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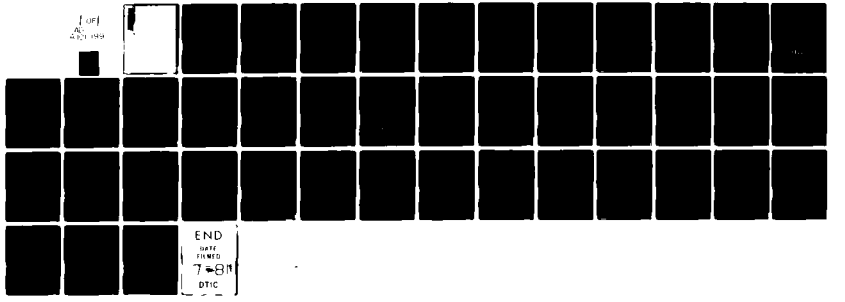

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: WHOI-81-57 (14)	2. GOVT ACCESSION NO.: AD-A102 799
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: FACTORS CORRELATED WITH INCIDENCE OF FISHBITE ON DEEP-SEA MOORING LINES (6)	5. TYPE OF REPORT & PERIOD COVERED: Technical Rept. (9)
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s): Bryce Prindle (10)	8. CONTRACT OR GRANT NUMBER(s): (15) NOAA *N00014-76-C-0197; NA-79-QA-A-00475
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: *NR 083-400
11. CONTROLLING OFFICE NAME AND ADDRESS: NORDA /National Space Technology Laboratory, Bay St. Louis, MS 39529 (11)	12. REPORT DATE: June 1981 (12) 43
	13. NUMBER OF PAGES: 36
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

This work was also funded by the National Data Buoy Office of the National Oceanic and Atmospheric Administration.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

1. Deep-sea lines
2. Fishbite risk
3. Environment

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

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UNCLASSIFIED 6/81 382 000 ltb

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WHOI-81-57

FACTORS CORRELATED WITH INCIDENCE OF FISHBITE ON DEEP-SEA MOORING LINES

by

Bryce Prindle

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June 1981

TECHNICAL REPORT

Prepared for the Office of Naval Research under Contract N00014-76-C-0197; NR 083-400 and the National Data Buoy Office of the National Oceanic and Atomospheric Administration under Contract NA-79-QA-A-00475.

Approved for Distribution: Earl E. Hays

Earl E. Hays, Chairman
Department of Ocean Engineering

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ACKNOWLEDGEMENTS

The author wishes to express his appreciation of the efforts of Robert G. Walden in the inception and encouragement of the investigative work herein reported; and to the agencies which have provided financial support. The developments described in this report have been made possible by funds provided by the National Data Buoy Office of the National Oceanic and Atmospheric Administration under Contract NA-79-QA-A-00475 and by the Office of Naval Research under Contract N00014-76-C-0197.

ABSTRACT

Data from 399 moored stations established over the years 1967 through 1978 have been analyzed with reference to fishbite. Fishbite appears to have been a significant hazard as it was found in 22% of the lines placed within 40 degrees of the equator and where parts of the lines were at 2000 meters depth or less. Latitude, depth of water, and distance of mooring components beneath the surface were found to be correlated with incidence of fishbite; duration of a mooring was not.

Introduction

The occurrence and nature of fishbite damage to lines used in the deep-sea have been documented (Prindle and Walden, 1976), but questions have remained concerning the actual degree of risk which is to be expected as lines are placed in the ocean under various circumstances. Given a number of moored stations, what percentage of the mooring lines might one expect to be bitten? What are the relationships between fishbite and such factors as geographical location, depth of water, surface vs subsurface mooring floats, and the service life of a mooring?

In an attempt to find quantitative answers to such questions, data from 399 moored stations placed by the Woods Hole Oceanographic Institution from 1967 through 1978 were assembled and analyzed, correlating incidence of fishbite with -

1. Depth of mooring components
2. Mooring site
3. Depth of water at mooring sites
4. Duration of moored stations

Procedure

Log sheets of Woods Hole Oceanographic Institution's moored stations were reviewed and data relative to fishbite tabulated for the years 1967 through 1978. In all, records of 399 stations are included in the study. 1967 was chosen as the starting year because it was the first year when fishbite observations were made on a routine basis. 1978 was the last year for which station logs were complete. The dates given for moorings are the dates of deployment. Moorings set each year are grouped together. As duration of moorings has increased, a number, of course, have not been recovered until sometime in the calendar year following that in which they were established. Nevertheless all are listed according to year of deployment.

Only data which are thought to have a direct bearing on fishbite are included; mooring site, float depth, depth of water, duration, and of course recorded observations of the occurrence or non-occurrence of fishbite. Except for moored station locations and fishbite records, data are used exactly as given in the station logs.

With reference to mooring site, two sets of figures for latitude and longitude are given in most logs reflecting either drifting or some variation in measurement of position at times of deployment and recovery. For purposes of this report, station location has been taken as the average between the two sets of data points.

Fishbite data have been reduced to "+", line bitten or "0", line not bitten, regardless of the number of bites found on any individual mooring line. It has been assumed that all lines were examined for evidence of fishbite and that in each case where typical damage was found a record of fishbite was made. In the cases of all other station logs, whether the record indicated a search for fishbite with negative results, or where a log contained no reference to fishbite, it has been assumed that the line was not bitten. Such a method may not lead to working figures which contain a record of every contact between lines and fish teeth. However, it would seem to be in line with practical considerations which govern the use of obviously damaged lines.

The fishbite data were recorded by personnel who happened to be aboard ship at the time of hauling. Hence, many observers with varied experience in detecting fishbite and often under pressure of other duties were involved. In the writer's experience, observers working under shipboard conditions usually do not find as many bites as a later, detailed examination of a line in the laboratory will reveal. The number of fishbites reported in the log sheets is therefore regarded as conservative.

Data from Woods Hole Oceanographic Institution's moored stations deployed from 1967 through 1978 inclusive are tabulated in the Appendix to this report. Records of moored stations 256 through 654, a total of 399 stations, are included.

Ocean Areas Included in the Study

385, or 96%, of all moored stations in the study were deployed in the north Atlantic Ocean. The remaining 14 were placed: five in the Pacific Ocean near Hawaii, four in the Phillipine Sea, and five in the Indian Ocean. In terms of world ocean space, therefore, the representation of data is predominately from the Atlantic Ocean north of the equator. What follows by way of interpretation of the data can be applied to that area with some degree of confidence. With reference to other parts of the world ocean, however, conclusions can only be tentative until more uniform coverage has been obtained.

Of the total number of stations, 261 or 65% were located in what will hereinafter be designated as the "fishbite zone". It is an ocean space bounded by latitude and by depth. It lies between 40° north and 40° south latitude. The depth boundaries are between the water-air interface and 2000 meters below the surface. The boundaries are based upon experience with deep-sea moorings and upon other information in the "Deep-Sea Lines Fishbite Manual, (Prindle and Walden, 1976). In the time period covered in the present report, 19 Woods Hole Oceanographic Institution buoys were deployed outside the area bounded by the 40° north and south parallels. None of those lines were bitten. Data for the same are presented in Table I. However, 11 of the 19 had all components below 2000 meters depth, so only eight were inside what has already been designated as the space where biting is likely to occur. The present data support the

Table I

WHOI Stations Moored Above 40° Latitude

Sta.No.	Float Depth m	Latitude	Longitude	Water Depth m	Duration Days	Bites
257	0	43.00 N	70.43 W	104	1	0
321	3	41.52 N	70.65 W	27	14	0
337	7	41.43 N	70.77 W	26	1	0
445	5107	40.06 N	49.84 W	5384	53	0
446	3966	40.56 N	49.75 W	4244	53	0
447	3405	41.00 N	49.77 W	3683	52	0
448	2741	41.50 N	49.73 W	3018	52	0
560	3137	41.48 N	54.98 W	4774	215	0
561	2932	40.47 N	55.02 W	5171	217	0
570	4190	52.71 N	33.99 W	4288	272	0
571	970	52.90 N	39.52 W	2895	273	0
572	956	52.77 N	35.50 W	3398	273	0
573	3962	41.49 N	54.98 W	4758	306	0
574	3966	40.45 N	55.05 W	5177	307	0
602	3953	41.47 N	54.92 W	4772	274	0
603	3966	40.45 N	55.02 W	5173	272	0
651	70	59.03 N	12.53 W	1558	41	0
652	0	59.03 N	12.55 W	1551	39	0
653	0	59.02 N	12.57 W	1551	39	0

use of 40° latitude as a boundary for the fishbite zone, but more information would be desirable.

With reference to depth, 96 moored arrays were placed inside the 40° parallels but with float depths greater than 2000 meters. Of these, none were reported bitten.

For purposes of this report, it will be assumed that moored station components located outside 40° north or south latitude and at depths greater than 2000 meters have been exposed to negligible risk of fishbite and will be considered to have been outside the fishbite zone. For a number of purposes, the incidence of biting will be calculated upon the basis of number of deployments within the delineated zone.

261, or 65%, of the total number of successfully completed and documented moorings were within the fishbite zone. Biting appears to have been a significant hazard as 22% of the mooring lines from within that group were reported to have developed markings characteristic of fishbite. Data for the same are summarized in Table II.

Seasonal Variations

Fishbite attack appears to have been quite variable from one year to another as is illustrated in Figure 1. For example, in 1968 no lines were reported to have been bitten; the next year, at the same location, (Site D, 39° N Lat., 70° W Long.) with a like number of lines exposed, the attack rate was 27%. From 1975 through 1978, the rate of attack at all stations appears to have been on the increase, rising from 8% to 62% of lines placed within the fishbite zone. Interesting, if true.

Taking the data as they stand in the record, several possibilities appear. One is that fishbite hazard may vary from time to time at the same location, especially if it is near the boundary of the fishbite zone. Site D is such a location. In 1968, 21 stations with buoys above

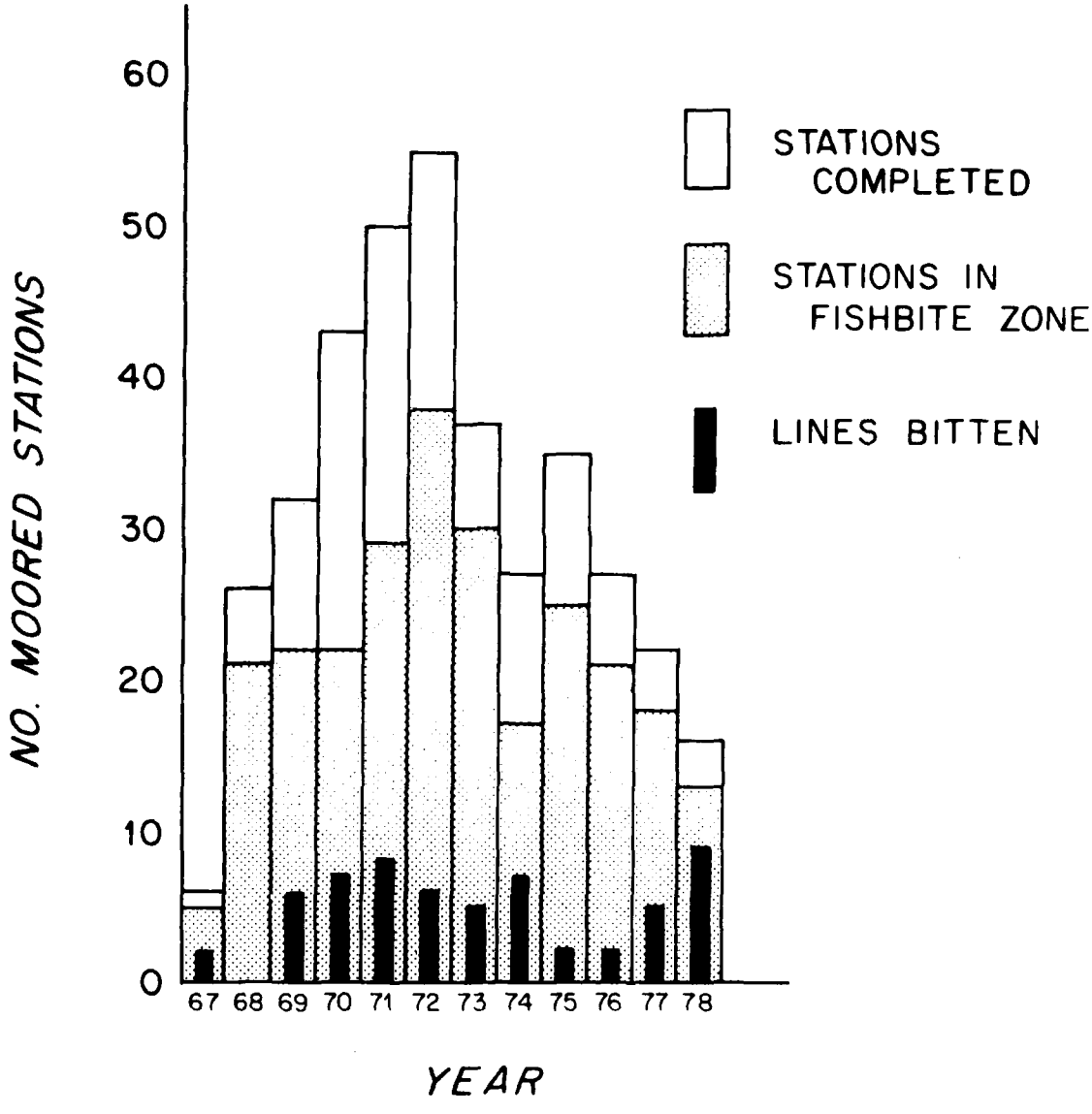

FIGURE 1: Fishbite at WHOI Moored Stations #256-#654

Table II

Incidence of Fishbite

on

WHOI Moored Stations in the Fishbite Zone

Year Set	Stations Completed	Lines Bitten No.	%
1967	5	2	40
1968	21	0	0
1969	22	6	27
1970	22	7	32
1971	29	8	28
1972	38	6	16
1973	30	5	17
1974	17	7	41
1975	25	2	8
1976	21	2	10
1977	18	5	28
1978	13	8	62
Overall	261	58	22

2000 meters depth were completed at Site D, and the record indicates that none of them were bitten. Indeed, 19 of the mooring lines were unprotected synthetic fiber and only one array was lost. The rest were all on station and appeared unbitten after durations of up to 180 days. In 1969, 22 buoys were moored in the same manner at Site D. Six of them, or 27%, had bitten lines when they were recovered. The data suggest that there had been some change at Site D, and in fact it is possible that a meandering of the Gulf Stream, put the edge of it over Site D in 1969 and that with the Stream came warm water, sharks, and perhaps other biting organisms.

The apparent rise in incidence of fishbite between the years of 1975 and 1977 is more difficult to explain. There does not seem to be a clear correlation between the trend and any recorded conditions of exposure. Data samples were small and decreased from 1975 to 1978. Possibly the increase may have been due to more acute observations of recovered lines as there were fewer to study.

Fishbite vs Float Depth

Previous experience, as reviewed in the Deep-Sea Lines Fishbite Manual, seemed to indicate that mooring lines with surface floats were more susceptible to fishbite than were those with subsurface floats. Results of analysis of the present data, assembled in Table III, however, seem to indicate that fishbite risk is about 30% at all depths to 500 meters. Beyond the 500 meter level, incidence of fishbite fell off until beyond a depth of 1500 meters there was no record of fishbite having occurred. Despite this record, however, it should be noted that data from other sources have indicated the occurrence of fishbite at depths ranging to 2000 meters. The 2000 meter depth should continue to be regarded as the minimum depth for use of non-bite-resistant lines in the fishbite zone.

Table III

WHOI Moored Stations 256 Through 654

All stations between 40° N & S Latitude

Float Depth Meters	Total Number	Number Bitten	% Bitten
	- - - Mooring - - -		
0	90	27	30
1- 99	6	0	
100- 199	28	8	29
200- 299	11	2	
300- 399	3	0	
400- 499	43	16	37
500- 599	31	3	10
600- 699	3	1	
700- 799	1	0	
800- 899	2	0	
900- 999	11	0	
1000-1099	5	0	
1100-1199	0	0	
1200-1299	1	0	
1300-1399	1	0	
1400-1499	9	1	
1500-1599	1	0	
1600-1699	2	0	
1700-1799	1	0	
1800-1899	0	0	
1900-1999	11	0	
2000+	103	0	0

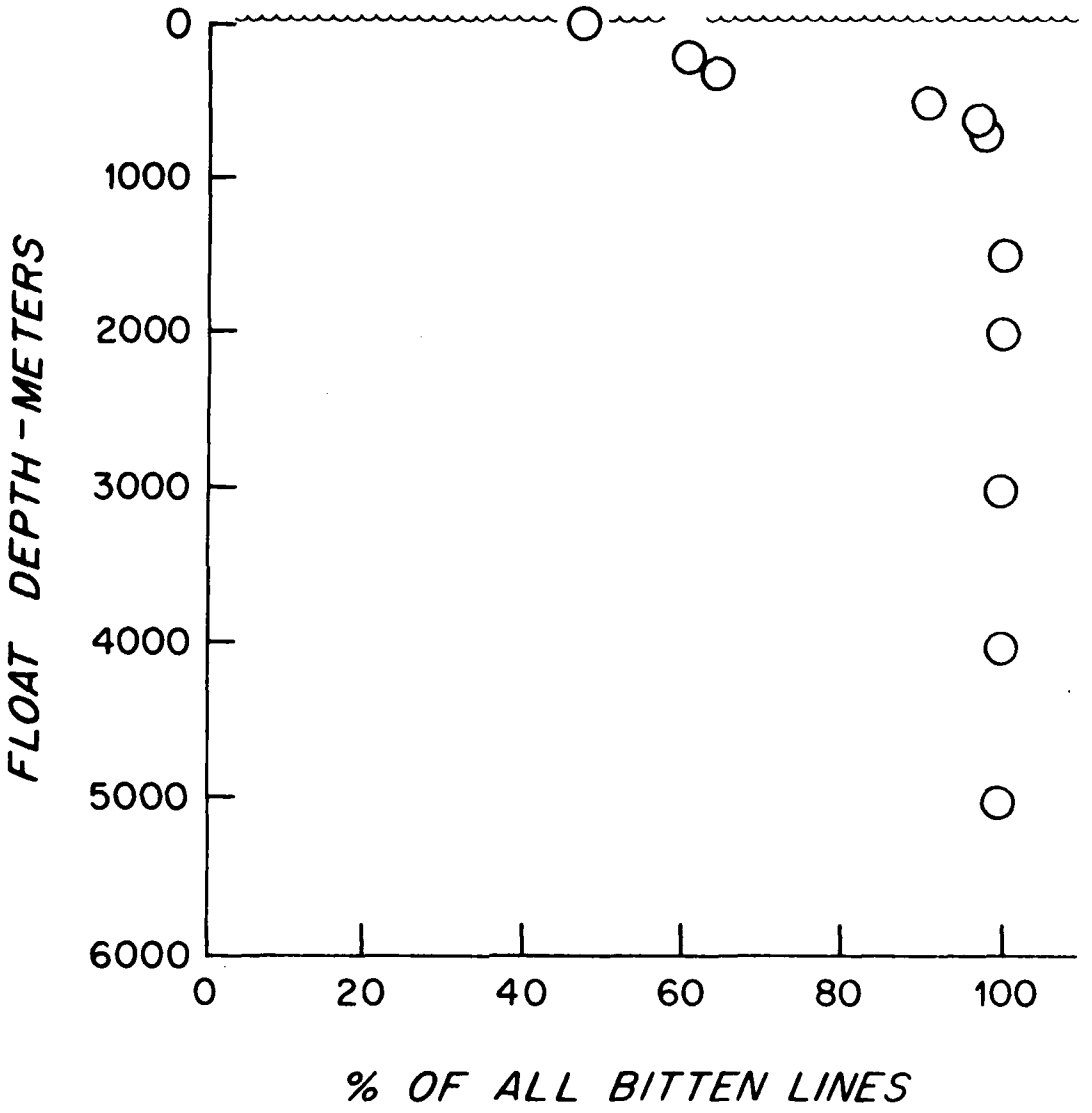

FIGURE 2: Fishbite vs Float Depth
WHOI Moored Stations #256-#654

Fishbite vs Latitude

One may well ask whether risk of fishbite was found to be uniform throughout the fishbite zone as bounded by the 40° parallels. The data indicate that it was not. The risk rose as stations were established closer to the equator. Considering the data in Table IV, it appears that in the three ranges of latitude where significant numbers of mooring were established, there was a close relationship between the percentage of lines bitten and the latitude at which a moored station was located. Using the three points noted, one can derive an equation: $y = -0.427x + 44.29$ where "x" is the % of all lines in the fishbite zone bitten within a five degree range of latitude and "y" is the average latitude of all lines within the same five degree range of latitude. The derived equation fits the observed facts well. As illustrated in Figure 3, the three data points lie very close to a line drawn using the equation. Furthermore, the equation predicts that there will be no lines bitten above 44° latitude; and 100% of the lines will be bitten when they are placed within 1.59° of the equator. The latter is what happened to 11 lines recently exposed at latitudes between 0.04° S and 0.782 N in the Indian Ocean.

Fishbite vs Depth of Water

To date, fishbite has been regarded as mostly a deep water phenomenon. Insofar as they go, the present data confirm such a viewpoint. No fishbites were recorded at 26 stations in 2000 meters of water or less, though all were within latitudes where fishbite had been encountered in deeper water. Until more evidence becomes available, however, one should probably not write off the possibility that fishbite may occur in shallow water. There is a wide range of conditions in water less than 2000 meters deep.

Fishbite vs Duration

One might surmise that the time a mooring line is in the water should

Table IV

Fishbite vs Latitude

WHOI Moored Stations 256 Through 654

All lines wholly or partially at 0 to 2000 m depth

- - - Mooring - - -

Latitude degrees	Total Number	Number Bitten	% Bitten
0 - 5	8	2	
6 - 10	0	0	
11 - 15	2	0	
16 - 20	4	0	
21 - 25	1	0	
26 - 30	62	24	39
31 - 35	54	14	26
36 - 40	132	18	14
41 - 45	2	0	
46 - 50	0	0	
51 - 55	2	0	
56 - 60	3	0	
61 - 90	0	0	

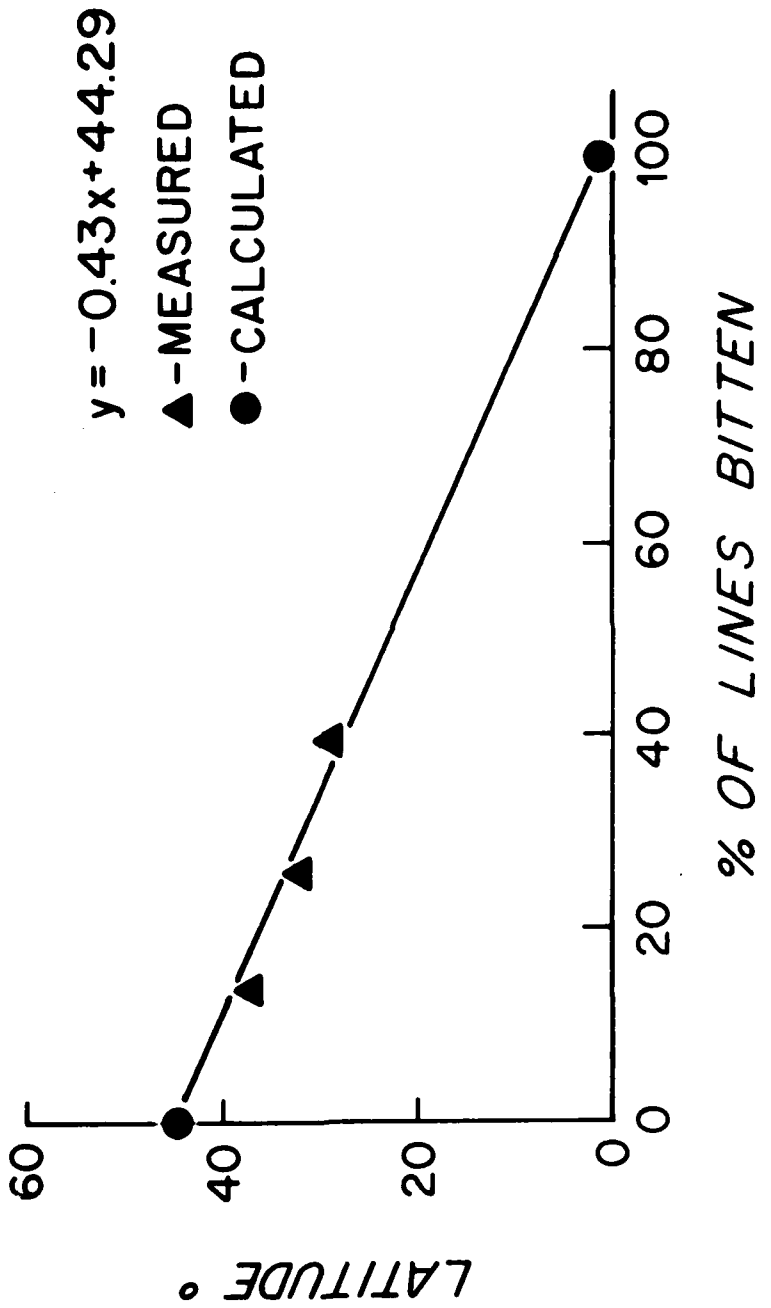

FIGURE 3: Fishbite vs Float Depth
WHOI Moored Stations #256-#654

Table V

Fishbite vs Depth of Water

WHOI Moored Stations 256 Through 654

All mooring lines within the fishbite zone

Water Depth meters	Total Number	Number Bitten	% Bitten
	- - - Mooring - - -		
0- 500	4	0	
501-1000	9	0	
1001-1500	6	0	
1501-2000	7	0	
2001-2500	4	3	
2501-3000	86	11	13
3001-3500	1	0	
3501-4000	7	5	
4001-4500	13	3	
4501-5000	13	3	
5001-5500	100	29	29
5501-6000	10	4	
6000+	1	1	

have some correlation with the probability that it will be bitten. Does longer duration increase risk of fishbite? Is there a minimum time for bites to develop; or is biting a random occurrence over a period of time?

The record of bites vs duration is given in Table VI. An attempt to analyze the data by the method of linear regression indicates that there was no correlation between the times that lines were in the water and the percentage of lines bitten. This would indicate that biting is a random occurrence vs time; that within the time span studied, up to 515 days, only certain lines, 22% of the total, became susceptible to biting; the majority did not. Another possibility is that lines were bitten mainly during deployment or recovery, not while on station.

Looking at the data another way, in which the duration times of stations hauled after a short time are considered to be samples of longer times at sea, and the data are summarized, as in Table VII, so that all bites up to a certain time are grouped together, it appears that the percentage of lines bitten increased from 13% in 10 days or less to 22% in 450 days. Results of this type of analysis suggest that the percentage of lines bitten may indeed increase with time but may approach a limit; in this case, 22% at 450 days duration. Why 22% should be a saturation point, if indeed it is, is not understood at present.

More work is needed to establish a clear relationship between the time a mooring line is in the water and the occurrence of fishbite.

Table VI

Fishbite vs Duration

WHOI Moored Stations 256 Through 654

All mooring lines within the fishbite zone

- - - Mooring - - -

Duration Days	Total Number	Number Bitten	% Bitten
0- 10	38	5	13
11- 50	31	4	13
51-100	47	11	23
101-150	45	5	11
151-200	18	10	
201-250	29	4	14
251-300	19	6	
301-350	15	4	
351-400	8	2	
401-450	9	5	
451-500	1	0	
501-550	2	2	
551+	0		

Table VII

Fishbite vs Duration

WHOI Moored Stations 256 Through 654

All mooring lines within the fishbite zone

- - - Mooring - - -

Duration up to - days	Total Number	Number Bitten	% Bitten
-10	38	5	13
-50	69	9	13
-100	116	20	17
-150	161	25	16
-200	179	35	20
-250	208	39	19
-300	227	45	20
-350	242	49	20
-400	250	51	20
-450	259	56	22
-500	260	56	22
-550	262	58	22

Conclusions

Analysis of data from 399 Woods Hole Oceanographic Institution moored stations, numbered 256 through 654 and established in the years 1967 through 1978, leads to the following conclusions:

1. Fishbite was found to have occurred only within an ocean space designated as the fishbite zone which was bounded by 40° north and south parallels and depth levels of 0 and 2000 meters.
2. Fishbite is a significant hazard to deep-sea mooring lines. It was reported on 22% of all lines from moorings within the fishbite zone.
3. Risk of fishbite was found to increase linearly with latitude from 0% of exposed lines at approximately 44° north latitude to 100% within 1.6° of the equator.
4. Within the fishbite zone, mooring lines had a uniform rate of fishbite risk throughout the top 500 meters of water. Below 500 meters, fishbite hazard fell off and was close to zero at 2000 meters depth.
5. A correlation between fishbite and the overall water depth at a mooring site is indicated. No fishbite occurred at 26 stations within the fishbite zone where water was shallow, i.e. less than 2001 meters deep.
6. Incidence of fishbite had no clear correlation with the length of time a mooring line was in the water. This may indicate that lines are bitten mainly during deployment and/or recovery.

APPENDIX

Table VIII

WHOI Moored Station Data Year - 1967

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
256	0	34.08 N	69.95 W	5364	54	+
257	0	43.00 N	70.45 W	104	1	0
258	0	39.33 N	70.02 W	2569	1	0
259	0	39.33 N	70.02 W	2562	5	0
260	0	39.26 N	70.01 W	2614	2	0
261	0	39.26 N	70.02 W	2616	1	+

Table IX

WHOI Moored Station Data Year - 1968

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
262	0	39.17 N	70.04 W	2680	1	0
263	0	39.14 N	69.99 W	2678	52	0
264	0	39.15 N	70.04 W	2680	50	0
265	2562	39.19 N	69.93 W	2678	52	0
266	0	39.15 N	70.05 W	2710	2	0
267	0	39.19 N	70.07 W	2663	75	0
268	2546	39.16 N	69.86 W	2658	165	0
269	0	39.16 N	70.03 W	2679	69	0
270	2615	39.13 N	69.92 W	2930	5	0
271	0	39.14 N	70.04 W	2683	6	0
272	0	39.15 N	70.10 W	2705	7	0
273	0	39.11 N	70.04 W	2694	1	0
274	0	39.16 N	70.06 W	2685	41	0
275	0	39.17 N	70.03 W	2677	35	0
276	0	39.21 N	69.27 W	1512	52	0
277	73	39.14 N	70.05 W		4	0
278	0	30.13 N	69.99 W	2675	2	0
279	0	39.13 N	70.02 W	2685	41	0
280	0	39.16 N	70.05 W	2685	70	0
281	0	39.89 N	69.23 W	1375	30	0
282	0	39.85 N	69.23 W	1610	30	0
283		39.17 N	70.08 W	2675	8	0
284	0	39.16 N	70.06 W	2690	119	0
285						
286					Lost	
287		39.17 N	70.03 W	2680	171	0
288	0	39.15 N	70.01 W	2678	180	0

Table X

WHOI Moored Station Data Year - 1969

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
289		38.02 N	4.99 E	2833	49	0
290	0	39.19 N	70.02 W	2682	8	0
291		39.15 N	70.04 W	2682	8	0
292	0	39.14 N	69.91 W	2686	2	0
293	2563	39.16 N	70.05 W	2678	7	0
294		39.17 N	70.00 W	2674	9	0
295		39.17 N	70.07 W	2690	3	0
296	0	39.18 N	70.03 W	2674	2	0
297	0	39.18 N	70.03 W	2672	1	0
298	0	39.15 N	69.98 W	2675		+
299	0	39.19 N	70.65 W		16	0
300	0	39.16 N	70.03 W	2680	105	+
301	0	39.16 N	69.94 W	2680	4	0
302	2577	39.11 N	70.00 W	2685	126	0
303	2624	39.11 N	70.04 W	2692	1	0
304	4266	36.42 N	70.00 W	4486	69	0
305	4206	36.72 N	70.00 W	4426	69	0
306	4148	37.03 N	70.00 W	4368	69	0
307	4061	37.34 N	70.02 W	4281	69	0
308	0	39.16 N	69.90 W	2682	120	0
309	0	39.15 N	70.00 W	2678	59	+
310		39.16 N	70.05 W	2683	146	+
311	0	39.19 N	70.08 W	2685	56	0
312	3974	37.93 N	70.00 W	4088	1	0
313	0	33.99 N	70.04 W	5368	2	0
314	0	34.03 N	70.02 W	5368	51	+
315	0	34.02 N	69.97 W	5368	51	0
316	0	39.11 N	70.01 W	2692	92	+
317	0	39.19 N	70.08 W	2681	91	+
318	0	39.33 N	70.04 W	2545	92	+
319	0	33.98 N	70.01 W	5370	2	0
320	0	34.02 N	70.07 W	5370		
321	2.7	41.52 N	70.65 W	27	114	0
324	0	31.83 N	65.25 W	2646		
325	0	31.83 N	65.25 W	2921		

Table XI

WHOI Moored Station Data Year - 1970

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
322	0	38.64 N	69.32 W	2690	55	0
323	0	33.98 N	69.97 W	5365	125	0
324						
325						
326	3988	37.64 N	70.01 W	4128	130	0
327	4203	36.77 N	70.00 W	4417	130	0
328	4243	31.00 N	69.30 W	5356	124	0
329	4236	31.00 N	70.49 W	5424	124	0
330	5464	27.99 N	69.97 W	5464	122	0
331	219	11.54 N	61.90 W	477	37	0
332	417	11.65 N	61.90 W	675	37	0
333	4	32.08 N	64.19 W	4384	48	0
334	0	33.97 N	69.93 W	5370	83	0
335	1300	32.13 N	64.13 W	4400	46	0
336	5284	33.98 N	69.94 W	5370	238	0
337	7	41.43 N	70.77 W	26	1	0
338	0	39.58 N	69.91 W	2322	51	+
339	0	39.13 N	70.03 W	2682	50	+
340	0	39.12 N	70.64 W	2754	51	0
341	0	34.04 N	70.00 W	5365	45	+
342	0	33.95 N	69.81 W	5363	6	0
343	2253	35.98 N	70.55 W	4444	56	0
344	0	33.98 N	69.98 W	5365	56	+
345	1492	39.39 N	70.98 W	2527	49	0
346	2155	39.60 N	70.96 W	2263	115	0
347	766	39.82 N	70.65 W	876	105	0
348	964	39.84 N	70.95 W	977	48	0
349	843	39.84 N	70.94 W	943	48	0
350	885	39.83 N	70.93 W	993	107	0
351	2049	39.61 N	71.24 W	2150	114	0
352	2377	39.39 N	71.03 W	2509	66	0
353	4108	35.97 N	70.57 W	4436	62	0
354	5281	34.03 N	69.98 W	5368	207	0
355	0	33.97 N	69.93 W	5361	60	+
356	0	33.80 N	70.20 W	5374	Lost	
357	2044	35.97 N	70.92 W	4425	148	0
358	1454	39.13 N	70.02 W	2680	137	0
359	3310	37.28 N	71.82 W	3528	139	0
360	3668	36.39 N	71.25 W	4230	141	0

Table XI - cont'd.

WHOI Moored Station Data Year - 1970

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
361		37.99 N	69.45 W	3950	0	+
362		38.03 N	69.40 W	3940	0	+
363	3897	38.39 N	68.31 W	4117	145	0
364	4695	36.97 N	67.88 W	4915	144	0
365	3904	36.98 N	69.17 W	4465	143	0
366	4149	36.76 N	70.28 W	4371	141	0
367	3775	37.67 N	70.70 W	3995	Lost	
368	3735	37.96 N	69.46 W	3955	143	0

Table XII

WHOI Moored Station Data Year - 1971

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
369	5601	22.80 N	66.48 W	5817	122	0
370	5186	22.25 N	67.32 W	5402	121	0
371	5294	21.27 N	68.00 W	5326	118	0
372	132	0.37 N	160.03 W	183	Lost	
373	0	1.00 N	150.00 W	4441	223	0
374	0	0.00 N	149.92 W	4451	7	0
375	0	1.04 N	149.85 W	4647	2	+
376		1.00 N	150.00 W	4431	Lost	
377	0	39.13 N	70.00 W	2665	27	0
378	0	39.13 N	69.99 W	2665	27	0
379	0	39.14 N	69.99 W	2662	91	0
380		37.34 N	70.37 W	4160	2	+
381	0	33.96 N	69.96 W	5375	184	+
382	2059	35.97 N	70.50 W	4445	87	0
383	4516	39.84 N	48.50 W	4803	91	0
384	3395	33.01 N	136.58 E	3578	108	0
385	1031	32.80 N	134.71 E	1211	106	0
386	880	32.97 N	134.30 E	880	Lost	
387	2058	31.52 N	132.48 E	2236	128	0
388	4775	37.76 N	64.49 W	5005	32	0
389	4766	37.95 N	64.66 W	4996	32	0
390	4770	38.17 N	64.80 W	5000	31	0
391	4701	38.39 N	64.97 W	4931	31	0
392	4640	38.58 N	65.16 W	4870	31	0
393	4580	38.80 N	65.37 W	4810	31	0
394	4550	39.00 N	65.52 W	4780	30	0
395	0	39.54 N	69.96 W	2428	45	+
396	0	39.16 N	70.13 W	2738	102	0
397	0	39.19 N	69.93 W	2655	106	+
398	0	39.13 N	70.00 W	2660	88	0
399	0	39.20 N	69.26 W	2927	8	0
400	2023	35.97 N	70.44 W	4447	136	0
401	0	33.87 N	69.99 W	5363	85	0
402	0	39.00 N	70.01 W	2754	93	0
403	0	35.93 N	70.30 W	4465	20	0
404	5265	34.01 N	70.02 W	5368	377	0
405	0	33.99 N	70.10 W	5373	109	0
406	0	28.00 N	70.00 W	5460	101	+
407	0	28.01 N	70.35 W	5465	102	+
408	1483	27.81 N	70.15 W	5470	102	0
409	1502	28.03 N	70.11 W	5465	102	0
410	1484	28.36 N	69.69 W	5460	101	0

Table XII - cont'd.

WHOI Moored Station Data Year - 1971

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
411	1456	28.01 N	69.52 W	5427	99	+
412	1482	28.00 N	69.70 W	5455	99	0
413	5422	28.00 N	69.97 W	5460	2	0
414	5400	28.03 N	70.01 W	5460	2	0
415	5325	23.36 N	69.14 W	5454	165	0
416	5261	23.80 N	68.63 W	5392	165	0
417	5249	23.80 N	69.61 W	5378	164	0
418	488	39.13 N	69.99 W	266	10	0
419	477	39.14 N	69.98 W	2654	9	0
420	0	39.17 N	69.95 W	2654	91	0
421	1989	35.97 N	70.50 W	4440	92	0

Table XIII

WHOI Moored Station Data Year - 1972

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
422	1009	39.04 N	70.04 W	2724	117	0
423	999	39.18 N	70.56 W	2729	107	0
424	0	28.17 N	68.62 W	5254	111	0
425	0	28.00 N	69.66 W	5462	Lost	
426	1690	17.61 N	65.25 W	1756	39	0
427	1727	23.60 N	65.24 W	1809	39	0
428	0	39.21 N	65.97 W	2640	1	0
429	0	39.17 N	69.99 W	2656	172	+
430	3962	28.16 N	68.57 W	5221	68	0
431	1440	28.34 N	68.40 W	5370	68	0
432					Lost	
433	1470	28.18 N	68.39 W	5380	68	0
434	1450	28.16 N	68.20 W	5275	67	0
435	437	27.98 N	68.41 W	5280	66	0
436	150	39.85 N	70.09 W	1072	71	0
437	5200	37.00 N	49.74 W	5477	59	0
438	5144	37.51 N	49.74 W	5421	58	0
439	5150	38.16 N	49.77 W	5412	58	0
440	5142	38.29 N	49.78 W	5419	56	0
441	4562	38.65 N	49.79 W	5419	56	0
442	4559	39.00 N	49.77 W	5416	56	0
443	4559	39.39 N	49.77 W	5416	55	0
444	4556	39.67 N	49.70 W	5413	54	0
445	5107	40.06 N	49.84 W	5384	53	0
446	3966	40.56 N	49.75 W	4244	53	0
447	3405	41.00 N	49.77 W	3683	52	0
448	2741	41.50 N	49.73 W	3018	52	0
449	1030	39.97 N	69.98 W	2769	102	0
450	995	39.15 N	70.51 W	2754	102	0
451	0	28.90 N	69.69 W	5437	162	+
452	540	27.99 N	70.65 W	5452	161	+
453	0	28.16 N	68.63 W	5261	158	+
454	0	27.56 N	69.69 W	5462	156	+
455	0	28.02 N	69.63 W	5462	160	
456	1999	33.68 N	62.59 W	2998	147	0
457	2894	33.68 N	62.87 W	4817	Lost	
458	1949	39.61 N	70.00 W	2263	147	0
459	2594	39.17 N	70.24 W	2709	150	0
460	2349	39.16 N	70.07 W	2664	150	0
461	2554	39.06 N	70.00 W	2669	Lost	
462	23	39.91 N	70.84 W	501	21	0
463	0	39.22 N	70.05 W	2646	72	0
464	107	39.21 N	70.05 W	2649	11	0
465	966	38.98 N	70.00 W	2756	103	0

Table XIII - cont'd.

WHOI Moored Station Data Year - 1972

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
466	963	39.15 N	70.51 W	2746	101	0
467	0	39.18 N	69.99 W	2655	1	0
468	991	39.17 N	70.05 W	2666	99	0
469	518	28.05 N	69.61 W	5462	6	0
470	5416	28.04 N	69.58 W	5462	7	0
471	5416	28.08 N	69.00 W	5462	7	0
472	5416	28.05 N	69.64 W	5462	7	0
473	349	28.18 N	68.61 W	5261	131	0
474	560	28.03 N	69.66 W	5462	126	0
475	2404	39.11 N	70.07 W	2687	5	0
476	0	39.07 N	69.98 W	2685	1	0
477	164	39.16 N	70.00 W	2653	108	0
478	962	39.17 N	70.52 W	2742	110	0
479	980	39.38 N	69.99 W	2558	106	0
483	481	29.04 N	68.23 W	5192	478	0

Table XIV

WHOI Moored Station Data Year - 1973

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
480	0	28.06 N	69.65 W	5462	Lost	
481	476	27.98 N	69.67 W	5462	116	0
482	476	28.16 N	68.65 W	5239	106	0
484	495	27.40 N	67.98 W	5151	112	0
485	490	26.40 N	69.34 W	5420	111	+
486	474	26.94 N	71.08 W	5474	110	0
487	488	28.55 N	71.38 W	5327	1	0
488	489	28.52 N	71.39 W	5325	108	0
489	489	29.60 N	69.99 W	5440	106	0
490	973	39.36 N	69.99 W	2559	203	0
491	180	39.13 N	69.97 W	2654	204	0
492	985	39.16 N	70.51 W	2749	201	0
493	471	28.70 N	70.27 W	5446	91	+
494	472	27.83 N	70.66 W	5446	89	0
495	476	27.14 N	70.01 W	5477	89	0
496	453			5286	1	0
497	463	27.80 N	69.02 W	5296	87	0
498	478	27.55 N	69.57 W	5463	86	0
499	478	28.15 N	70.14 W	5461	87	0
500	474	28.28 N	69.28 W	5456	84	0
501	472	28.84 N	69.31 W	5379	87	0
502	450	28.15 N	68.69 W	5255	231	+
503	466	28.00 N	69.74 W	5461	170	+
504		20.31 N	73.67 W	1503		0
505		20.28 N	73.63 W	1505		0
506	168	39.38 N	70.00 W	2559	237	0
507	178	39.16 N	70.01 W	2662	176	0
508	2613	39.17 N	70.18 W	2714	52	0
509	160	39.14 N	70.55 W	2746	176	0
510	0	27.74 N	69.80 W	5459	51	0
511	0	27.81 N	69.85 W	5461	Lost	
512	5223	27.73 N	69.82 W	5455	8	0
513	5223	27.76 N	69.87 W	5455	8	0
514	5223	27.71 N	69.87 W	5455	8	0
515		27.73 N	69.85 W	5455	45	0
516	0	27.73 N	69.80 W		2	0
517	172	39.19 N	70.00 W	2647	363	+
518	2126	33.59 N	62.49 W	3138	134	0
519	2073	33.49 N	62.47 W	3088	134	0
520	2115	33.51 N	62.61 W	4366	133	0
521	482	28.13	68.68 W	5265	128	0
522	460	28.01 N	69.75 W	5462	128	0

Table XV

WHOI Moored Station Data Year - 1974

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
523	161	39.43 N	69.99 W	2504	240	0
524	174	39.13 N	70.00 W	2664	240	0
525	175	39.12 N	70.55 W	2759	239	0
526	1988	38.78 N	70.01 W	3007	238	0
527	1959	39.17 N	69.00 W	2978	239	0
528	2307	38.58 N	69.15 W	3326	240	0
529	2467	38.36 N	70.00 W	3480	239	0
530	2796	38.02 N	69.99 W	3815	245	0
531	2908	38.01 N	69.27 W	3291	243	0
532	3191	37.49 N	69.32 W	4210	244	0
533	3151	37.51 N	70.00 W	4182	244	0
534	3308	37.02 N	69.98 W	4339	245	0
535	3411	36.99 N	69.33 W	4450	243	0
536	3437	36.50 N	69.33 W	4468	243	0
537	3431	36.50 N	70.00 W	4463	244	0
538	465	28.05 N	69.74 W	5457	100	+
539	0	28.02 N	69.95 W	5457	2	0
540	483	28.15 N	68.67 W	5265	100	0
541	316	38.32 N	69.66 W	3583	89	0
542	467	28.02 N	69.65 W	5462	274	+
543	476	27.96 N	64.97 W	5363	272	+
544	493	28.00 N	60.10 W	6043	Lost	
545	477	27.84 N	55.57 W	6015	284	+
546	480	27.90 N	54.90 W	5773	283	+
547	478	28.21 N	54.95 W	5785	284	+
548	474	31.03 N	60.07 W	5550	279	+
549	476	33.99 N	60.01 W	4687	269	0
550	1977	36.04 N	60.04 W	4894	Lost	
551	689	36.04 N	69.98 W	4533	130	0

Table XVI

WHOI Moored Station Data Year - 1975

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
552	1698	38.30 N	69.99 W	3540	1	0
553	286	31.78 N	64.44 W	4353	273	0
554	294	32.36 N	65.45 W	4774	272	0
555	297	32.98 N	64.40 W	4527	271	0
556	1298	33.34 N	64.10 W	4662	17	0
557	581	35.89 N	55.09 W	5089	230	0
558	589	35.94 N	54.70 W	5379	223	0
559	568	35.96 N	53.78 W	5478	222	0
560	3137	41.48 N	54.98 W	4774	215	0
561	2932	40.47 N	55.02 W	5171	217	0
562	1930	39.49 N	54.98 W	5279	216	0
563	1926	38.50 N	54.96 W	5353	217	0
564	561	37.49 N	55.03 W	5350	217	0
565	617	35.59 N	55.10 W	5162	225	+
566	576	34.89 N	55.03 W	5515	223	+
567	599	31.58 N	55.09 W	5296	216	0
568	571	35.93 N	59.01 W	5205	217	0
569	2808	39.01 N	71.32 W	2941	4	0
570	4190	52.71 N	33.99 W	4288	272	0
571	970	52.90 N		2895	273	0
572	956	52.77 N	35.50 W	3398	273	0
573	3962	41.49 N	54.98 W	4758	306	0
574	3966	40.45 N	55.05 W	5177	307	0
575	3963	39.50 N	55.00 W	5264	308	0
576	3957	38.49 N	54.92 W	5340	307	0
577	548	37.48 N	55.02 W	5310	308	0
578	537	35.97 N	53.76 W	5463	300	0
579	550	35.92 N	54.78 W	5338	298	0
580	547	31.59 N	54.93 W	5587	310	0
581	547	34.93 N	55.08 W	5502	306	0
582	548	35.57 N	55.11 W	5107	303	0
583	564	35.88 N	55.04 W	5043	302	0
584	555	35.95 N	59.03 W	5202	288	0
585	932	39.78 N	69.89 W	1584	75	0
586	280	39.79 N	69.90 W	1483	116	0

Table XVII

WHOI Moored Station Data Year -1976

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
587	101	39.93 N	71.05 W	496	181	0
588	256	39.61 N	70.94 W	2305	180	+
589	1958	39.28 N	70.84 W	2645	180	0
590	267	39.71 N	71.78 W	502	183	0
591	265	39.91 N	69.39 W	273	155	0
592	74	17.73 N	64.94 W	972		
593	150	0.05 N	50.46 E	5082	234	+
594	148	0.01 N	52.98 E	5074	28	0
595	149	1.50 N	52.98 E	5117	231	0
596	220	0.00 N	57.00 E	4711	226	0
597	148	0.01 N	52.99 E	5072	202	0
598	560	35.95 N	59.03 W	5206	208	0
599	3962	35.97 N	55.46 W	5457	238	0
600	559	35.93 N	54.83 W	5318	237	0
601	563	35.96 N	53.78 W	5467	237	0
602	3953	41.47 N	54.92 W	4772	274	0
603	3966	40.45 N	55.02 W	5173	272	0
604	3972	39.48 N	55.01 W	5266	270	0
605	3968	38.48 N	54.93 W	5340	267	0
606	574	37.48 N	54.99 W	5334	266	0
607	607	36.49 N	55.02 W	5445	264	0
608	564	35.88 N	55.08 W	5054	261	0
609	560	35.59 N	55.08 W	5115	261	0
610	558	35.24 N	55.00 W	5487	260	0
611	561	34.93 N	55.08 W	5506	258	0
612	563	31.57 N	54.95 W	5595	246	0
613	3580	31.57 N	55.00 W	5581	246	0
614	362	31.53 N	55.01 W	5581	83	0

Table XVIII

WHOI Moored Station Data Year - 1977

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
615	548	31.55 N	54.97 W	5584	165	0
616	1960	30.92 N	76.65 W	2993	357	0
617	557	30.53 N	75.10 W	3801	358	+
618	1952	30.72 N	74.18 W	4002	354	0
619	551	30.81 N	74.01 W	4597	Lost	
620	1913	31.06 N	73.44 W	5187	353	0
621	5328	28.52 N	70.44 W	5453	94	0
622	5403	28.54 N	70.43 W	5453	93	0
623	87	27.40 N	41.12 W	4251	349	0
624	212	27.29 N	40.71 W	4372	347	+
625	150	27.25 N	40.36 W	4723	347	0
626	176	26.89 N	41.23 W	4315	346	0
627	152	26.17 N	41.69 W	3847	344	+
628	184	27.43 N	47.84 W	4961	340	0
629	161	28.02 N	48.06 W	4954	339	0
630	163	27.86 N	48.66 W	4895	338	0
631	171	27.93 N	48.87 W	5106	337	+
632	149	26.88 N	49.24 W	4881	336	+
633	565	32.52 N	64.75 W	1611	388	0
634	217	32.54 N	64.74 W	942	395	0
635	199	32.37 N	65.01 W	924	395	0
636	4202	4.05 N	39.68 W	4456	362	0
637	4100	4.01 N	39.33 W	4304	362	0

Table XIX

WHOI Moored Station Data Year - 1978

Sta.No.	Float Depth m	Latitude Degrees	Longitude Degrees	Water Depth m	Duration Days	Bites
638	452	31.43 N	69.48 W	5362	447	+
639	450	31.16 N	69.37 W	5355	447	+
640	182	31.01 N	69.49 W	5355	448	+
641	446	31.17 N	69.63 W	5349	448	+
642	462	30.95 N	69.88 W	5403	447	0
643	469	30.82 N	69.60 W	5375	439	0
644	501	30.59 N	69.47 W	5366	440	0
645	207	31.01 N	69.45 W	5367	Lost	
646	450	30.83 N	69.33 W	5339	438	+
647	436	31.04 N	69.17 W	5286	438	0
648	137	27.86 N	48.58 W	4881	515	+
649	156	27.42 N	41.16 W	4236	513	0
650	460	38.05 N	68.89 W	3964	200	+
651	70	59.03 N	12.53 W	1558	41	0
652	0	59.03 N	12.55 W	1551	39	0
653	0	59.02 N	12.57 W	1551	39	0
654	414	32.53 N	64.78 W	1244	30	+

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(REVISED NOVEMBER 1978)

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Woods Hole Oceanographic Institution
WHOI -81-57

FACTORS CORRELATED WITH INCIDENCE OF FISHBITE ON DEEP-SEA MOORING LINES by Bryce Prindle. June 1981. Prepared for the Office of Naval Research under Contract N00014-76-C-0197; NR 083-400 and the National Data Buoy Office of the National Oceanic and Atmospheric Administration under Contract NA-79-QA-A-00475.

Data from 399 moored stations established over the years 1967 through 1978 have been analyzed with reference to fishbite. Fishbite appears to have been a significant hazard as it was found in 22% of the lines placed within 40 degrees of the equator and where parts of the lines were at 2000 meters depths or less. Latitude, depth of water, and distance of mooring components beneath the surface were found to be correlated with incidence of fishbite; duration of a mooring was not.

1. Deep-sea lines
2. Fishbite risk
3. Environment

I. Prindle, Bryce
II. N00014-76-C-0197; NR 083-400
III. NA-79-QA-A-00475

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