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NATIONAL MARINE FISHERIES SERVICE

PACIFIC ENVIRONMENTAL GROUP

P.O. BOX 831

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FEBRUARY 1984

PRELIMINARY EVALUATION OF ALBACORE TUNA FISHING, WIND AND SELECTED VARIABLES

by

Paul N. Sund

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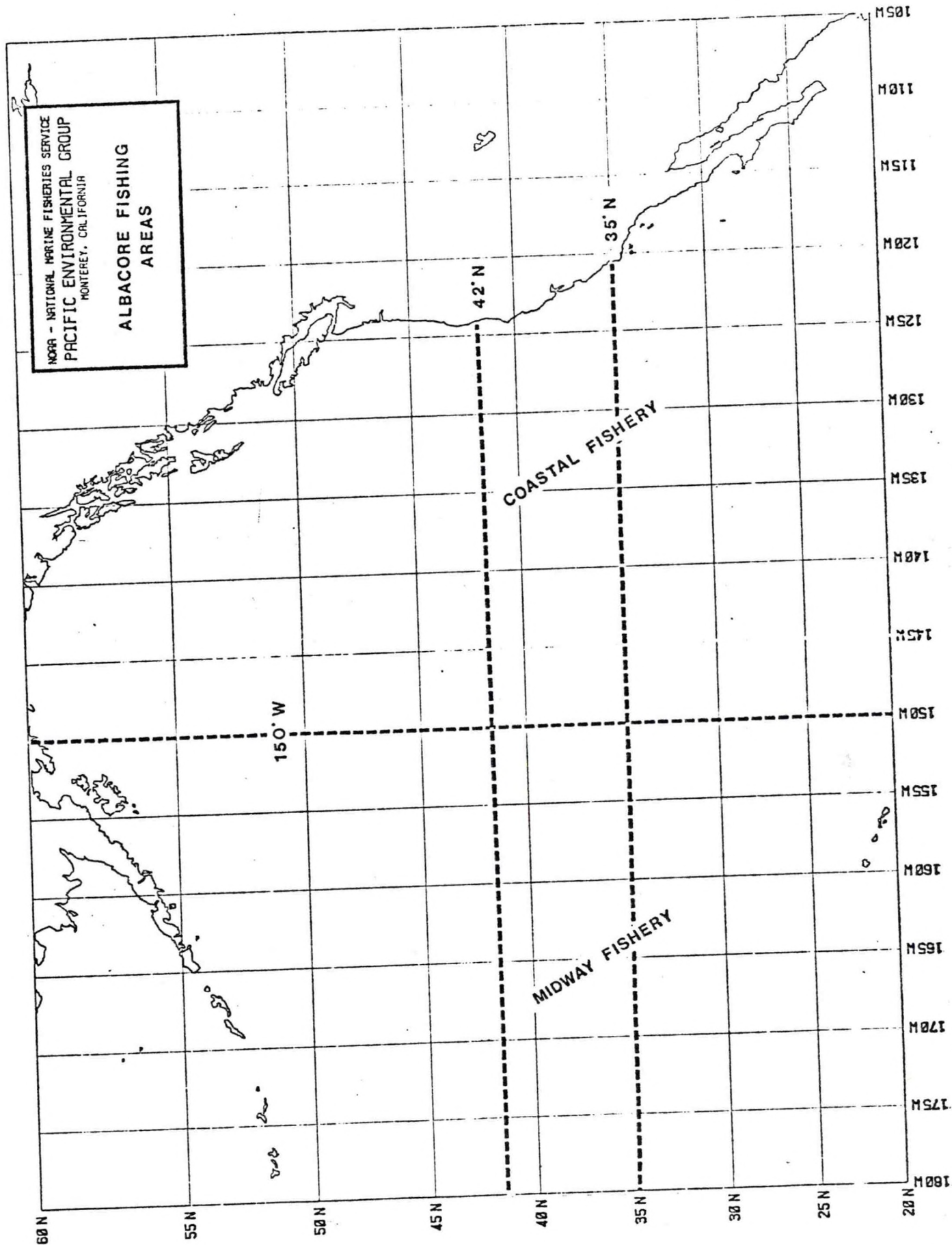
The Pacific Environmental Group has undertaken the task of developing a WIND-FISHABILITY INDEX for inclusion in the Southwest Fisheries Center Albacore Model^{1/}. This index would provide a means to investigate the influence of wind on fishing effort, and how catch/effort is to be interpreted with reference to this environmental factor.

In order to develop a meaningful index, it is necessary to understand ways in which the wind and fishing are inter-related in the west coast albacore fishery. A number of 3-way comparisons have been made of data contained in the SWFC albacore logbook data files (daily catch records, 1973-1981). These comparisons all have wind and fishing activity as common factors and they are combined with the variables: season (month), vessel type, vessel size, and sea surface temperature. These are further compared among different geographic segments of the fishery.

Logbooks are available to a differing extent each year, and represent from about 10 to 15 percent of the total number of vessels participating in the fishery (T. Majors, personal communication, SWFC). The statements made in this report are based on the assumption that the logged data are representative of total fleet activity and environmental conditions encountered.

A number of geographic "slices" were made of the data to find where similarities and differences occur. The albacore fishing regions compared in this report are the coastal fisheries east of longitude 150°W and the Midway fishery west of longitude 150°W (Fig.1). Comparisons also are made of sub-areas in the coastal fisheries separated by latitudes 35°N and 42°N. The coastal fisheries are separated in two ways: North and South of 35°N and North and South 42°N. These two separations were done because the data based on the trial "slices" showed certain patterns. Also these latitudinal separations coincide with "North" and "South" designations of other investigations of the albacore fishery (Laurs and Lynn (1977).

Figure 1. Geographic areas considered in this report.



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The logbook data include information on the place and time of fishing, catch (number of fish and average weight of fish caught), weather observations (average wind speed for the day, sea state), vessel type (jigboat, baitboat, both, longliner), vessel size in 10 foot length groupings starting at 25 feet and vessel registry. The character of the fleet composition, i.e., predominant method of fishing, has changed over the years. For summaries of fleet composition and characteristics of the fishery, the reader is referred to the annual reports of the Pacific Marine Fisheries Commission.^{2/}

The wind data recorded in the logbooks are the fishermen's estimates of the average wind condition for the day. One of five wind speed categories is selected from choices available on the daily log form: Category 1 indicates calm; 2 indicates winds less than 10 knots; 3 indicates winds between 10 and 20 knots; 4 indicates winds between 20 and 30 knots; 5 indicates winds in excess of 30 knots.

The data tabulated in this report are the frequencies of reports of wind and SST during the months of years by baitboats and jigboats of various size categories. What one would like to presume is that the reported frequencies represent levels of fishing activity. Actually, I have no direct way of testing and documenting how representative those data are of fishing.

The percent frequency distributions of winds recorded in the logbook data were compared with those at selected locations recorded in the U.S. Navy Marine Climatic Atlas of the World Volume II, North Pacific Ocean (Revised, 1977). Particular attention was later paid to wind category number 5, winds over 30 kts., because winds of high speed are known to affect fishing operations adversely. Frequency distributions of wind speeds by months during the principal fishing season, June to October, for the coastal fishing areas, were compared with those of Atlas locations off Oregon, Central California, and the Southern California bight (areas 19, 27 and 28). These data are presented in Table 1.

Since the Climatic Atlas was assembled largely from reports from maritime ships, one would assume that operations (and corresponding report density) would be less affected by extreme wind conditions than would albacore fishing operations. However, the overall pattern in frequency distributions of the two wind data sets appears to be similar. Differences are expected because of geographic variability between the areas compared. The portion of the data of particular interest is the relative frequency of occurrence of winds at the higher (greater than about 30 kts) speeds which potentially influence -- adversely -- fishing operations. These were

TABLE 1.

Percent frequencies of winds at speeds (categories) by month for areas along the U.S. Pacific Coast. Area 19: offshore Oregon; Area 27: offshore central California; Area 28: Southern California Bight.

ATLAS WINDSPEED CATEGORIES (Knots)

Area	Mth	0	4	7	11	17	22	28	34	41	48+
19	J	8	12	25	31	16	6	1	+	+	+
	J	5	11	23	33	17	9	2	+	0	0
	A	6	11	28	32	15	6	2	+	0	0
	S	7	11	20	30	20	10	2	1	0	0
	O	5	9	16	28	19	13	7	3	+	+
	Ave	6.2	10.8	22.4	30.8	17.4	8.8	2.8	0.8	-	-
27	J	3	8	19	32	23	12	4	1	+	+
	J	3	8	20	30	23	12	3	1	+	0
	A	5	10	22	32	21	8	1	+	0	0
	S	6	11	22	29	18	9	3	1	0	0
	O	7	14	24	26	16	10	3	1	+	+
	Ave	4.8	10.2	21.4	29.8	20.2	10.2	2.8	0.8	-	-
28	J	7	17	26	31	13	5	1	+	+	
	J	7	14	27	34	13	4	+	+	0	
	A	8	17	27	33	12	3	+	+	0	
	S	8	15	26	33	14	4	+	+	0	
	O	10	18	27	30	11	4	1	+	0	
	Ave	8	16.2	26.6	32.2	12.6	4	0.4	-	-	
Overall Ave		6.3	12.4	23.4	30.1	16.7	7.8	2	0.5	-	-

ALBACORE LOGBOOK WINDSPEED CATEGORIES

	1	2	3	4	5
North of 42°N	23.2	17.4	39.8	18.2	1.4
North of 35°N	25.7	17.9	34.1	18.4	3.4
South of 42°N	28.5	21.2	35.8	11.5	2.8
South of 35°N	28.0	23.2	41.0	6.8	1.0

found to be of close similarity between the two data sets and also to frequency distribution of wind speeds for a larger area (20° to 50°N and 105° to 140°W) from the TDF 11 Marine Weather Deck ship reports (C. Nelson, unpublished data).

The similarity of the data sets indicates that:

- (1) The albacore fleet encounters and reports windspeeds with frequency distributions similar to that of other reporting systems.
- (2) The albacore fleet data are representative of windspeed data reported by other means.

Therefore, one also could conclude that there is evident no adverse effect on fishing operations by windspeeds. This probably is due to the limits of the categorizations used in the log form and to lack of sufficient detail in reporting. It is a certainty that windspeed indeed influences fishing, and even causes operations to stop (or to not even begin for vessels in port) at some value determined by a complex mixture of factors such as vessel size and behavior, local physiography, time of year, etc.

So, in spite of the fleet wind data being representative of the "true" frequency distribution winds in the areas fished, any adverse influence on fishing by higher windspeeds is not indicated by these particular data. For example, if less than "true" frequencies of high winds were reported by the fleet, one could conclude that less fishing occurred at higher windspeeds. Such is known to be true, but that influence is not indicated from the logbook data. As stated above, this probably is due to the categorizations used in the log forms. The large "batch size" into which higher windspeeds are grouped precludes identification of speeds at which fishing is influenced or stopped. Thus, some source other than the fleet logbook windspeed data is required to identify the wind fishing index. And that other data source must have a finer scale of separation of speeds, particularly at values over 20 to 30 knots.

"Coastal" Fishery versus "Midway" Fishery (East versus West of 150°W)

In the area east of 150°W the fishing season extends from June to January whereas the Midway fishery runs from May to August with peak activity in August and July, respectively. In the coastal area, observation frequency is reduced by at least half from windspeed categories 3 (10-20 kts) to 4 (20-30 kts), and by another 25± percent from 4 (20-30 kts) to 5 (30 kts). In the Midway area a similar drop-off in frequency of reports is seen, with essentially no observations reported in winds over 30 kts.

EAST OF 150°W

Month	Wind Speed					KTS
	1 CALM	2 10	3 10-20	4 20-30	5	
1	0	1	1	0	0	
2	0	0	2	2	0	
3	0	0	0	0	0	
4	0	0	0	0	0	
5	0	0	0	0	0	
6	5	16	23	2	0	
7	326	277	578	299	62	
8	844	643	1171	487	57	
9	480	316	192	185	47	
10	50	58	71	16	5	
11	2	5	5	3	1	
12	0	1	1	0	0	

WEST OF 150°W

Month	Wind Speed					KTS
	1 CALM	2 10	3 10-20	4 20-30	5 30	
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	22	5	10	4	0	0
6	16	9	25	5	0	0
7	36	22	28	11	3	3
8	15	11	18	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

[illegible]

Midway area observations indicate fishing at SST's ranging from 58° to 68°F with a maximum at 64°F . The drop-off noted above at windspeeds over 30 kts is again evident. The coastal area fishing ranges over temperatures from 58° to 73°F . The peak observation frequency is in the range of 61° to 65° .

There is no fishing by baitboats in the Midway fishery. The smallest two vessel length categories are not represented in the Midway fishery data and the mean-size vessel evidently is larger. The size/report frequency/wind distribution pattern is similar for the two areas. There are essentially no winds reported in excess of 30 knots in conjunction with fishing reports in the offshore fishery area whereas there are some reports from the coastal area. The frequency there is much reduced from that at winds below 30 kts.

Bait boat reporting in the coastal area is about 5 to 15% of that of jig boats at windspeeds below 20 kts. Both gear types show reduced reporting frequency of winds over 20 kts; bait fishing reporting is essentially nil at winds over 30 kts. Based on this limited analysis one might conclude that baitboats cannot or do not fish in winds as high as those fished by jig boats. However, one cannot preclude the influence of factors such as bait availability, season and/or geographic fishing differences, or others. Coastal fishing activity far exceeds that of the "Midway" fishery. For example, the 1981 catch by U.S. vessels off the Pacific Coast states was approximately 27 million pounds. Vessels fishing the "Midway" area landed an additional 3 million pounds.

Coastal Fishery, North versus South of 42°N Latitude

The southern season is longer than the northern one; it starts in June and runs into January. The north fishing season runs from June to October. The records indicate that in both areas, frequency of reports drops off as winds reach 30 kts.

In the south, fishing occurs at SST's from 58° to 73°F ; in the north from 59° to 67°F ; i.e. fishing occurs over a more restricted temperature range in the northern area where warmer waters do not occur. Based on frequency of reports, peak temperatures most frequently fished are 64°F in the south and 62° in the north. The wind report distribution differs in the two areas in that reports in the south decline between windspeed categories 3 and 4 and decline again between categories 4 and 5, whereas the major drop-off occurs from categories 4 to 5 in the north; i.e. fishing apparently tends to occur at higher wind speeds in the north. This may be in part due to larger vessels comprising a portion of the fleet in the north (see next paragraph), although at this stage one cannot discount the possibility that it merely reflects a greater prevalence of high winds in the north.

NORTH OF 42°N

Wind Speed

	1	2	3	4	5
	CALM	10	10-20	20-30	30 KTS
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	153	106	321	226	48
8	526	388	816	344	27
9	116	71	159	53	8
10	15	9	15	1	3
11	0	0	0	0	0
12	0	0	0	0	0

Month

SOUTH OF 42°N

Wind Speed

	1	2	3	4	5
	CALM	10	10-20	20-30	30 KTS
1	0	1	1	0	0
2	0	0	2	2	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	5	16	23	2	0
7	200	193	308	110	15
8	339	265	377	154	31
9	364	246	333	132	39
10	35	49	56	15	2
11	2	5	5	3	1
12	0	1	1	0	0

Month

Surface Temperature

57	0	0	0	0	0
58	0	0	7	1	0
59	8	6	25	9	2
60	35	40	97	38	4
61	90	69	230	122	12
62	153	103	302	158	33
63	157	123	251	129	10
64	117	72	137	55	3
65	86	42	40	10	0
66	31	19	5	3	1
67	13	9	5	1	0
68	8	3	1	0	0
69	0	0	0	0	0
70	0	0	0	0	0
71	0	0	0	0	0
72	0	0	0	0	0
73	0	0	0	0	0
74	0	0	0	0	0

Surface Temperature

57	0	0	0	0	0
58	1	2	2	0	0
59	6	9	18	6	2
60	42	35	36	18	4
61	47	42	83	58	9
62	75	86	140	51	4
63	130	90	129	61	14
64	218	187	231	63	13
65	183	112	162	29	7
66	60	55	91	24	3
67	26	33	38	13	0
68	14	8	16	3	0
69	7	6	7	0	0
70	3	1	0	0	0
71	1	0	0	1	0
72	1	0	0	0	0
73	1	0	0	0	0
74	0	0	0	0	0

Boat Length		Boat Length										
Boat Type	JIG BAIT	25-34	35-44	45-54	55-64	65-74	75-84	85-94	95-104	105-114		
		10	224	309	218	29	13	1	0	0	0	
		7	142	316	158	25	5	0	0	0	0	
		4	222	452	224	34	6	1	0	0	0	
		6	75	160	71	11	3	0	0	0	0	
		1	18	19	10	6	2	0	0	0	0	
		1	1	1	1	1	1	1	1	1	1	
Boat Type		JIG	BAIT	Boat Type								
JIG	BAIT	712	610	868	312	51	Boat Type					
		166	98	107	22	7	JIG	BAIT				
							680	473	1076	516	65	
							24	15	14	2	0	

NORTH OF 35°N

Wind Speed

5
30 KTS4
20-303
10-202
101
CALM

Month

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
2	4	4	6	147	382
184	534	1015	242	51	60
695	274	445	446	4	50
430	51	180	66	2	47
48	4	16	2	0	5
0	0	3	0	0	1
0	0	0	0	0	0

Surface Temperature

0	0	0	0	0	0
1	1	7	1	0	0
8	14	40	14	0	0
54	51	127	51	0	4
126	152	289	152	0	8
211	186	395	186	0	20
243	169	322	169	0	37
244	98	249	98	0	22
177	26	109	26	0	16
68	16	45	16	0	7
18	7	14	7	0	3
11	0	2	0	0	0
1	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

SOUTH OF 35°N

Wind Speed

5
30 KTS4
20-303
10-202
101
CALM

Month

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
5	15	20	2	0	0
153	146	216	64	7	7
205	163	231	81	12	12
108	80	119	27	3	3
6	18	19	5	0	0
2	1	4	2	0	0
0	1	1	0	0	0

Surface Temperature

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
19	3	6	6	1	1
11	20	32	16	1	1
25	46	53	17	1	1
56	35	71	27	4	4
108	106	137	34	0	0
108	71	110	21	2	2
36	43	67	17	3	3
24	28	33	12	0	0
10	6	16	3	0	0
7	5	7	0	0	0
3	1	0	0	0	0
1	0	0	1	0	0
1	0	0	0	0	0
1	0	0	0	0	0
0	0	0	0	1	1
0	0	0	0	0	0

Boat Length		Boat Length									
25-34	7	6	4	2	0	25-34	14	2	6	8	1
35-44	90	102	128	40	3	35-44	277	101	297	134	29
45-54	147	151	246	70	8	45-54	458	484	817	373	58
55-64	128	93	130	36	3	55-64	305	205	379	159	18
65-74	19	9	23	7	0	65-74	76	41	56	31	8
75-84	12	0	0	0	0	75-84	1	5	11	5	2
85-94	0	0	1	0	0	85-94	1	0	0	0	0
95-104	0	0	0	0	0	95-104	21	10	11	6	1
105-114	0	0	0	0	0	105-114	0	0	0	0	0
Boat Type		Boat Type									
JIG	335	333	488	148	14	JIG	1104	821	1532	698	112
BAIT	120	66	67	14	2	BAIT	91	58	72	17	5

The recorded frequencies of different size vessels at the various windspeeds is similar for both areas for boats of lengths up to 74 feet; but higher frequencies occur in the north of larger vessels up to 104 feet. The inferred declines in fishing (see above) at windspeeds of 20 to 30 and at over 30 kts is similar for both areas.

Comparing gear-type and windspeeds for the two areas shows the same tendency: The frequency of reports of winds in excess of 30 kts from jig boats drops whereas there is a decline in frequency of reports of winds greater than 20 kts from the baitboats.

Coastal Fishery, North versus South of Point Conception (35°N Latitude)

The southern area reporting frequencies indicate some fishing from June to January; whereas in the north, the season is from June to October/November. In the south, observation frequency drops significantly between windspeed categories 3 and 4, and again between 4 and 5. In the north the major drop occurs principally at windspeeds between categories 4 and 5.

The temperature range over which fishing reports occur is about the same in both areas. Peak reporting activity is centered on 64°-65°F in the south and 62°-64°F in the north; i.e. in slightly warmer waters in the south.

A narrower size range of boats report fishing in the southern area, the greatest number being in the 45-64 ft lengths. The same size range holds the majority of boats in the north also, but some larger vessels fish in those grounds. There is no clear evidence of larger vessels fishing in higher winds.

In the south, jig boats show decreased observations in conjunction with fishing when winds are above 20 kts and observational frequency further declines to very low levels at winds over 30 kts (between windspeed categories 4 and 5). Baitboat report frequency in the south responds similarly to windspeed. In the north, the drop off in wind conditions reported by the two gear types in conjunction with fishing is similar to that in the south.

Conclusion and Summary

The stated objective of this study, that of developing a wind-based fishability index, was not realized. The failure to accomplish this goal is considered to be due to the limitations of the log book wind speed data, which are categorized into

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arbitrary groups. The wind speeds at which effects on fishing are evident are not revealed by the data because such influence is obscured by virtue of the categorizations. It may yet be possible to learn from information sources other than wind records from albacore logs (i.e., interviews or questionnaire surveys of fishermen, covering various sizes and types of vessels from different geographic regions) of the wind speeds at which fishing is adversely affected. The characteristics of those wind speeds in terms of geography and season could then be described based on alternative data sources such as observed wind records (wind atlas, vessel reports) or derived winds (computed estimates based on models using barometric pressure, etc.). The desired index then should be possible to be produced.

This study has yielded some useful related information. It has demonstrated that the winds reported by the albacore fleet are similar to those of other data sets. And some characteristics and comparisons of fishing activity - inferred from fishing reports - in various sub-regions of the U.S. albacore fishery are revealed in terms of where and when fishing takes place, in what temperatures fishing is reported, and some of the differences related to vessel size and type.

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Footnotes

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