Appendix B: Analgesic Agents for Use in Fish

Drug	Species	Dose	Route	Comments
Opioids*				
Butorphanol (**Recommended**)	Zebrafish	0.2-0.5 mg/L	Immersion	Efficacious dose varies with species
	Goldfish	0.1-0.4 mg/kg	IM	
	Dogfish	0.25-5 mg/kg	IM	
	Carp	0.4-10 mg/kg	IM	Decreased ventilation and buoyancy problems seen
Morphine	Zebrafish	3-6 mg/kg 1, 2, or 48 mg/L	IM Immersion	Hyperactivity may occur; possible anxiolytic effect
	Goldfish	10-50 mg/kg 0.12-48 mg/L	IM Immersion	Hyperactivity may occur; possible relief of pain-associated behaviors
	Rainbow Trout	40 mg/kg 300 mg/kg	IM IP	Possible relief of pain-associated behaviors
	Salmon	300 mg/kg	IM, IP	Possible anxiolytic effect
	Carp	5 mg/kg 20 mg/kg	IM IP	Hyperactivity may occur; anti-inflammatory effects
	Flounder	17 mg/kg 40 mg/kg	IV IP	Bradycardia may occur
Buprenorphine	Zebrafish	0.005-0.2 ug/ml	Immersion	Zebrafish: may cause hyperactivity
	Rainbow Trout	0.01-0.1 mg/kg	IM, SC	Rainbow trout: depressed activity noted at 1 mg/kg
Tramadol	Zebrafish	10 ug/fish	IM	Hyperactivity and surface respiration noted
	Carp	10-100 nmol/g	IM	Increased nociceptive threshold
NSAIDs				
Carprofen	Rainbow Trout	1-5 mg/kg	IM	Decreased activity at 5 mg/kg noted
Flunixin	Zebrafish	8-20 mg/L	Immersion	
	Rainbow Trout	0.5 mg/kg	IM	
Ketoprofen	Goldfish	0.5-2 mg/kg	IM	
	Rainbow Trout, Carp	2 mg/kg	IM	Decreased postsurgical muscle damage in carp
	Dogfish	1-4 mg/kg	IM	
Ketorolac	Rainbow Trout	0.5 mg/kg	IM	
Ibuprofen	Zebrafish	400 uM	Immersion	
	Minnows	5-470 mg/L	Immersion	Anti-inflammatory effects
Aspirin	Zebrafish	1-2.5 mg/L	Immersion	
Other				
Lidocaine	Zebrafish	1-5 mg/L	Immersion	
	Rainbow Trout	4.5-18 mg/kg	SC	
Medetomidine	Goldfish	0.01-.025 mg/kg	IM	

***** When **preemptive analgesia** is used, consider reducing the dose of anesthetic (whether inhalant or injectable) to the low end of the recommended range. Anesthetic depth must be carefully monitored and drug doses may need to be titrated to maintain appropriate levels. With new projects, sexes, strains or anesthetic analgesic combinations, assess a subset of animals before expanding to use in a larger cohort.