

California Survey COMPILATION					
GEAR INNOVATION					
	Cost to Fishery (HIGH/LOW)	IS IT DOABLE?	LIKELY TO MAKE A DIFFERENCE TO WHALES? YES/NO/MAYBE	TESTABILITY (GOOD PROSPECT FOR TESTING?) YES/NO/MAYBE	Comments
Sinking or neutral lines	* Let NMFS pay for it Medium? Low Low Low  Don't know	Yes Yes Yes Yes Yes Yes	Maybe Hope so Maybe Maybe Maybe Yes Maybe  Maybe/Yes	Maybe Maybe Yes Yes Yes Yes Yes	Depends on fishermen's inputs  Easily adjusted  Line profile testable
Change length of trailer lines	* Low Low Low Low Low 0  Low	Yes Yes Yes Yes Yes Yes Yes	Maybe Hope so Maybe Maybe Maybe Maybe Yes  Yes Maybe/Yes	Yes Maybe Yes Yes Yes	Easily done; Very easily adjusted Line profile can be tested; actual impacts on entanglements not easily tested because entanglements are rare Testability depends on the question  Long trailer lines potentially increase injury to entangled whale; also add to surface line that can get run over  Yes, if this works for fishermen to try, could be very helpful to decrease whale entanglements Yes, measure when it comes off entangled whales
Keep gear tighter	* Low Low ? Low Low Low Low Low Low	Yes to a point Yes Yes Yes Yes Yes Yes Yes Yes	Maybe Hope so Maybe Maybe/maybe not Maybe Maybe Maybe Yes Yes Yes	Maybe Maybe Yes  Yes Yes Yes Yes Yes Yes Yes	What would recommended scope be?    Line profile and physical models testable       Line profile
Breakaway gear (weak links, "finger traps")	* High? ? High High Low	Yes In the future Maybe? ? Yes Maybe Yes	Yes(likely) Maybe Maybe Maybe Maybe Maybe   Maybe/Yes	Yes   ? Maybe Yes	Need to consider weak link at trap, not buoy. Need to consider a link that goes from weak while fishing to strong when hauling.  Possible gear loss Needs development before testing. Would require new technologies, e.g. smart link that is strong during haul but weak when fishing. Testable for feasibility, likely nothing else  Even with breakaway there may still be entanglements

Whale-friendly buoys	* Low Medium ? High Low High	Yes Low Yes ? Yes Yes Yes	Maybe Maybe No Unlikely Yes Maybe Yes  no	Maybe Maybe Maybe ? No Maybe	Not known to be useful Not testable, unless on a massive scale  Hard to test
Time-release line cutter tool	* High High High High High High		Maybe		Benefits unknown  Still does not mitigate problem Would this leave some gear on the whale though?
Pool noodle deflection sleeve below buoy	*  Med Med Low Low Low	Yes  Yes ? Yes Yes Yes	Maybe  No Unknown Maybe Maybe Maybe  No	Yes  Maybe Not really No Maybe Maybe	Easy, cheap to try. Good candidate for “mock up” of whale  Assumes whales get caught just below buoy  Would likely come apart; floating debris Difficult to test Would only work if line is taut. If slack would float on surface horizontally. Also would they fall apart?
Line visibility Colored lines or lights	* Low Medium Low if phased in as line replaced Low Low Low ?	Yes Yes Yes Yes  Yes Yes Yes Yes	Maybe Maybe Maybe Maybe  Maybe Yes No ?  Maybe	Yes Maybe Yes Maybe  Maybe Yes  ? Needs more research	Limited testing is easy, showing effect on entanglement is not  Hard to test unequivocally Depends on whale interaction—do the colored/contrast lines attract them more than deter?
Multiple traps on line (less vertical lines)	*  Med High High High  ?	Not legal  No No Yes No  Yes	Maybe  No No Maybe Maybe  Yes  Maybe	No  Yes No Maybe Maybe  ?	Doubles, not more  Could increase severity of injuries, deaths. Would required vessel changes, dangerous Limited testing is easy, showing effect on entanglement is not  Don’t know Might provide opportunities for reduced activity in problem areas/times

Sampson line (stronger, thinner rope)	*  High  High High ?  	No  Yes No Yes No Yes  	No  No No No No Negative diff  No	No  Yes No No Maybe No	Potentially worse impact on whales  Smaller, stronger line will cut [whales] easier  Limited testing is easy, showing effect on entanglement is not  No-more damage to whales potentially
Elimination, where possible, of lead and line splices	*  Low Med Low Low Low	Yes, in combo with small line Yes Yes Yes Yes Yes	Maybe  Maybe Maybe Yes Maybe Maybe  Maybe	Maybe  Maybe Yes Maybe Maybe	Limited testing is easy, showing effect on entanglement is not
Buoyless gear (line free gear, remote release)	*  High Very High High High High	Yes  No ? Yes No ?  	Yes  Maybe Yes Yes Maybe Yes  Maybe	Yes  No ? No Maybe Maybe	Issue with reliability—need a backup if retrieval fails  CA Enforcement issue, because cannot know # of traps  Worthy of further exploration, but difficult to test This seems like a great way to lose gear if release fails. Might be worth testing to see if works for fishermen at all
Acoustic deterrence	High High High Low High ? ? ?	Not yet Don't know Yes Yes Maybe Yes	Maybe Maybe Maybe Maybe Maybe  Maybe	Yes Maybe Yes Yes Maybe Yes	More research needed    Worth exploration Definitely should test! Has worked in other fisheries
OTHER? *(Comment for first column above) : For all the gear innovation ideas, the cost to test is probably low, but the cost to implement all over is probably high in general, if need to change all gear  Swivel on the line to allow for line to rotate  Tending gear more often  Coated Line					

LOST GEAR RETRIEVAL					
	Cost to Fishery (HIGH/LOW)	IS IT DOABLE	LIKELY TO MAKE A DIFFERENCE TO WHALES? YES/NO/MAYBE	TESTABILITY (GOOD PROSPECT FOR TESTING?) YES/NO/MAYBE	Comments
Expand/change in-season gear retrieval program (e.g. allow for in-season or earlier gear recovery—e.g. in April)	Low Low Low Low  Low Low  Low Unknown	Yes I hope so Yes Yes  Yes Yes  Yes Unknown	Yes Yes Maybe Maybe small benefit, but unclear No Yes  Yes Less	Yes Yes Yes N/A  Yes Maybe  Yes	Costly to the fisherman who loses the gear     Don't know how feasible in California  Earlier gear recovery permits could be great! (Important) Great to do but little effect
Expand/change in-season gear retrieval program	Low Low Low ?  Low   Low	Yes Yes Yes ?  Yes   Yes	Yes Yes Maybe ?  Yes   Yes	Yes Yes Yes ?  Maybe   Yes	
Other? Allow more pots from others on boats in CA (currently only 6)					
SEASONAL CHANGES					
	Cost to Fishery (HIGH/LOW)	IS IT DOABLE	LIKELY TO MAKE A DIFFERENCE TO WHALES? YES/NO/MAYBE	TESTABILITY (GOOD PROSPECT FOR TESTING?) YES/NO/MAYBE	Comments
Close or decrease fishing effort in spring (reduced pot limits, earlier closure, other mechanisms?) (requires state level action)	High High High Variable High High Moderate  High	Maybe Yes Yes Yes Yes No Yes	Maybe Yes Maybe Yes Maybe No Yes  Yes	No Yes Maybe  No Maybe	Impact to small boats would be significant If early season fishing is good, & other fishing opportunities exist, (e.g. salmon) cost could be low. If domoic acid closes fishery until spring cost very high Very important: likely to disproportionately effect smaller boats  Most beneficial to whales, but hurts all season crabbers.

Change contour lines in response to specific oceanographic conditions; prey type/conditions; predicted whale presence	Unknown	Maybe	Maybe	No	If early season fishing is good, & other fishing opportunities exist, (e.g. salmon) cost could be low. If domoic acid closes fishery until spring cost very high  Would require good data/models on whale presence
	Low	Yes	Yes	Hope so	
	Variable	Maybe for part of fleet	Maybe	Maybe	
	Low High Could be H	Yes No Yes	Maybe No Maybe	Yes Maybe	
Seasonal gear changes			Maybe		
Start the season early if market sizes met in November	High	Maybe	Maybe	Maybe	
	High	Yes	Maybe	Maybe	
	High	Yes	Maybe	Yes	
	Low-Med	Yes	Maybe	Maybe	
	Low	Yes	Maybe	Maybe	Can test how fishing changes, but prob. not entanglements. Would possibly help if end of seasons shortened & whales are mostly gone by early Nov.
	Low	No	No	Maybe	
	High				
			Maybe		
	Low	Yes?	Maybe/likely	Yes	Could be useful in considering spring closures
	Low	Yes	Maybe	Yes	
	Low	Maybe	No	Yes	
			Maybe	Yes	
	Low	Yes	Yes	Yes	
	Low	Yes	Maybe	Maybe	
	Low	Yes	Maybe		
			Still Whales		

## RESEARCH QUESTIONS

Use simulations (Tim Werner working with Duke University on this for right whales) of humpbacks to test entanglement dynamics. Determining how/whre on the string entanglement occur is kep (surface or @ depth)
We need to know where the whales are and their habitats to make an appropriate determination
See list from meeting (as projected)
How do whales behave around real (not modeled) crab gear? What can physical models teach us about entanglements—should allow for some gear testing. Line profile studies need those physical model studies or they are meaningless.
Study gear/whale interactions specifically line profile studies
[Effects of] reducing slack in the line and reduce trailer buoy lengh

## WHAT HAS ALREADY DONE? (what things have already been done that have helped to reduce entanglements)

CA Best Practices Guide (mentioned 4 times); Increased awareness among fishermen
CA Whale entanglement working group (mentioned 4 times)
Responsiveness of NMFS to high # of whales, want to find solutions
Working group developing fishery monitoring tools and supporting development of whale & prey distribution models (K.Forney, NMFS SWFSC and Jarrod Santana (U.C. Santa Cruz)
Collaborative Research