(min)	0	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
	10	0/5	0/5	3/5	5/5	-	0/5	0/5	0/5	0/5	0/5	1/5	5/5
	30	3/5	10/10	5/5		-	0/5	5/5	0/5	8/10	4/5	5/5	
	60	5/5	5/5			-	0/5		5/5	5/5	5/5		

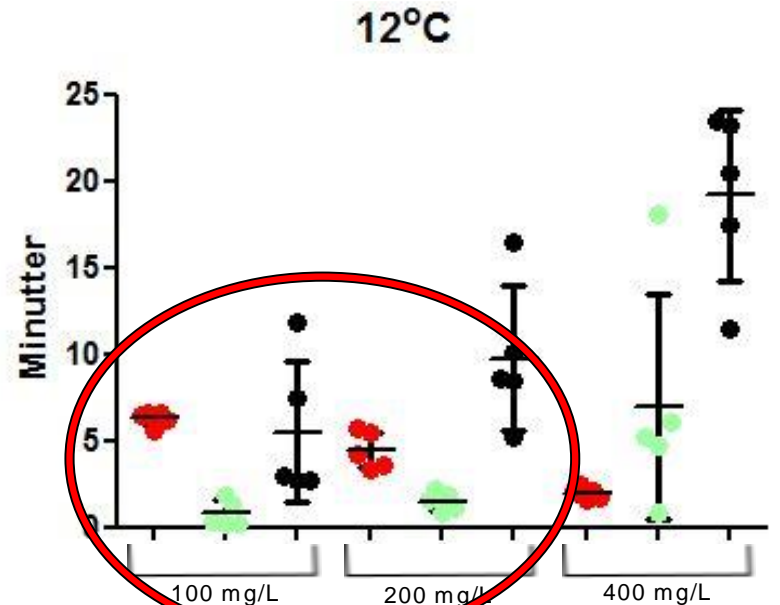
Induction and recovery (600g+ n=5)

- 6°C – 600+ gram

Medikament		Metacain				
Dose		100	200	400	800	1600
Eksp.tid* (min)	0	0/5	0/5			
	10		0/5			
	30					
	60					



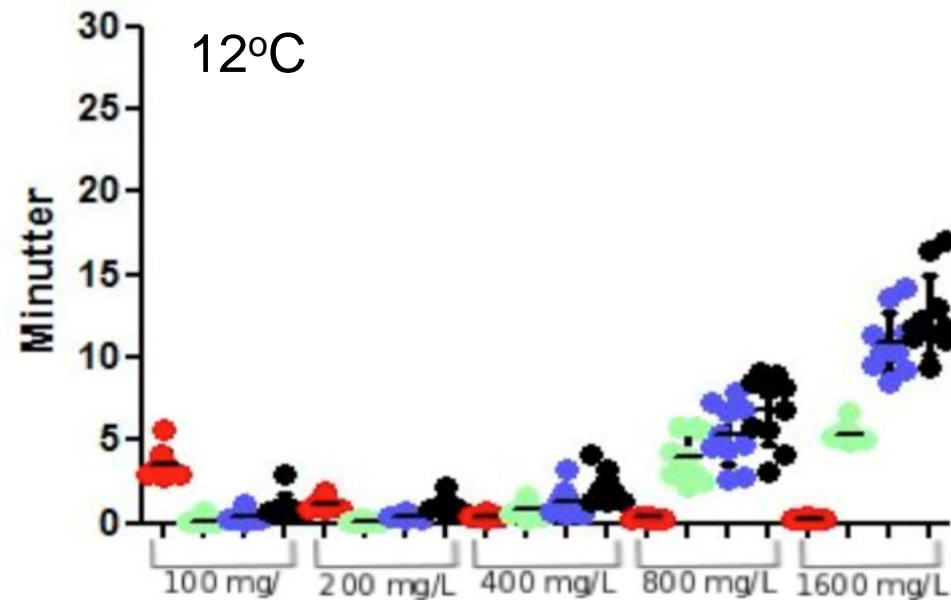
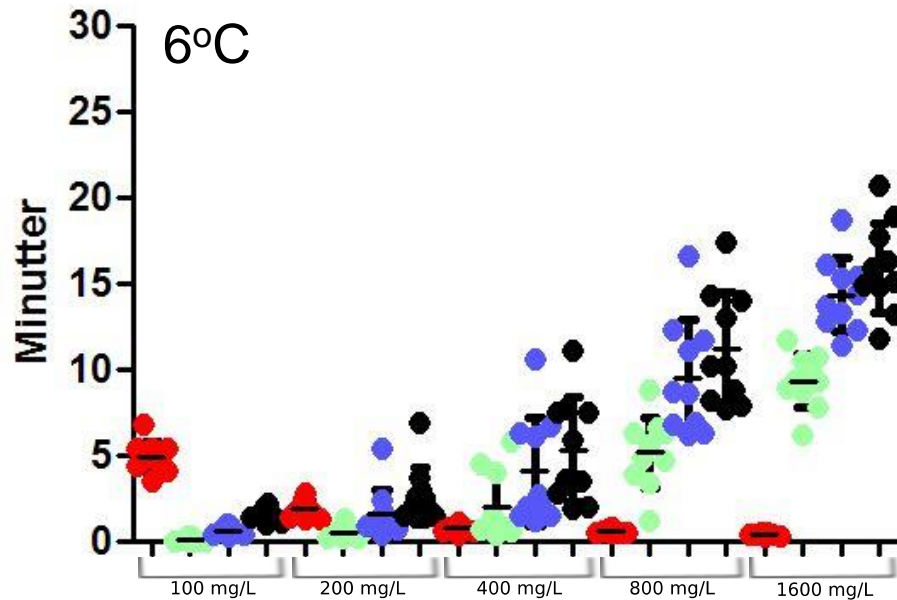
Medikament		Metacain				
Dose		100	200	400	800	1600
Eksp.tid* (min)	0	0/5	0/5	0/5		
	10	0/5	0/5	0/5		
	30					
	60					



Trends

- Induction- and recovery- period decreases with increasing temperature

Metacaine



- Respiration stop
- Respiration start

- Normal respiration
- Starts swimming

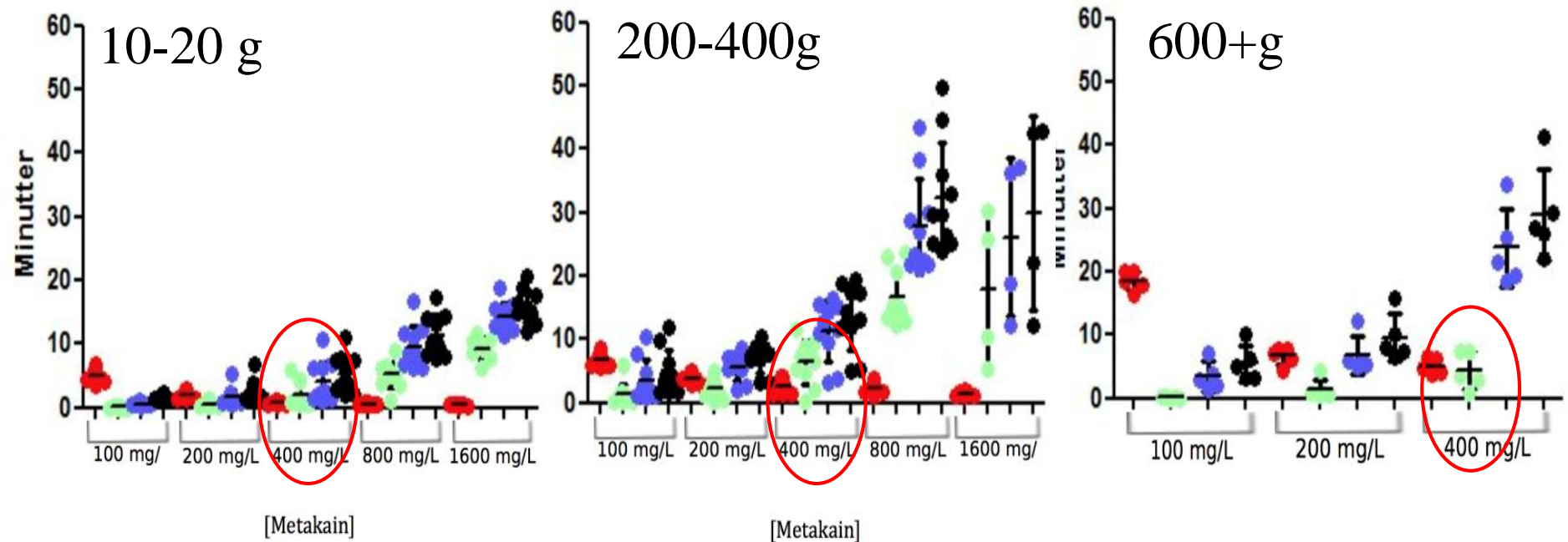


Trends

- Induction- and recovery-period increase with increasing weight.



Metacaine



- Respiration stop
- Respiration start

- Normal respiration
- Starts swimming



Final recommendations

Medikament	Storleik	Temp.	Normal anestesi	Maks eksponeringstid	Hurtig anestesi	Maks eksponeringstid
Benzokain	10-20 g	6°C	100-200 mg/L	10 minutt	400 mg/L	10 minutt
		12°C	100-200 mg/L	10 minutt	400 mg/L	<10 minutt*
	200-400 g	12°C	200 mg/L	<10 minutt**		
Metakain	10-20 g	6°C	100-200 mg/L	10 minutt (30 ved 100 mg/L)	400 mg/L	10 minutt
		12°C	100-200 mg/L	10 minutt (30 ved 100 mg/L)	400 mg/L	10 minutt
	200-400 g	6°C	100-200 mg/L	60 minutt		
		12°C	100-200 mg/L	30 minutt (60 ved 100 mg/L)	400 mg/L	30 minutt
	600+g	6°C	200 mg/L	10 minutt		
		12°C	100-200 mg/L	10 minutt		

*Ved eksponering i 10 minutt døydde 60% **Ved eksponering i 10 minutt døydde 20%



Takk for meg !

