

Supplementary Material

Acoustic Ecology Metrics in an Alaska Marine Protected Area Reveal Underwater Marine Mammal Communication Masking and Management Alternatives

Supplementary Tables

Supplementary Table 1. Specifications for vessels used in modeling communication space and masking.

Categories refer to Park administrative categories (see Table 2). Source levels are given in dB re 1 μ Pa at 1m within the 40-780 Hz frequency band of interest for humpback whale and harbor seal communication sounds (Table 2). Vessel source levels marked with an asterisk (*) are derived from calibrated measurements of that specific vessel. All others are estimated based on sound levels from comparable vessels.

Model Day	Category	Type	Description	Length (m)	Engine Type	Engine Specifications	Median Speed (kts)	Source Level*
1	charter	overnight passenger vessel	wooden hull, former minesweeper, now 12-passenger vessel	30.0	single diesel	400 hp diesel	3	132.7*
1	charter	day excursion vessel	fiberglass hull runabout	11.6	twin gas inboard-outboards	185 hp Volvo 41 P diesels	9	173.6
1	charter	overnight passenger vessel	steel hull passenger vessel	19.1	twin diesels	251 hp John Deere 6068 4-stroke dry exhaust diesels	12	174.5
1	charter	overnight passenger vessel	steel hull passenger vessel	13.7	single diesel	225 diesel	8	174.6
1	charter	day excursion vessel	Munson Pack-Cat	11.6	twin diesels	350 hp Navistar Power-stroke diesels	20	177.2
1	commercial fishing	fishing vessel	USGS research vessel, converted F/V, Ledford fiberglass hull	15.2	single diesel	480 hp diesel	6	172.8
1	cruise ship	1,432 passenger cruise ship	direct drive cruise ship	238.0	diesel electric	diesel-electric with five 514-rpm, 4-cycle, diesel generators, and two main propulsion electric motors. Two propulsion shafts and two 4-bladed controllable	17	180.4*

Model Day	Category	Type	Description	Length (m)	Engine Type	Engine Specifications	Median Speed (kts)	Source Level*
						pitch propellers.		
1	NPS	pilot boat	Kvichak Marine aluminum cabin cruiser, planing hull	10.4	twin diesels	310 hp Cummins 5.9 liter I-6 diesels	7	153.2*
1	NPS	pilot boat	Kvichak Marine aluminum cabin cruiser, planing hull	10.4	twin diesels	310 hp Cummins 5.9 liter I-6 diesels	8	153.2*
1	NPS	patrol vessel	aluminum hull workboat	8.5	twin outboards	225 hp outbds	20	156.5*
1	NPS	research skiff	Lund aluminum skiff	5.5	single outboard	40 hp Mercury hp 4-stroke outbd	7	165.5*
1	private	powerboat	Grady White Seafarer powerboat	8.5	twin outboards	225 hp 4-stroke outbds	15	155.3
1	private	sailboat	wooden sailing sloop	12.6	single diesel	25-40 hp diesel inbd	7	155.5
1	private	sailboat	Beneteau sailing vessel	12.9	single diesel	50 hp Yanmar diesel engine	7	155.5
1	private	powerboat	aluminum hull landing craft	8.5	twin outboards	225 hp Honda outbds	18	157
1	private	powerboat	Nordic Tug	9.8	single diesel	305 Cummins diesel Single	0	168.4
1	private	powerboat	Nordic Tug	13.2	single diesel	220 Cummins diesel	3	168.6
1	private	powerboat	fiberglass hull power boat	11.5	single diesel	diesel engine	0	170
1	private	sailboat	sailing sloop	14.7	single diesel	125 hp Yanmar diesel	5	172.6
1	private	powerboat	fiberglass powerboat	9.1	unknown	225 hp Yamaha outbds	9	176.7
1	private	sailboat	McGregor sailing vessel	7.9	single outboard	8 hp Nissan 2-stroke outbd	0	176.8
1	private	sailboat	Waterline 50 sailing vessel	15.4	single diesel	160 hp Yanmar 4LHA-HTP diesel	6	176.8
1	private	powerboat	Armstrong aluminum catamaran powerboat	9.4	twin outboards	250 hp Yamaha outbds	11	182.8

Model Day	Category	Type	Description	Length (m)	Engine Type	Engine Specifications	Median Speed (kts)	Source Level*
1	private	powerboat	aluminum hull landing craft	8.5	twin outboards	225 hp Honda outbds	25	198.2
1	research	research skiff	rubber inflatable	4.8	single outboard	50 hp Honda 4-stroke	15	180.5
1	tour	day tour vessel	aluminum hull catamaran passenger vessel	21.8	twin diesels	873 hp Caterpillar C-18 diesels	25	144.5*
1	tour	day tour vessel	aluminum hull catamaran passenger vessel	23.9	twin diesels	600 hp diesels for jet drives	9	166.7*
1	US Coast Guard	patrol vessel	Juniper-Class Buoy Tender	63.7	twin diesels	3100 hp Caterpillar 3608 diesel engines, single shaft, 450 hp bow thruster, 550 hp stern thruster	10	179.4
2	charter	overnight passenger vessel	wooden hull, former minesweeper, now 12-passenger vessel	30.0	single diesel	400 hp diesel	8	132.7*
2	charter	overnight passenger vessel	steel hull passenger vessel	19.8	twin diesels	300 hp John Deere diesels	10	169.4
2	charter	overnight passenger vessel	steel hull passenger vessel	13.7	single diesel	225 diesel	8	169.9
2	charter	day excursion vessel	fiberglass hull runabout	11.6	twin gas inboard-outboards	185 hp Volvo 41 P diesels	9	169.9
2	cruise ship	2,670 passenger cruise ship	azipod cruise ship	289.9	diesel electric	gas turbine 25 MW /2 azipods 21,000 KW each	13	174.9*
2	cruise ship	1,970 passenger cruise ship	direct drive cruise ship	293.8	diesel electric	combined diesel and gas-turbine configuration with two diesel generator-sets	13	175.7*
2	NPS	pilot boat	Kvichak Marine aluminum cabin cruiser, planing hull	10.4	twin diesels	310 hp Cummins 5.9 liter I-6 diesels	7	147.2*
2	NPS	pilot boat	Kvichak Marine aluminum cabin cruiser, planing hull	10.4	twin diesels	310 hp Cummins 5.9 liter I-6 diesels	6	147.2*
2	NPS	research skiff	Safeboat skiff with pilothouse, planing hull	5.8	single outboard	150 hp 2-stroke E-Tec Evinrude outbd	5	147.8*
2	NPS	patrol vessel	Metalcraft aluminum cabin cruiser with planing hull	7.9	twin gas inboard-outboards	210 hp V6 Mercruiser gasoline inbd-outbd engines	16	149.2*

Model Day	Category	Type	Description	Length (m)	Engine Type	Engine Specifications	Median Speed (kts)	Source Level*
2	NPS	research vessel	Stanley Bullnose aluminum landing craft	7.9	single diesel	350 hp Mercruiser 350 Magnum I/O w/ Bravo 3 outdrive	10	155.3*
2	NPS	research skiff	Lund aluminum skiff	5.5	single outboard	40 hp Mercury hp 4-stroke outbd	19	155.3*
2	NPS	research skiff	Lund aluminum skiff	5.5	single outboard	40 hp 2-stroke outbd	8	155.8*
2	NPS	research skiff	Lund aluminum skiff	5.5	single outboard	40 hp Mercury hp 4-stroke outbd	23	188.2*
2	private	sailboat	Hunter sailing vessel	11.3	single diesel	40 hp Yanmar diesel	7	147.2
2	private	powerboat	Hewscraft Sportsman aluminum powerboat	4.9	single outboard	70-90 hp Yamaha outbd	6	149.2
2	private	powerboat	Armstrong aluminum catamaran powerboat	9.4	twin outboards	250 hp Yamaha outbds	1	150
2	private	sailboat	staysail sailing ketch	23.8	single diesel	170 hp Rolls-Royce CN34	5	151.3
2	private	powerboat	Hewscraft cabin cruiser	7.9	twin outboards	115 hp Yamaha outbds	7	151.9
2	private	sailboat	Sailing vessel	10.5	single diesel	335-370 hp diesel. estimated QSB 380 diesel	5	154
2	private	powerboat	Bayliner powerboat	17.7	single diesel	150 hp, 4 cylinder, 4-stroke in line water cooled diesel	0	157.3
2	private	sailboat	Caliber 40 LRC sailing vessel	11.9	single diesel	50 hp Yanmar diesel	5	158.3
2	private	motor yacht	Selene motor yacht	18.3	twin diesels	330 hp Cummins diesels	6	158.3
2	private	powerboat	North River aluminum powerboat	6.1	single outboard	150 hp outbd	1	159.4
2	private	motor yacht	North Pacific motor yacht	16.0	single diesel	490 hp Cummins QSB diesel	6	163.5
2	private	motor yacht	motor yacht	17.8	single diesel	330 hp actual	6	166.6

Model Day	Category	Type	Description	Length (m)	Engine Type	Engine Specifications	Median Speed (kts)	Source Level*
2	private	powerboat	Nordic Tug	9.8	single diesel	305 Cummins diesel Single	0	167.3
2	private	motor yacht	motor yacht	13.4	single diesel	450 hp Cummins diesel engine	10	168.4
2	private	motor yacht	Ta Shing Yacht Ltd. Fiberglass motor yacht	20.7	single diesel	425 hp @ 1900 rpm, 6135AFM75	7	169.3
2	private	motor yacht	Selene 60 motor yacht	19.8	twin diesels	330 hp Cummins diesels	9	169.9
2	private	motor yacht	motor yacht	12.0	single diesel	diesel engine	0	170.1
2	research	research skiff	Kellahan Marine aluminum powerboat, displacement hull	6.1	single outboard	115 hp Yamaha outbd	11	169.7
2	tour	day tour vessel	aluminum hull catamaran passenger vessel	21.8	twin diesels	873 hp Caterpillar C-18 diesels	23	144.5*
2	tour	overnight passenger vessel	steel hull passenger vessel	37.2	twin diesels	680 hp diesels	7	161.3*
3	charter	overnight passenger vessel	steel hull passenger vessel	13.7	single diesel	225 diesel	8	173.5
3	commercial fishing	fishing vessel	steel hull commercial trolling vessel	14.6	single diesel	300 hp diesel	8	180.4
3	commercial fishing	fishing vessel	commercial fishing vessel	11.6	single diesel	210 hp diesel	7	182.6
3	NPS	pilot boat	Kvichak Marine aluminum cabin cruiser, planing hull	10.4	twin diesels	310 hp Cummins 5.9 liter I-6 diesels	4	153.2*
3	private	motor yacht	Bayliner fiberglass motor yacht	14.3	single diesel	310 hp Hino W06DTII diesel	7	155.5
3	private	motor yacht	CHB Sedan motor yacht	13.6	twin diesels	350 hp Caterpillar 3208 diesels	6	170.8
3	private	powerboat	Radier 8422 powerboat	6.7	single outboard	200 hp outbd	0	172.5
3	private	skiff	Hewscraft 160 Sportsman aluminum skiff	4.9	single outboard	70-90 hp Yamaha outbd	3	175.6
3	private	motor yacht	Hakvoort steel and aluminum hull motor yacht	50.0	twin diesels	1290 hp Caterpillar diesels	11	175.6
3	private	skiff	Cobra aluminum skiff	6.7	single outboard	140 hp Suzuki 4-stroke outbd	0	176.8

Model Day	Category	Type	Description	Length (m)	Engine Type	Engine Specifications	Median Speed (kts)	Source Level*
3	private	motor yacht	Bayliner 4788 motor yacht	14.4	twin diesels	330 hp Cummins diesels	0	183.5
3	private	powerboat	fiberglass Seasport	9.1	twin diesels	300 hp Volvo Penta KAD diesels	8	183.7
3	State of Alaska	research ship	steel hull research vessel	33.5	twin diesels	600 hp Cummins V1692 diesels	7	171.9
3	tour	day tour vessel	aluminum hull catamaran passenger vessel	21.8	twin diesels	873 hp Caterpillar C-18 diesels	23	144.5*
3	tour	overnight passenger vessel	steel hull passenger vessel	38.6	twin diesels	1400 hp 6140 Lugger diesels	7	166.4
3	US Coast Guard	patrol vessel	Kvichak Marine aluminum hull vessel	13.7	twin diesels	825 hp Detroit Series 60 turbocharged diesels with Rolls Royce water jet propulsion	12	180.2*
3	US Coast Guard	patrol vessel	Kvichak Marine aluminum hull vessel	13.7	twin diesels	825 hp Detroit Series 60 turbocharged diesels with Rolls Royce water jet propulsion.	13	180.4*