

# Can circle hooks mitigate bycatch of marine megafauna? A case study of Kenyan artisanal handline and longline fisheries



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# Why we should care about bycatch of marine megafauna

- Marine megafauna – (whales, dolphins, sharks, rays and turtles);
- Increasing threats to vulnerable marine megafauna populations globally;
- Bycatch in the WIO artisanal fisheries is poorly documented (Everett et al., 2011). (No. stock assessments conducted);
- Efforts made to fill these gaps (FAO, 2006; Kiszka & Muir, 2007, SWIOFP)
- Little to no bycatch mitigation methods for marine megafauna in artisanal fisheries



# By-Catch Assessment and Mitigation in the Western Indian Ocean (BYCAM)

## Objectives

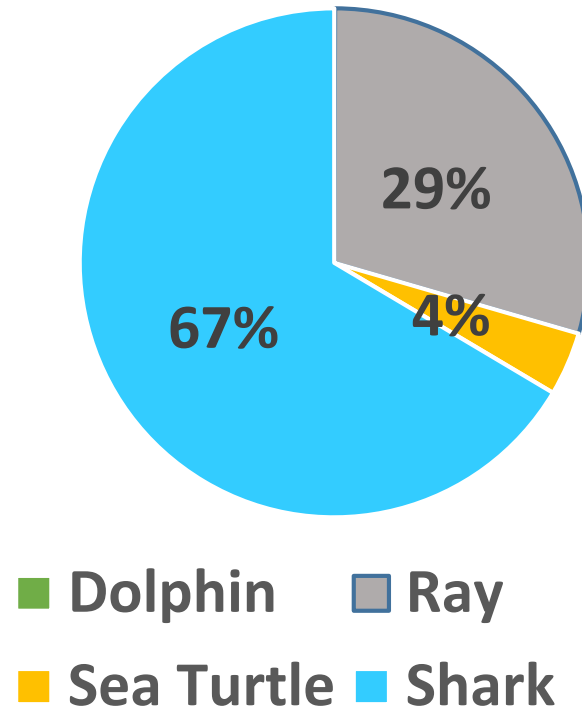
1. Assess the current regional fisheries statistics and bycatch data
2. Assess bycatch in coastal gillnet, longline and prawn trawl fisheries
3. **Develop bycatch mitigation methods in coastal gillnet, longline and prawn trawl fisheries**
4. Data mapping (spatial data management)
5. Comprehensive Final Framework



# Justification – Why it matters?

## Species distribution

Species	Numbers sampled
Dolphin	1
Rays	538
Sea turtles	74
Sharks	1215
<b>Total</b>	<b>1828</b>



Most species considered threatened, endangered, at risk

Opportunistic samples collected from 1 spinner dolphin, a dugong, humpback whale and a whale shark caught during study period



Trial objective: Assess the performance of J hooks and circle hooks in mitigating marine megafauna bycatch in artisanal longline and handline fisheries

**Specific objectives**

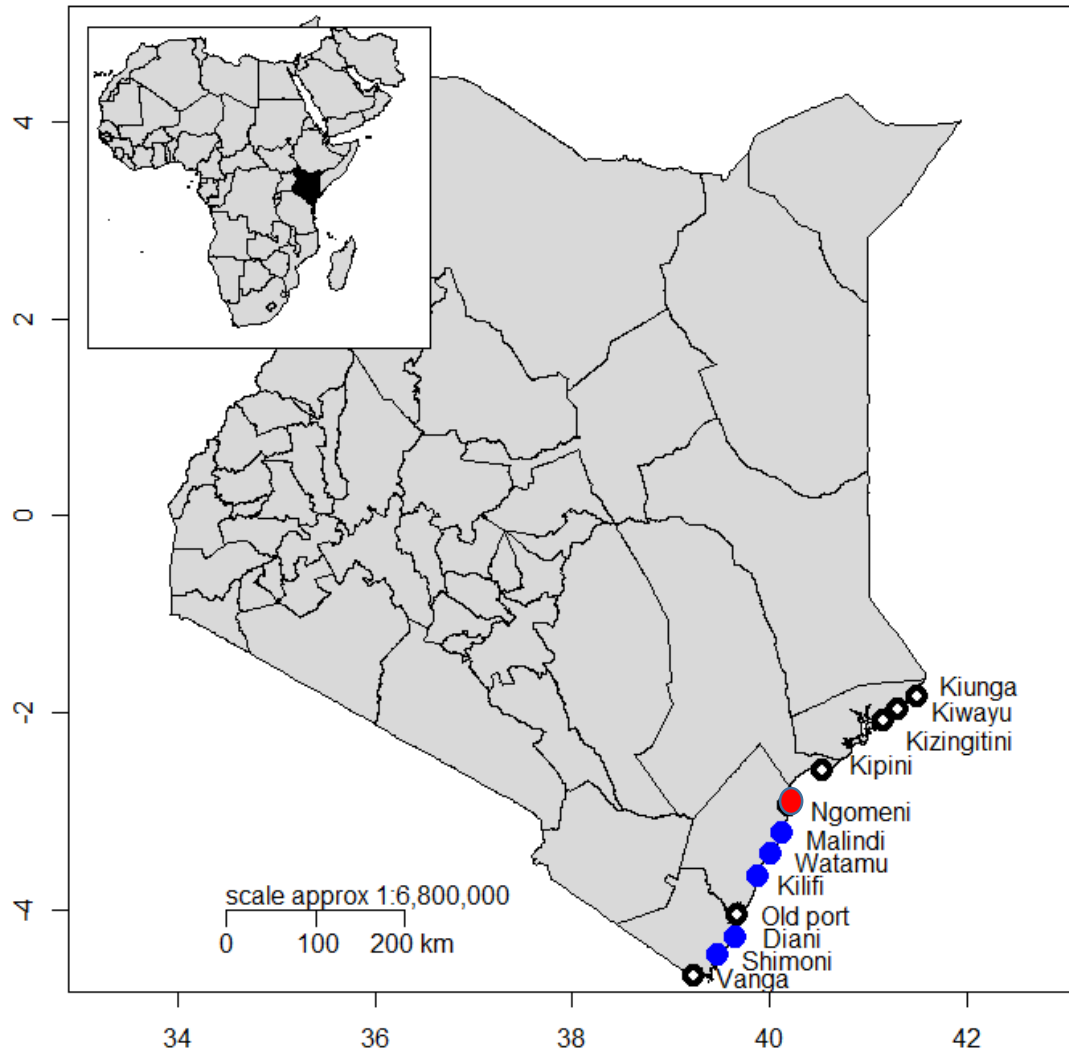
1. Evaluate CPUE for non-target and target species
2. Determine influence of various predictor variables on the CPUE of target and bycatch



# Materials and methods

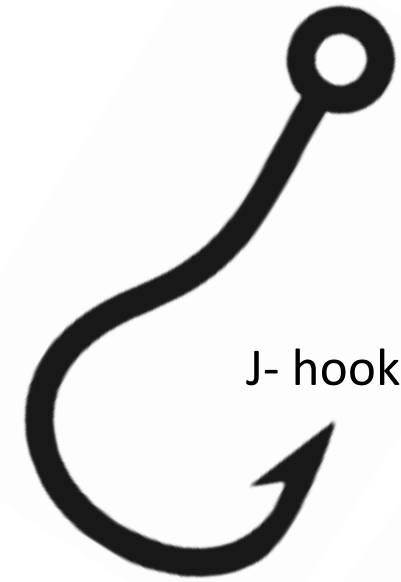
## Pilot study

- Focused on Ngomeni landing site
- Pilot for other mitigation methods (using pingers from Coke bottles)
- February – April 2018
- Citizen Science (17 vessels participated)



# Sampling design and analysis

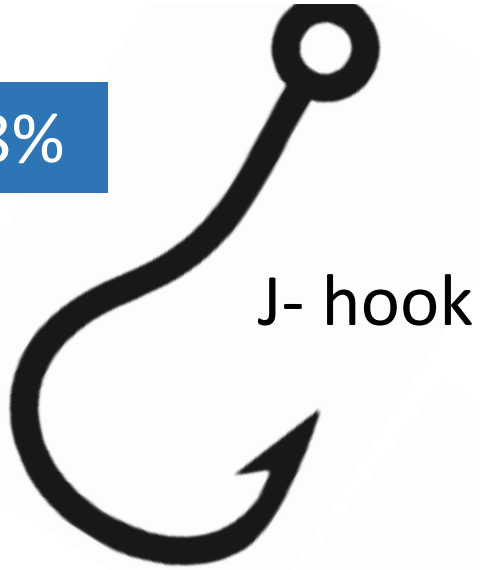
- Three sizes of circle hooks (8/0, 9/0, and 10/0) and two sizes of J-hooks (5/0 and 6/0) were tested respectively;
- Fishers deployed each type of hook separately (either J or Circle hooks), or combination of both (“Combo”);
- Catch data was recorded which included various variables of interest;
- Socio-economic survey (interviews) to develop a conceptual framework;
- Catch Per Unit Effort differences; and
- Multi-linear regressional models to assess effect of predictor variables on CPUE.



Circle hook

# Results

62.8%



J- hook

30.1%



Circle hook

7.1%

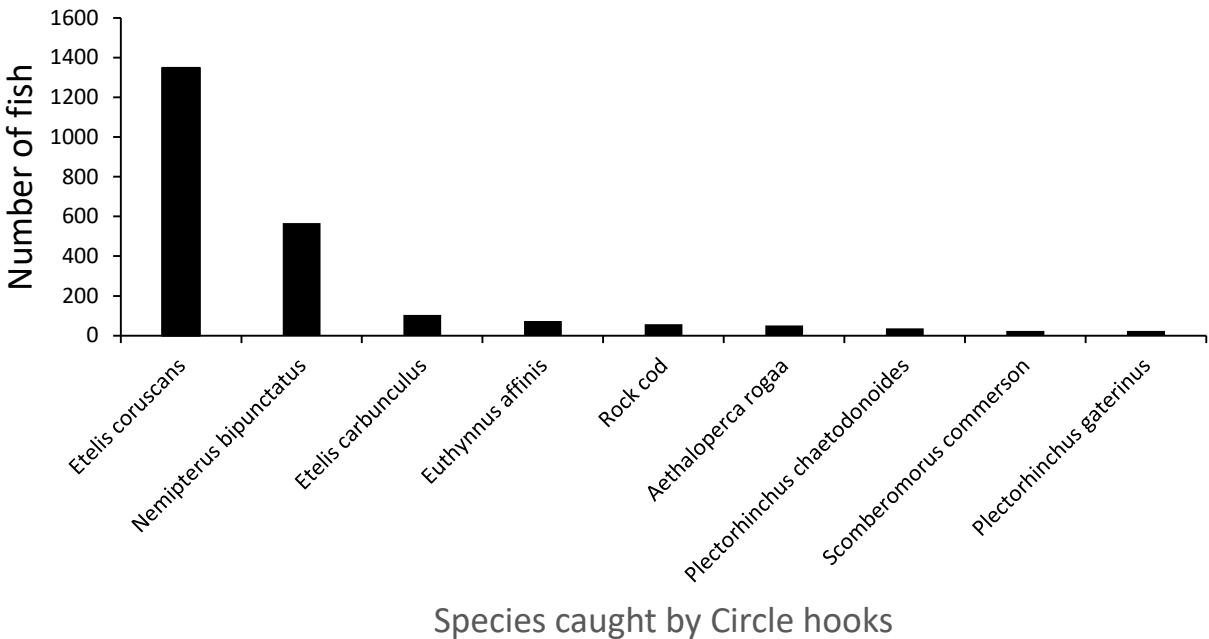
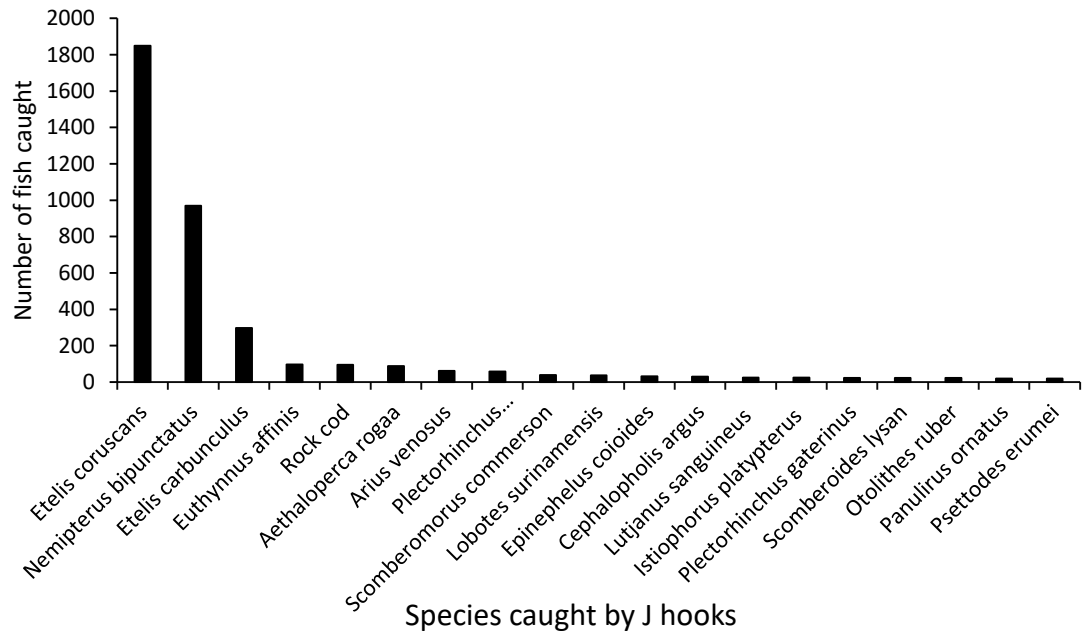


'Combo'

Percentages of target and bycatch (non-target) landings from J, Circle and Combo

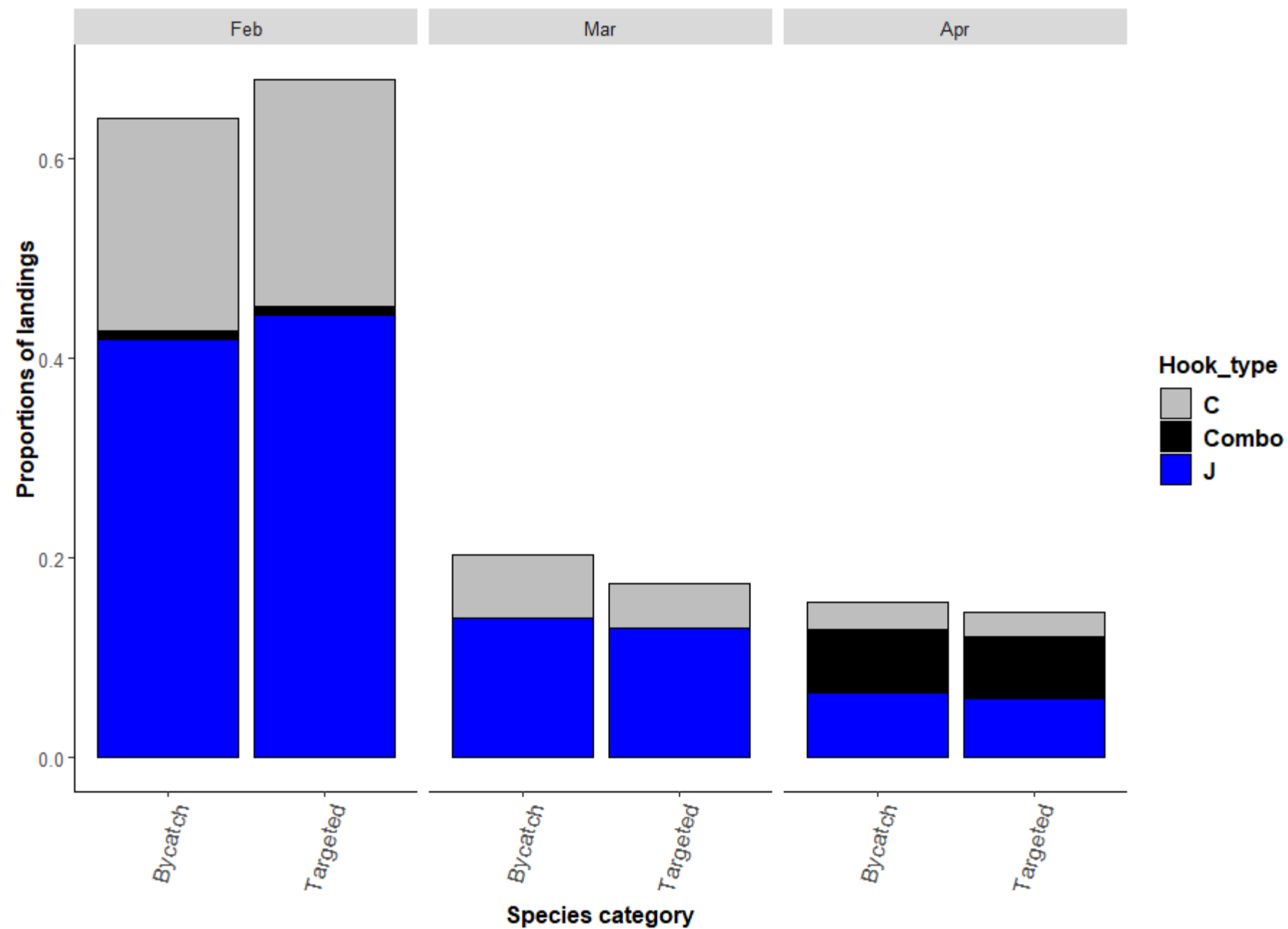


# The fishery

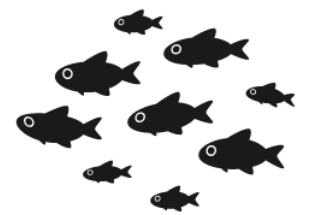
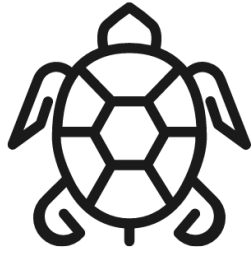


Teleosts dominated the 20 most dominant species caught by J-hooks except for billfishes

Species caught	C	J	Combo	Grand Total
Billfishes	14	13	0	27
Dolphin	0	1	0	1
Other teleosts	1299	2675	596	4270
Rays	13	6	1	20
Sharks	13	64	3	80
Turtle	1	1	1	3
Grand Total	1340	2760	601	4701



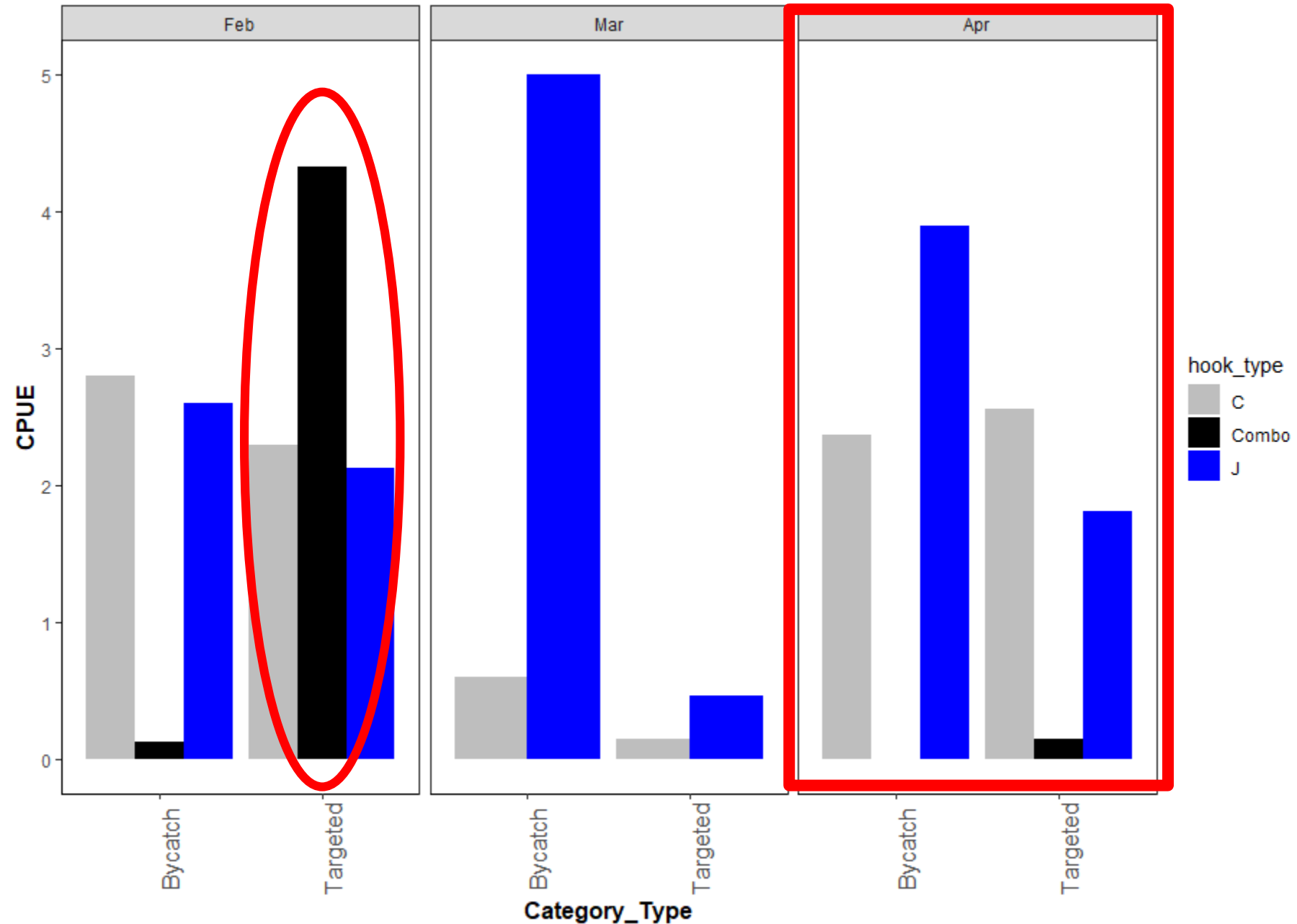
# Catch Per Unit Effort (kg/hr/no of hooks)



Circle hooks			0.28± 0.18	5.02 ± 13.68	0.69 ± 0.59	0.11± 0.19
J hooks	0.04±0.5		0.20±0.2	0.93± 0.68	0.37± 0.85	0.10±0.17
Combo			0.05±0.01		0.06± 0.01	0.17+0.91

- The use of J-hooks, circle hooks, and the combination had an impact on marine megafauna;
- Overall, J hooks had the most Catch-Per-Unit effort in both target and non-target species followed by circle hooks and 'combo';
- But surprisingly , Circle hooks were effective at catching the non-target as well.

The use of J-hooks, circle hooks, and the combination had an impact on marine megafauna



Akaike Information Criteria (AIC) values for each stage of the stepwise model selection process, with depth fished (D), no. of Hauls (NH), hook type (HT), hours Fished (H) and area Fished.

Model 5 =(CPUE~depth\_fished+haul\_no+hook\_type+hours\_fished+area\_fished)

Model names	K	AICc	Delta_AICc	ModelLik	AICcWt	LL	Cum.Wt
Model_5	16	-7167.31	0	1	1	3599.73	1
Model_4	7	-6771.78	395.53	1.29e-86	1.29e-86	3392.91	1
Model_1	3	-6383.05	784.26	5.01e-171	5.01e-171	3194.53	1
Model_3	6	-5778.86	1388.45	3.18e-302	3.18e-302	2895.44	1
Model_2	4	-5634.18	1533.13	0	0	2821.10	1

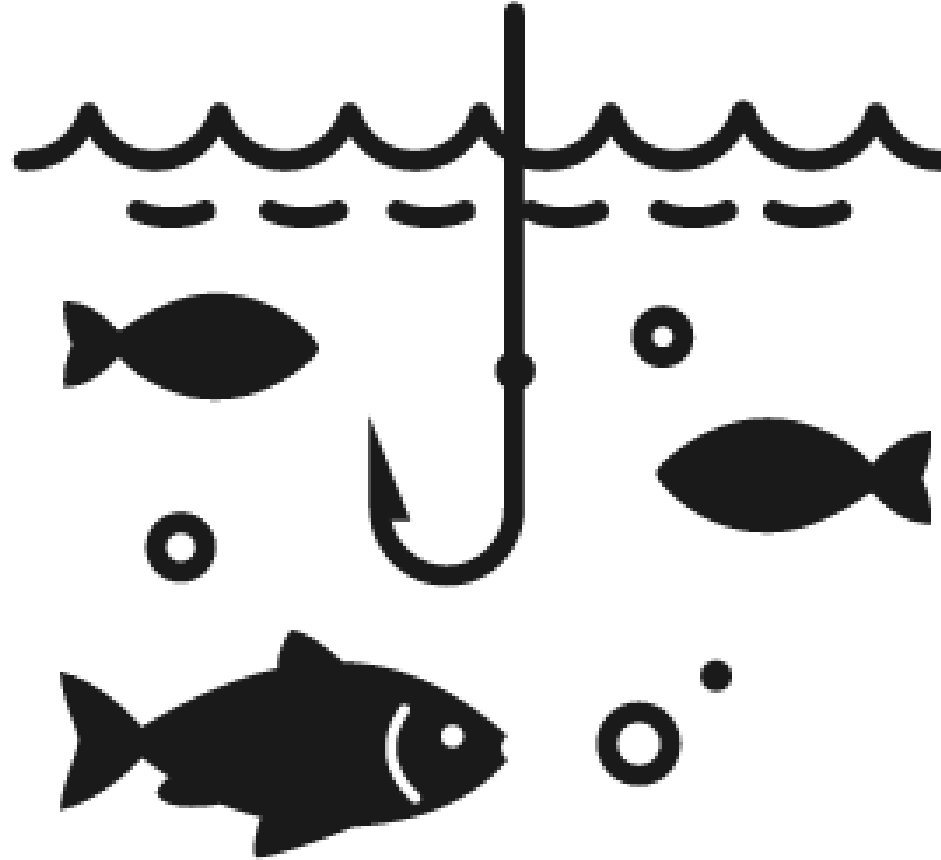


# Coefficients from the best model fitted to CPUE



Area fished

No. of hauls

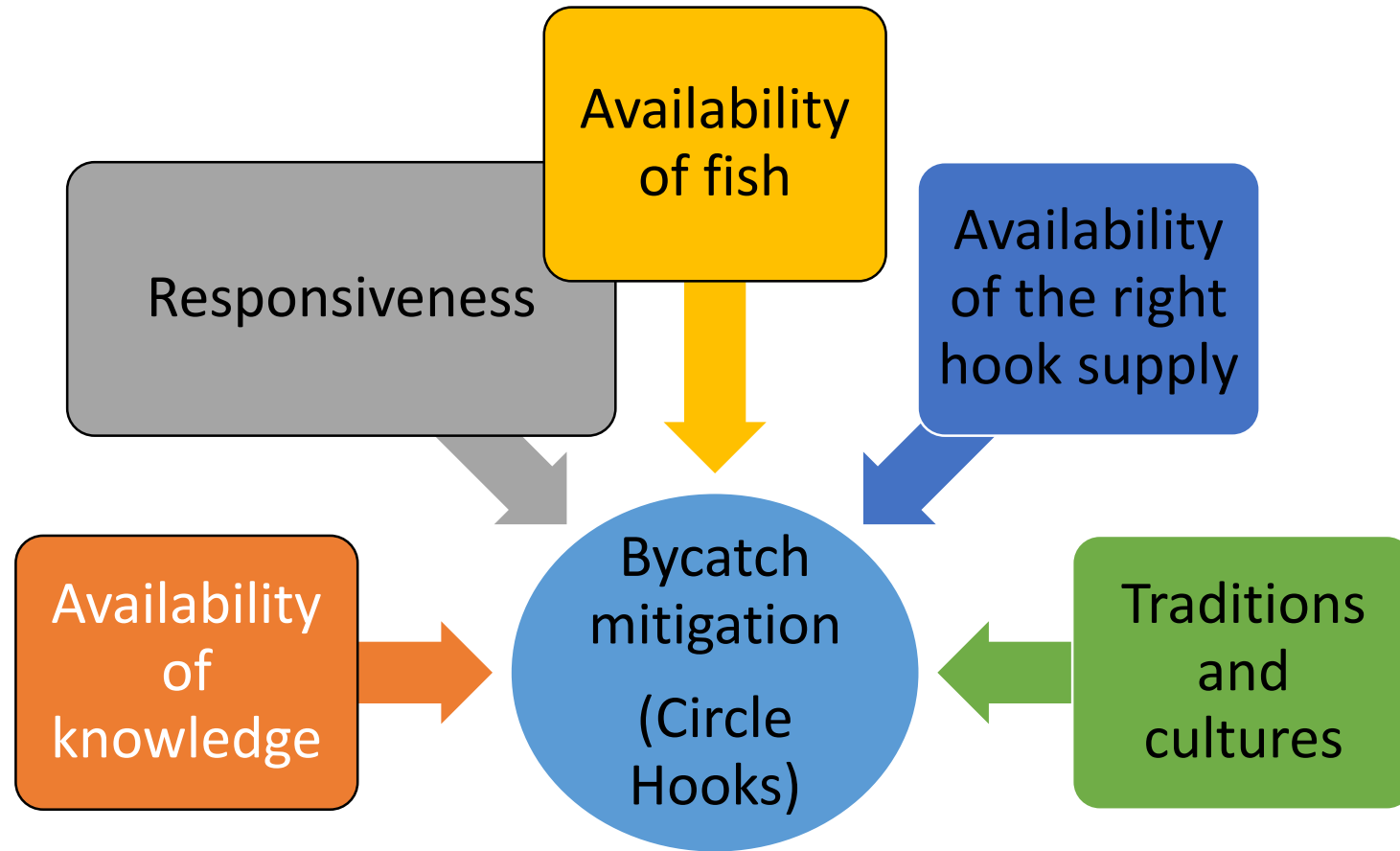


Hours fished

Hook type

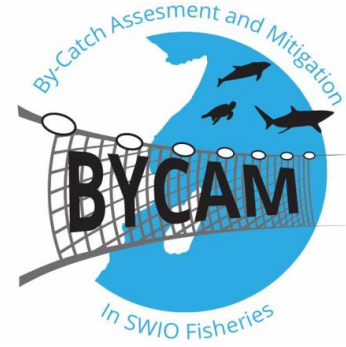
Depth

# Fisher perceptions on use of circle hooks



- Most fishers considered circle hooks to be expensive;
- Fishers perceived that using circle hooks would reduce their catches;
- Thus, preference was given to 'Combo';

# Conclusions



1. The type of hooks used had an impact on the composition of landings and calling into question the need to define and evaluate bycatch in artisanal fisheries particularly for critically endangered species.
2. These findings underscore the impact of artisanal longline fisheries on bycatch as a priority for further research and management in Kenya and the WIO.
3. Local fishers were trained on fish data collection and willingly took up the task (Citizen science) e.g., cameras were given to fishers to take photos of all species landed to ease identification (Citizen science)

# Recommendations

- There is need to conduct long term studies to measure the efficacy of C hooks in artisanal fisheries.
- A longer trial period is advised to create a robust answer
- Awareness creation especially for the species in the IUCN Redlist Appendix II



# Acknowledgements

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- (African Billfish Foundation) for collaborating
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- Field assistants (Mike Mwang'ombe (Watamu Marine Association (WMA) and Regina Wanjiru (ABF))





# Thank you



## Coefficients from the best model fitted to CPUE

	Estimate	Std. Error	t value	P-vale
(Intercept)	0.394710302	0.090109606	4.380335	1.22e-05
depth_fished	-0.000149713	2.80E-05	-5.33906	9.93e-08
haul_no	5.01E-05	3.35E-05	1.49478	0.13506
hook_typeCombo	0.631911871	0.039828877	15.86567	7.90e-55
hook_typeJ	0.010503163	0.003295878	3.186757	0.001451
hours_fished	-0.027769953	0.001254997	-22.1275	9.07e-102
area_fishedKiwayu	0.072818697	0.089340362	0.815071	0.415086
area_fishedLamu	0.250970831	0.09970389	2.517162	0.011874
area_fishedMambrui	0.141369548	0.102480343	1.37948	0.167833
area_fishedMbwanyongo	-0.182800747	0.089548951	-2.04135	0.04129
area_fishedNgomeni	0.07730301	0.090872661	0.850674	0.395008
area_fishedNorth Kenya Banks	0.00670943	0.088777239	0.075576	0.939761
area_fishedRas Ngomeni	-0.020785073	0.089588198	-0.23201	0.816546
area_fishedWatamu	0.110719854	0.099323557	1.114739	0.265037
area_fishedZiwayu	0.01138707	0.090303594	0.126098	0.899662