Title: **CATCH AND BYCATCH EFFECTS OF LARGE CIRCLE HOOKS IN A TUNA LONGLINE FISHERY**

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Eighteen vessels within the Hawaii-based tuna longline fleet were contracted to test the catch efficacy of large circle hooks versus the existing hooks in use by the fishery. Large circle hooks have been shown to reduce the catch and mortality of sea turtles in other longline fisheries. This study was intended to test the effects of using large circle hooks on target, incidental, and bycatch species in the fishery. The majority of the fleet uses "Japanese" style tuna hooks (3.6 sun, about the same size as most 14/0 circle hooks), but some of the vessels contracted use "J" style hooks (size 9/0). The large circle hooks tested were stainless steel (size 18/0) circle hooks made in Korea. Vessels were mandated to alternate hook type throughout the mainline and to maintain a 1:1 ratio of circle hooks to existing hooks. Every trip was accompanied by a National Oceanic and Atmospheric Administration certified observer who collected information on catch by hook type, the daily tally of the total numbers of each type of hook used, and a vessel's ability to follow experimental protocols. The experiment was conducted from July of 2005 until February of 2006. A total of 1393 sets were analyzed; 1182 sets were large circle hooks versus 3.6 sun tuna hooks, and 211 sets were large circle hooks versus 9/0 J hooks.

Two statistical methods were used to assess catch or catch rate differences for 18 individual species between hook types: randomization tests and Generalized Linear Mixed Models. There was no significant difference in the catch of the target species, bigeye tuna (*Thunnus obesus*) by hook type. However, results showed strong statistical evidence that the use of large circle hooks would reduce the catch of incidental species such as billfish, pelagic sharks, opah, and dolphinfish in the Hawaii-based tuna longline fishery (Table 1). Mean fork length and survival upon longline retrieval showed little or no difference by hook type for most species. These results indicate that large 18/0 circle hooks maintained the target species catch rate and reduced incidental catch of billfish, other tunas, pomfrets and a variety of bycatch species. Large circle hooks show promise in reducing bycatch although there is economic concern of lost revenue due to lower catch rates of billfish and some pelagic sharks that are often retained and marketed.

Table 1. Randomization test results (10,000 resamples) to estimate probability of significance ($p < .05$) for different catch rates by hook type for 18/0 large circle hooks (C) versus "J" style hooks and Japanese style tuna hooks (T) for 18 species of Hawaii-based longline caught fish.

	Total Catch(C vs. J)				Total Catch (C vs. T)			
SPECIES NAME	C hooks	J hooks	p value	(p<.05)	C hooks	T hooks	p value	(p<.05)
Tuna, Bigeye	930	843	0.2551	No	4722	4630	0.6116	No
Tuna, Yellowfin	232	263	0.486	No	960	1097	0.178	No
Tuna, Skipjack	93	106	0.7119	No	403	466	0.1619	No
Tuna, Albacore	25	29	0.7164	No	144	207	0.0088	Yes
Swordfish	19	27	0.3106	No	120	231	0.0001	Yes
Marlin, Striped	48	71	0.0544	No	370	642	0.0001	Yes
Marlin, Blue	20	41	0.0362	Yes	94	133	0.0198	Yes

Spearfish, Shortbill	66	111	0.0049	Yes	265	510	0.0001	Yes
Shark, Bigeye Thresher	47	55	0.6509	No	117	156	0.0498	Yes
Shark, Blue	630	796	0.0391	Yes	3425	4044	0.0007	Yes
Stingray, Pelagic	8	25	0.0114	Yes	76	241	0.0001	Yes
Snake Mackerel	60	171	0.0001	Yes	571	1690	0.0001	Yes
Opah	76	85	0.5524	No	448	591	0.0006	Yes
Pomfret, Sickle	281	307	0.5974	No	902	1165	0.0001	Yes
Lancetfish, Longnose	1145	1452	0.1423	No	6129	8337	0.0001	Yes
Dolphinfish	204	323	0.002	Yes	2060	3560	0.0001	Yes
Escolar, (Smith's)	83	118	0.0537	No	733	882	0.0066	Yes
Wahoo	98	140	0.0182	Yes	337	440	0.0018	Yes