

Diving Behavior in artisanal fishermen of the Yucatan Peninsula



UCLA

Introduction and Background

In the small communities of San Felipe and Rio Lagartos, located on the north coast of the Yucatan Peninsula in Mexico, fishing provides a primary source of income for many people, with lobster being the most profitable fish.

Fisherman utilize *hookah* diving systems to dive in deep waters far off the coast. This method of fishing allows the fishermen to remain at increased barometric pressure for extended periods of time, thereby increasing their risk of decompression stress, injury and ultimately, decompression sickness (DCS).



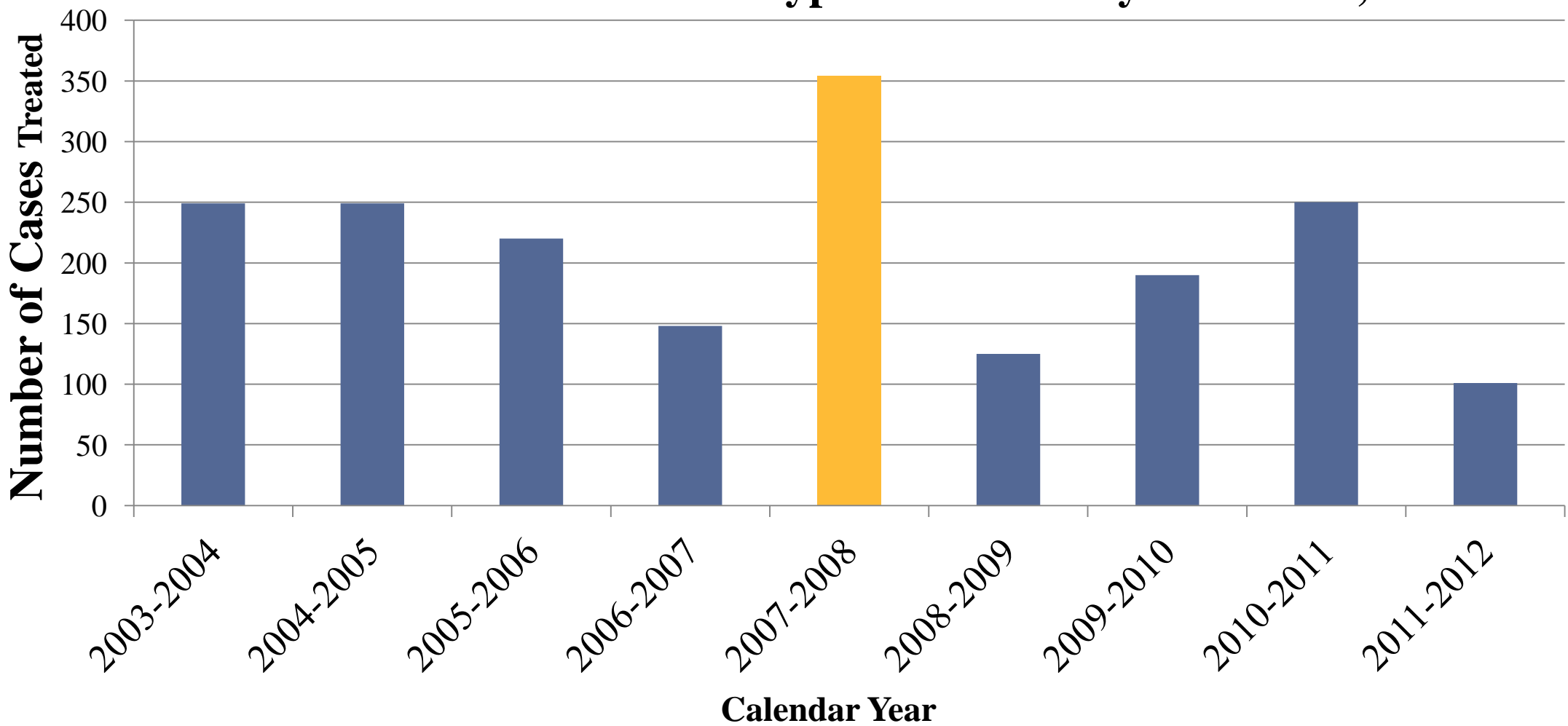
Diver using the *hookah* diving system underwater



The *hookah* diving system

Today, more than one-third of the fishing population in the Mexican Yucatan Peninsula has experienced DCS qualifying this as an epidemic. We hypothesize that there will be a correlation between socio-economic stresses, amount of fish caught, and risk of DCS.

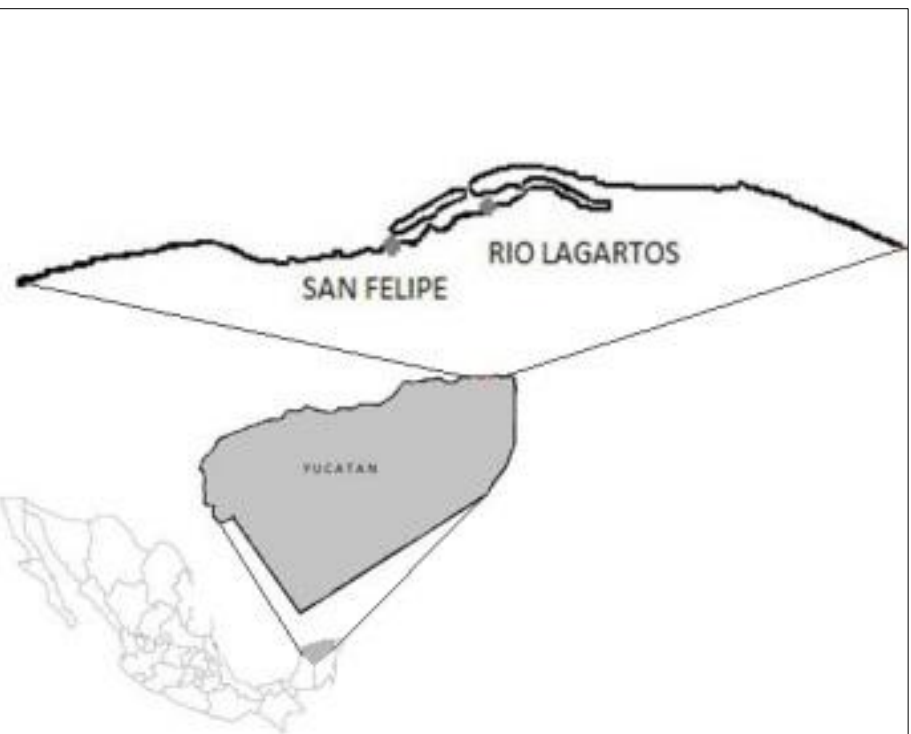
Cases of DCS treated at the Hyperbaric Facility in Tizimin, Mexico



Materials and Methods

Fieldwork was conducted on fishermen from Rio Lagartos and San Felipe, for the 2012-2013 fishing season. Subjects were chosen based on fishing skills. Skills were defined as *catch per unit effort (CPUE)* which is the amount of kilograms of fish a fisherman brings in per fishing trip.

Mean CPUE for the entire population was compared against each fisherman's mean CPUE to determine their percentile: top 25 percentile, intermediate 50 percentile, or lowest 75 percentile. Six fisherman were randomly selected, three from each community and one from each percentile and were classified with identifier letters RL or SF respectively, followed by numbers.



Diver	Age (years)	Height (m)	Weight (kg)	BMI	Fishing Experience (years)	DCS
RL000	53	1.74	109	36.00	28	3
RL060	46	1.60	78	30.45	22	5
RL105	43	1.71	96	33.50	21	9
SF005	38	1.67	87	31.95	20	14
SF013	21	1.54	58	24.45	6	1
SF019	36	1.67	86	30.83	17	9

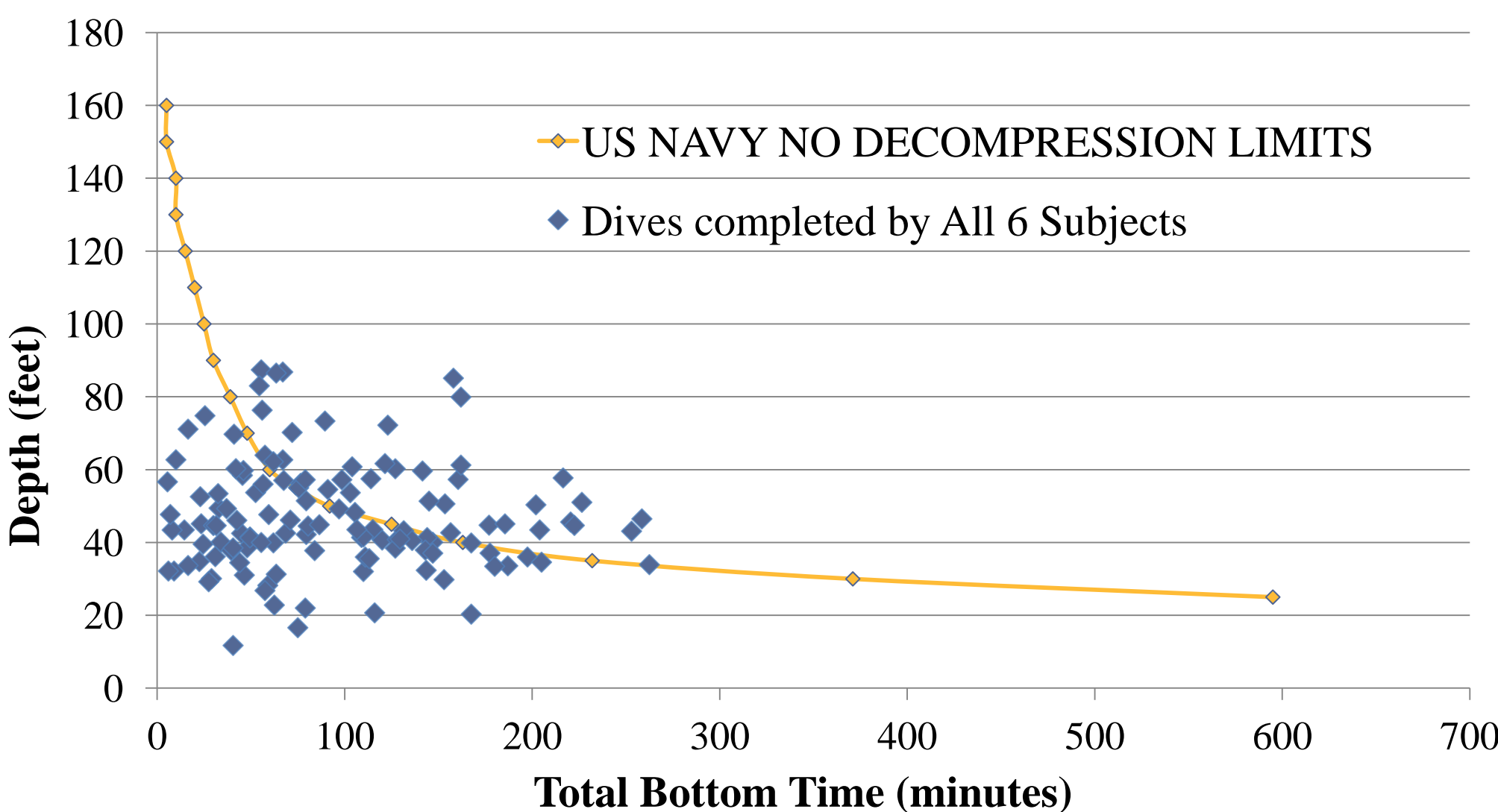


Six Sensus Ultra dive computers were used to record diving data from each fisherman. One dive computer was assigned to each fisherman and was attached to the fisherman's weight belt before their first dive each day. All computers were collected at the end of the day when the fisherman exited the ocean and the data was downloaded to a desktop workstation.

Results

We found that the fishermen used a yo-yo dive pattern. Therefore to define a dive, we used the U.S. Navy definition of a dive. Using this definition, a total of 120 dives over 52 fishing trips were recorded. The fishermen averaged 2.5 dives per day, 47.2 FSW \pm 2.21 per dive, and 95.12 minutes \pm 10.81 of total bottom time (TBT) per dive. 24% of all dives exceeded the no-decompression limit.

Due to the yo-yo dive pattern, 319 ascent rates were calculated revealing an average speed of 20.28 FSW/min with 5% of ascents exceeding the recommended speed of 30 FSW/min.



Linear regression showed a correlation with amount caught (AC) to maximum depth (MD) ($t=15.69$, $P<0.0000$), TBT to AC ($t=9.56$, $P<0.0000$), and TBT to income ($t=9.35$, $P<0.0000$). Two subjects reported musculoskeletal DCS while all 6 subjects experienced skin DCS.

Diver	Dive Days	Max depth (FSW)	Avg depth (FSW)	Total bottom time/day (min)	Max ascent rate (FSW/min)	Musculoskeletal DCS	Avg catch/Day (kg)	Avg income/day (\$)
RL000	4	60.23	38.41	97.25	27.44	No	47.64	130.50
RL060	11	57.50	41.29	83.35	52.50	No	54.63	168.09
RL105	9	76.00	51.00	72.06	78.22	No	85.56	283.44
SF005	7	73.00	50.26	92.30	36.57	No	64.91	179.50
SF013	16	59.50	38.90	154.02	32.67	Yes	69.98	193.62
SF019	4	87.37	76.36	79.85	62.72	Yes	68.75	186.75

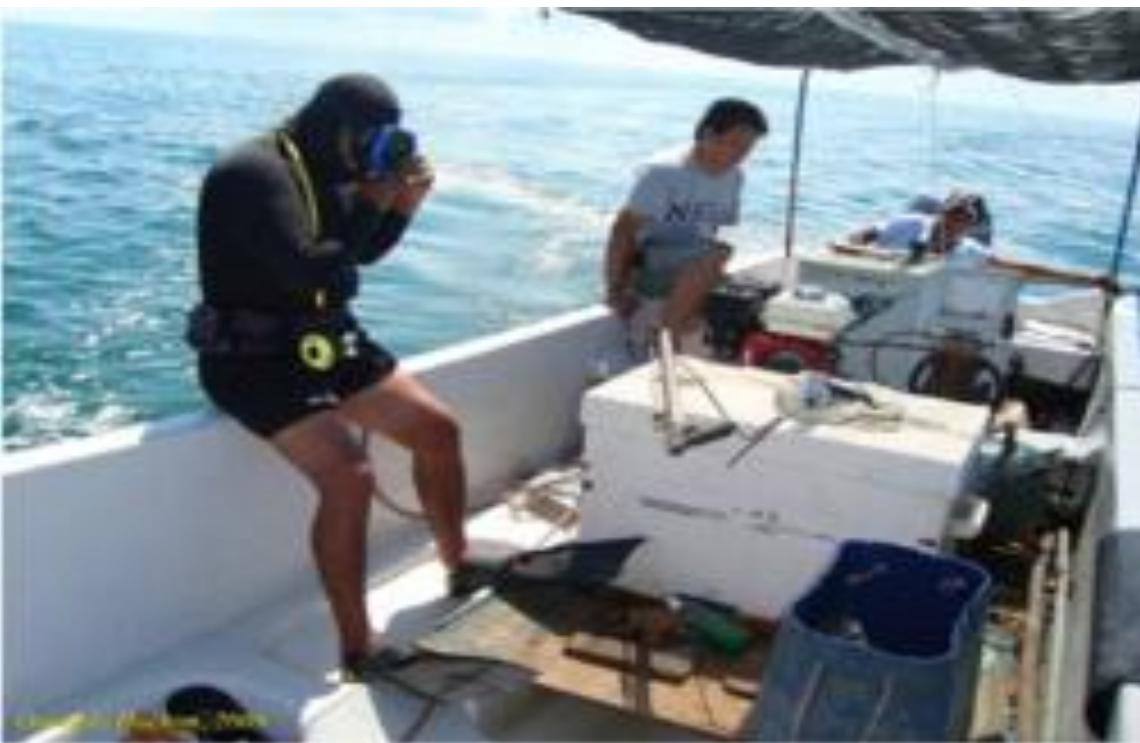
Summary Results

Conclusion and Recommendations

Socio-economic factors such as increasing market demands, scarcity of catch, and financial stress may contribute to the high-risk diving behavior and decompression stress of fishermen. The positive correlations between amount caught and maximum depth and amount caught and total bottom time show that the depth to which the fishermen are diving and their total bottom times are factors that increase their risk of DCS.

Two fishermen reported musculoskeletal DCS, neither chose to get treatment. This lack of treatment is a common problem in both fishing populations. Often time fishermen omit treatments for various reasons, with economic stress being one major reason. Lack of transportation to the hyperbaric center which is located more than 40 miles from the communities and cost of treatment are also reasons for omission.

It is difficult to apply US NAVY decompression tables that were not designed for this population. The diving behavior of the artisanal fishermen was analyzed based on the US Navy tables and US Navy No-decompression limits. One solution would be the creation of a basic decompression model for this population. Taking into account the socio-economic factors, diving behavior, and current risk of DCS. Furthermore, we believe that educational interventions could help mitigate risk of DCS in these populations. These interventions could then be applied elsewhere



Acknowledgements and Contacts

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