

Measuring the Accuracy of Artisanal Fishermen's Underwater Depth Perception

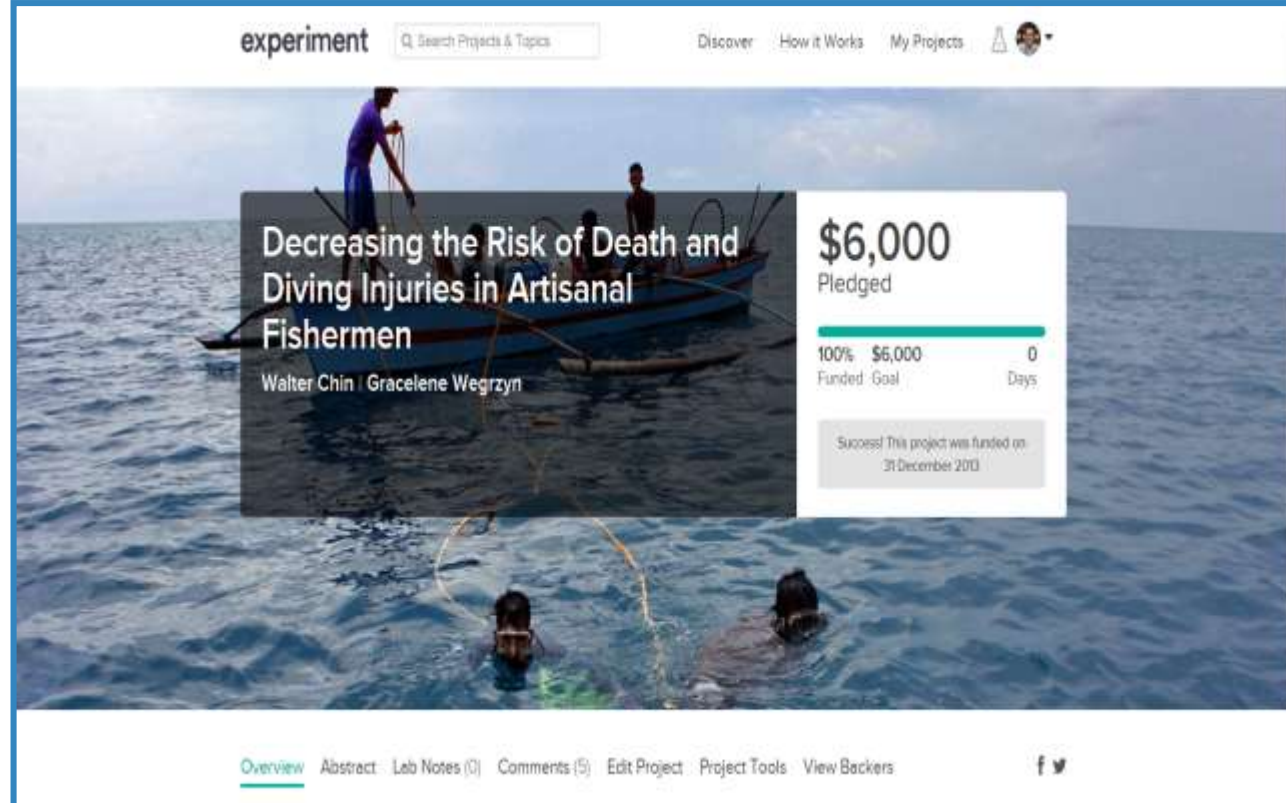
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- Employment
 - Program Director for for Oxyheal Health Group

Funding and IRB

- UCLA Medical IRB-approved
 - IRB Number:
13-00532
- Microryza Crowd funding
 - \$6,000



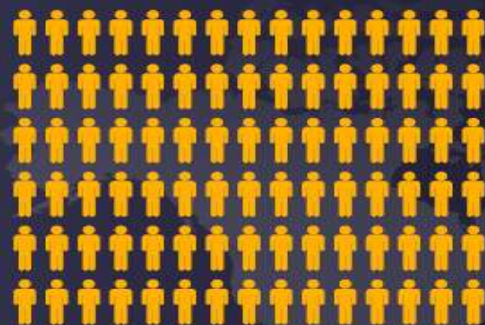


Local Communities Depend Upon Artisanal Fishing as a Source of Food and Livelihoods



90%
of Fishing Jobs
are Small-Scale

Of the estimated 26-29 million total fishing jobs in developing countries, approximately 25-27 million are in the small-scale fisheries sector.

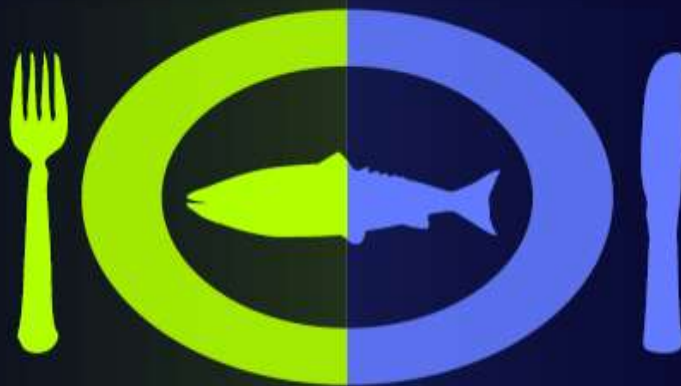


90 Million
Related Jobs

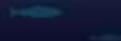
Small-scale fisheries provide additional jobs in fish processing, distribution, and marketing.

Small-Scale Yields Equal Large-Scale Industrial Yields for Direct Human Consumption

30
Million Tonnes
Small-Scale
Fisheries



30
Million Tonnes
Large-Scale
Fisheries



Commercial fisheries catch an additional 35 million tonnes of fish for fishmeal, oils, etc

Bycatch Can Harm Ecosystem Structure, Affecting Existing Populations as Well as Potential Future Catch

79.5
Million Metric Tonnes
Total Global Marine Catch (2008)



7
Million Metric Tonnes
Estimated Total Global Catch that is Discarded

This estimate does not account for unreported bycatch and discards or illegal, unreported or unregulated (IUU) fish catch.



**Non-Target Species Are Often Discarded
When Dead or Dying.**

SOURCE:
FAO, 2010.







Problem Statement

- Decompression Illness (DCI) is an epidemic among artisanal fishermen of the Yucatan Peninsula. Over ~**20%** of 1,300 fishermen in the Yucatan experience DCI annually.
- Minimal dive equipment
 - No Depth gauges
 - No time keeping devices.

Our Question

1. How Accurate is the depth perception of these fishermen divers?

Methods

Subjects

Six fishermen belonging to the cooperatives of Río Lagartos, in the Yucutan Peninsula were invited to participate.

Materials

Sensus Ultra Dive™ recorders with an accuracy of ± 1 Foot of Seawater (FSW) were attached to the fishermen's weight belts. The recorders activated at 3 FSW and recorded data every ten to thirty seconds.

The fishermen were followed throughout each observed fishing day for two months. After each dive, they were asked to recall their estimated working depths in arm strokes (1 arm stroke = ~ 1.86 meters).



Variables

- **Depth Perception** of the fishermen. Since accurate values of depth and time are necessary in avoiding DCI, we believed that the accuracy of the fishermen's perception was skewed.
- **Arm strokes** of the Fishermen. Fishermen use each arm-stroke that they use to propel themselves deeper. However arm strokes are standardized (1.86 m) and the fishermen's arm lengths are not.

Measured Variables

- Estimated depth, measured in arm spans (in meters)
- Recorded depth, measured by the Sensus Ultra dive recorder (in meters)

Transducer Depth

Over	Mean	Std. Err.	[95% Conf. Interval]	
RL1	12.51667	1.151413	10.23675	14.79658
RL2	9.2168	.4591433	8.30765	10.12595
RL3	14.24171	.5084464	13.23494	15.24849
SF1	15.141	.8558344	13.44636	16.83564
SF2	12.6	.6879657	11.23776	13.96224
SF3	21.64375	.2095398	21.22884	22.05866

Estimated Depth

Over	Mean	Std. Err.	[95% Conf. Interval]	
RL1	9.144	3.57e-16	9.144	9.144
RL2	11.26541	.5654512	10.14576	12.38506
RL3	20.4981	.9401977	18.63642	22.35979
SF1	19.10296	.8390505	17.44156	20.76436
SF2	14.1732	.7004818	12.78618	15.56022
SF3	23.0886	.3346361	22.42599	23.75121

Estimated Depth Frequencies

Estimated depth

7.315
9.144
10.973
12.802
14.63
16.459
18.288
19
20
21.946
23.774
27.432
29.261

0

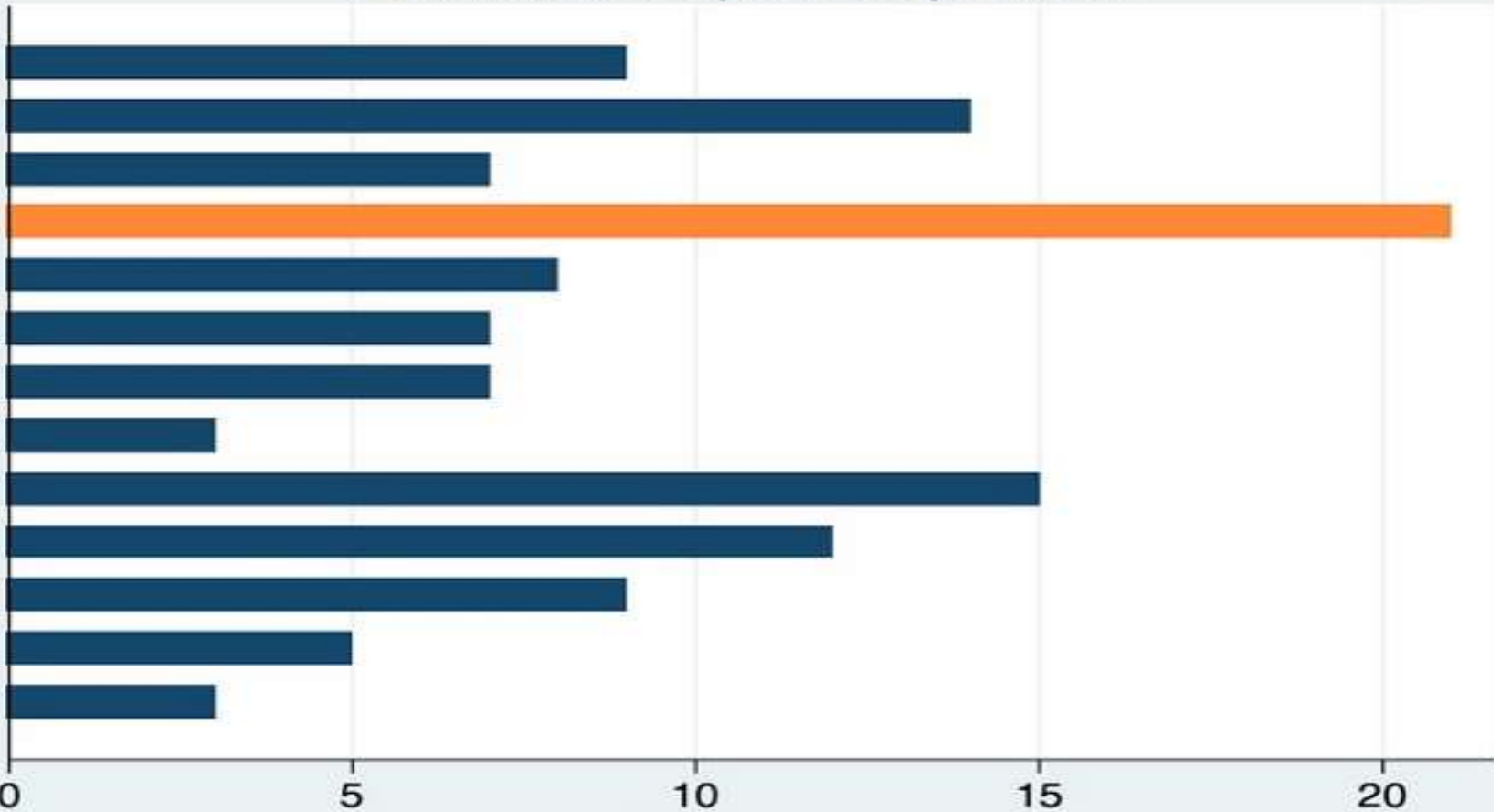
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10

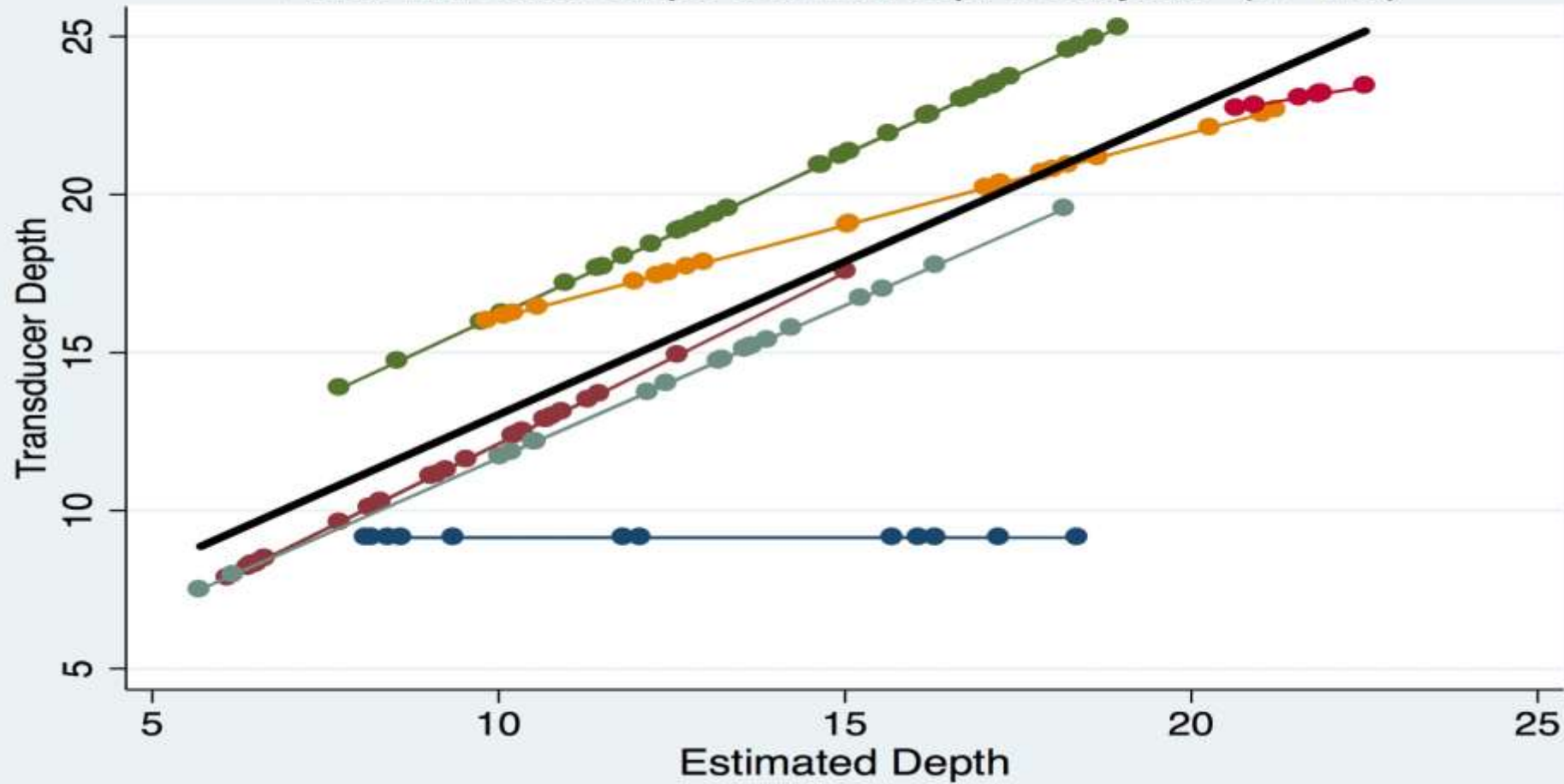
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20

Frequency



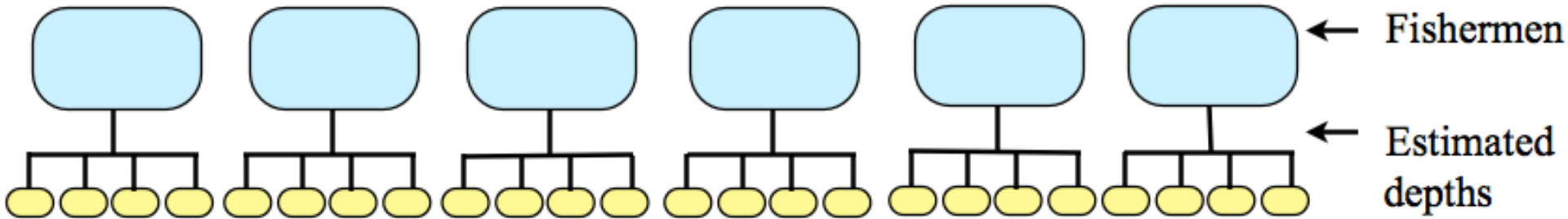
Estimated Depth vs. Transducer Depth
Each individual Slope and Intercept 6 Subjects (N=120)



Mixed Effect model

- Data displayed heteroscedasticity
- The data represents multiple dives from 6 different fishermen
- Some dove more than others, giving them more weight
- The variability of the variables was unevenly distributed across the range of second variables

Levels



The estimated depths are nested within the subjects.

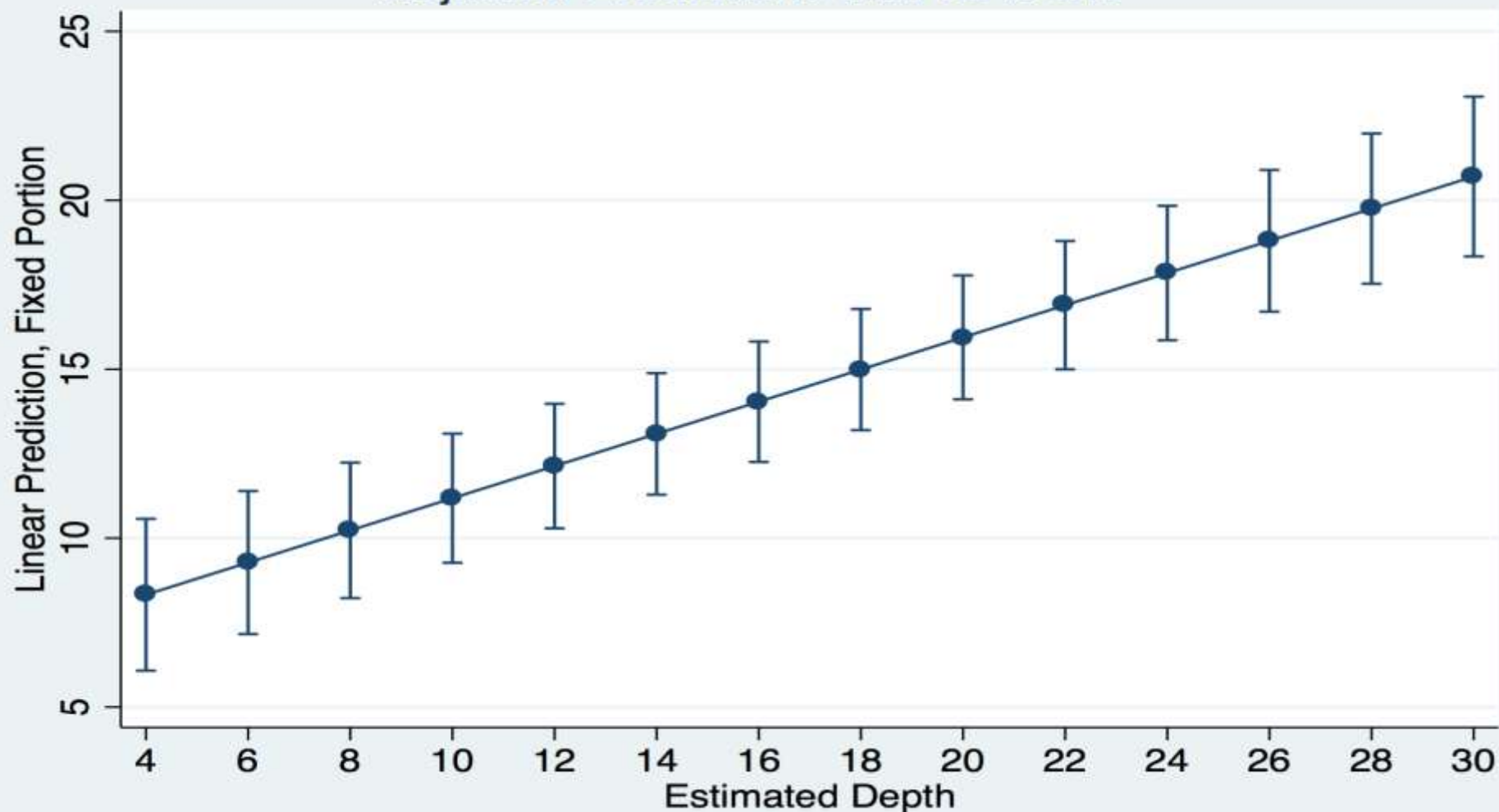
Results

A mixed effect regression model showed a significant difference between the estimated and recorded depth as $P > |z| = 0$.

reco_depth	Coef.	Std. Err.	z	$P > z $	[95% Conf. Interval]	
est_d	.476079	.0573024	8.31	0.000	.3637683	.5883897
_cons	6.420776	1.298167	4.95	0.000	3.876416	8.965137

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
sub1: Identity				
var(_cons)	4.57858	2.978522	1.279368	16.38575
var(Residual)	6.209443	.8242018	4.787068	8.054446

Adjusted Predictions with 95% CIs



Limitations

- Low number of subjects
- We did not measure each the fishermen's arm lengths
- Assumption were that each arm stroke pushed them forward by ~1.86 Meters
- Response bias

Discussion

This could suggest that the artisanal fishermen display risky behavior. It could be an example of their tendency to ignore potential risks to their health and safety in pursuit of a greater catch.

Thank You