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**SUMMARY OF NON-LETHAL TECHNIQUES FOR THE STUDY OF CETACEAN**

<b>Summary of Non-Lethal Research Techniques for the Study of Cetacens</b>					
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<b>TECHNIQUE NON-LETHAL</b>	<b>EQUIPMENT</b>	<b>QUESTIONS ADDRESSED</b>	<b>KEY STUDIES</b>	<b>ADVANTAGES/DISADVANTAGES</b>	<b>POTENTIAL IMPACTS TO MARINE MAMMALS</b>
Biopsy/skin scrapes	Darts; cross bows/guns	Organochlorine/toxin exposure; feeding ecology; population structure, divergence, and gene flow; genetic tagging of individuals; kinship; sexing	humpback whales (North Atlantic, central California, southeastern Alaska, Hawaii); North Atlantic right whales (Bay of Fundy, Gulf of Maine); bottlenose dolphins (NE Bahamas); blue, fin and Bryde's whales (Gulf of California, Mexico); sperm whales (South Pacific, Mediterranean Sea, North Atlantic, Indian Ocean)	high resolution studies; behavioral changes elicited	behavioral changes observed
Faeces collection	platform; net to gather samples	diet analysis; genetic analysis (of whales); population structure, divergence, and gene flow; genetic tagging of individuals; culturing/diagnosing bacterial infections; mercury/toxin loads	sperm whales; right whales (east coast USA); bottlenose dolphins (Atlantic, NE Bahamas); Pacific white-sided dolphins; beluga whales; pygmy blue whale; humpback whales; blue, fin and Bryde's whales (Gulf of California, Mexico); sperm whales (Galapagos); North Atlantic right whale (Bay of Fundy and Gulf of Maine)	fecal plumes diffuse; difficulty amplifying DNA of whales/food; methods improved	approaches by boats; mostly benign
Genetic sampling from sloughed skin	Net to gather skin samples	animal sexing; population structure;	sperm whales (Mediterranean); blue whales (Baja California); humpback whales (Cook Islands);	viable alternative to biopsy darting where not permitted or desirable; non-invasive technique; more frequent in some species and lower latitudes	approaches by boats, swimmers; mostly benign
Line transect surveys	Platform; trained observers	relative or absolute abundance	blue whales (southern California); fin whales (southern California); harbor porpoise (US west coast); multiple marine mammal species (Northern Gulf of Mexico; mid- and North Atlantic; Hawaiian Islands; California)	dependent on weather, sea state, daylight hours, animals surfacing, suitability of platform; can estimate relative abundance and density	approaches by boats; mostly benign
Passive acoustics	Hydrophones, autonomous recording devices; sonar and DIFAR buoys; recording platform; computer; analysis software	relative or absolute abundance; behavior as relates to sound; vocalization rates; signature whistles; social structure; distribution; migration; vocal repertoire; species ID	harbor porpoise (Baltic); sperm whales (Mediterranean Sea); humpback whales (Dominican Republic; Hawaii; Brazil; British Isles; North Pacific); bottlenose dolphins (Florida); Orcas (Washington State, Vancouver); North Atlantic right whales (east coast USA); bowhead whales (Alaska); fin whale (Hawaii, North Pacific, Sea of Cortez, southern California); blue whale (Hawaii, northeast Pacific, southern California); sperm whale (Hawaii; Caribbean; North Pacific); Short-finned pilot whale (Hawaii); bowhead whale (Alaska); North Pacific right whale (Alaska); minke whale (Puerto Rico, St. Lawrence estuary); common dolphin (West Wales)	reliance on animals vocalizing; field work not necessary	benign
Photogrammetry	Camera; aerial platform; models for size estimation	size; pregnancy rates (based on width); condition; age estimation; morphology; tracking movements	grey whales (California); Mesoplodon spp. (eastern tropical Pacific); bottlenose dolphin (New Zealand); Hector's dolphin (New Zealand); spinner dolphin (Mexico); striped dolphin (eastern Pacific); common dolphin (eastern Pacific); bowhead whale (Alaska)	dependent on weather, sea state, daylight hours, animals surfacing; non-invasive	approaches by air; mostly benign

TECHNIQUE NON-LETHAL	EQUIPMENT	QUESTIONS ADDRESSED	KEY STUDIES	ADVANTAGES/DISADVANTAGES	POTENTIAL IMPACTS TO MARINE MAMMALS
Photo-identification	Camera, platform, photo-id catalogue	Distribution; return rate; age of sexual maturity; age; migration; population estimates	Humpback whales (e.g. Gulf of Maine; Alaska; Australia; Brazil); bottlenose dolphins (Florida); sperm whales (e.g. Galapagos; E. Caribbean, New Zealand); North Atlantic right whales; Southern right whales (e.g. Argentina; South Africa); orca (e.g. Puget Sound, USA; Argentina); Minke whales (e.g. Australia); blue whales (e.g. Chile; Mingan Island)	high resolution studies; labor intensive; time-consuming	approaches by boats; mostly benign
Playback/Controlled Exposure Experiments (CEE)	shore and ship based observers; platform (ship); playback recordings, speakers	stimulus/noise response; avoidance behavior	grey whales (California); North Atlantic right whales (Bay of Fundy); sperm whales (Orkney Islands, Canary Islands); bottlenose dolphins (Florida); fin whales (California Bight); blue whales (California Bight); humpback whales (Hawaii); bowhead whales (Alaska); beluga whales (Alaska); southern right whales	controlled measurements/responses to noise; introduces stimuli; provides baseline for noise impact mitigation	introduction of stimuli; behavioral responses
Sampling from live capture	experienced catcher/captain; platform (boat); net; chase boats with dolphin handlers; sampling equipment; animal processing boat/flat platform	sexing; morphometrics; population structure	beluga (Canada); bottlenose dolphin (Florida, Taiwan, Western Australia)	high resolution studies; labor intensive; highly invasive	highly invasive
Satellite tags	tags; deployment ship; trained tag deployers	migration; movements; population structure; speed; diving behavior	beluga (Alaska); right whale (North Atlantic); grey whale (Mexico); sperm whales (Dominica); bottlenose dolphins (Florida)	potentially invasive (suction vs. subcutaneous); required close approach; high resolution of data	behavioral responses
Stranding	morphometric/necropsy tools; trained data collectors	causes of mortality; life history; diet; social structure; organochlorine/toxin loads; population structure	North Atlantic right whales; short-finned pilot whales (New Caledonia, Canary Islands); pygmy sperm whale (New Caledonia, England, Wales); sperm whales (Denmark); Risso's dolphin (England, Wales, Spain); white-beaked dolphin (England, Wales); common dolphin (England, Wales, Spain); striped dolphin (England, Wales, Spain); long-finned pilot whale (England, Wales, western North Atlantic, Patagonia, Spain); Atlantic white-sided dolphin (England, Wales, western North Atlantic, Spain); Sowerby's beaked whale (England, Wales); fin whale (England, Wales); minke whale (England, Wales); Blainville's beaked whale (England, Wales); bottlenose dolphins (Spain); harbor porpoise (Spain, Norway); Cuvier's beaked whale (Spain)	non-invasive; opportunistic	benign
Suction tags	tags; deployment pole/ship; trained tag deployers	response to stimulus	North Atlantic right whales; sperm whales	less invasive than subcutaneous tags; high resolution data (vocalizations, depth, orientation and fluke rates); close approach necessary	approach by boats; mostly benign