A PRELIMINARY REPORT ON THE FOULING CHARACTERISTICS OF PONCE DE LEON TIDAL INLET, DAYTONA BEACH, FLORIDA

By

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INTRODUCTION

In December 1941, the writers visited the exposure location of the North Florida Test Service on Ponce de Leon Inlet, near Daytona Beach, Florida, for the purpose of examining the extent of borer attack in this locality, and to determine the station's suitability for exposure tests on treated piling and for tests in the related field of marine fouling. Arrangements were effected for exposing a series of gum pine blocks throughout the year 1942 to record the progressive borer attack, and simultaneously, to record the growth of all marine fouling organisms prevalent at this location.

The exposure plan required immersion of 13 untreated wood blocks 6″ x 8″ x ¾″, marked 0, 1–12, on January 1, 1942. The blocks were nailed to a supporting two-by-four and submerged in the same manner as their paint test panels—2 feet below the low-tide line.

On the first of February the blocks marked "0" (control) and "1" were removed, packed in wet newspaper, and shipped to Duxbury for detailed examination; at the same time a new "0" control block was inserted in the rack. Thus, each month a control block would be obtained which represented growths that accumulated in the previous month and a numbered block which represented the accumulated growth from January 1, 1942 to the date of its removal. This plan was successfully followed throughout 1942.

The present report is based only on the monthly "control" blocks. Conclusions drawn from the continued exposures will be presented in a later contribution.

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EXPOSURE SITE DATA

The marine exposure facilities of the North Florida Test Service are located on the north shore of Ponce de Leon Inlet, one-fourth of a mile from the Atlantic Ocean. The flow of water past the piers, from which the racks of panels are suspended, is decidedly strong, the direction of flow depending on the tide. The piers extend out into the water for approximately 60 feet and are L shaped; from the heads of these the total immersion racks are suspended in water which is 8 to 10 feet deep at low tide. The total immersion panels are suspended 1–2 feet below the low water mark. Intertidal panels are at the median tide line. The tide averages about 4 feet at this location. Both total immersion and intertidal panels are hung in wooden frames consisting of grooved 2″ x 4″ wood lapped and bolted at the four corners. The panels, six to eight on a rack depending on their size, are mounted in the rack edge to edge, but not touching each other. The surfaces of the panels are exposed to the sweep of the current, since the racks are hung in the same direction as the current. There is no chance of dead water forming between panels hung in this manner, as may be the case when panels are suspended from a rack with the surfaces of the panels facing each other. The racks are suspended from the pier by brass chain.

The general fouling picture at this location is impressive, not only in types of organisms, but also in intensity. Barnacles and the filamentous bryozoans, *Bugula*, are the predominant forms. Calcareous tube worms, hydroids, encrusting bryozoans, mollusks (oysters and clams) and algae are also found in considerable numbers. Several species of Teredinidae are very prevalent. As a rule these organisms are very destructive in timbers where fouling organisms thrive—in which respect the Daytona location seems to be typical. The fouling intensity and species show seasonal fluctuations; however, an unprotected panel immersed at this site for at least two months at any time of the year is heavily fouled at the end of the two-month period.

The conventional meteorological data for the test site are recorded in Table I.

TABLE I—METEOROLOGICAL DATA

Average wind velocity	9 mph. southeast	
Annual rainfall:	47.25 inches	
Annual total sunlight:	240 days	
Percentage of theoretical total sunlight:	69%	
Average relative humidity:	86% at 7:30 A. M. 54% at 12:00 M.	
Maximum current velocity:	4 mph	
Mean average tide:	3.8 feet	
	1941	1942
Average water temperature:	70° F	69° F
Maximum recorded water temperature:	84° F	81° F
Minimum recorded water temperature:	54° F	58° F

RESULTS OF THE SURVEY

For purposes of this report the detailed memoranda describing the incidence of the various identifiable organisms on the test blocks have been summarized in the following tables. Table II shows the borer

TABLE II—MONTHLY BORER ATTACK IN CONTROL PANELS IN 1942

Month	*Water Temp. on 20th in °F*	*Total No. of* Teredinidae	*Size Range in mm*	*Total No. of* Pholadidae	*Total No. Limnoria lignorum* White
January	68	0	——	0	18
February	61	0	——	0	4
March	58	5*	min.	0	51
April	60	11	min.	0	131
May	67	960*	min. to 40	0	81
June	72	250*	min. to 30	0	40
July	78	5*	min. to 15	0	132
August	76	0	——	0	v
September	81	250*	min. to 40	v**	25
October	76	5*	min.	0	50
November	72	24*	min. to 5	0	57
December	66	5	min.	0	101

KEY: 0 Organism absent.
* Identified specimens of *Bankia gouldi* Bartsch included in totals.
** Identified specimens of *Martesia striata* L. included.
v Organism present, but no count available.
min. Minute.

attack; Table III the attack by fouling organisms. It should be noted that these summaries were compiled from the *control* blocks only, and thus represent the incidence and growth in each month, *independent* of the previous month.

DATA ON BORER ATTACK

In general, the data in Table II are self-explanatory, and need no comment. Seasonal effects for the Teredinidae are obvious. It appears that the 1942 periods of heaviest attack were May–June, and September.

There appears to be more intense *Limnoria* infestation in the period April through July. However, the *Limnoria* attack is not of sufficient intensity to enable positive conclusions to be drawn concerning seasonal variations. The figures may well represent the expected variation in *Limnoria* counts on single test panels.

DATA ON FOULING ORGANISMS

The data in Table III are sufficiently detailed as to need little comment. Seasonal effects are again obvious. Thus, there appears

TABLE III—Monthly Fouling Incidence in 1942

Month	Water Temp. on 20th in °F	Total No. of Balanus	Size Range in mm	CRUSTACEA—CLASS CIRRIPEDIA: Balanus improvisus Darwin	Balanus amphitrite Darwin	Balanus eburneus Gould
January	68	7200	min. to 3	0	0	0
February	61	7440	min. to 4	z	z	0
March	58	1565	min. to 4	z	z	0
April	60	605	embryonic	0	0	0
May	67	175§	juv. to 7	0	z	z
June	72	250§	3 to 7	0	0	z
July	78	250§	1 to 3	0	z	0
August	76	6500§	1 to 3	0	0	0
September	81	800§	3 to 10	z	z	z
October	76	125§	juv. to 5	0	0	z
November	72	6500§	juv. to 4	0	0	0
December	66	250§	juvenile	0	0	0

TABLE III—Monthly Fouling Incidence in 1942 (cont.)

Month	Water Temp. on 20th in °F	BRYOZOA: Bugula sp.	Bugula flabellata (Thompson)	Bugula neritina (L.)	Electra crustulenta (Pallas)	Electra monostachys (Busk)	Schizoporella unicornis (Johnston)	Cryptosula pallasiana (Moll)
January	68	0	0	0	0	0	0	0
February	61	0	0	0	0	0	0	0
March	58	5	0	4	2	0	1	2
April	60	30	5	41	num.	0	many	few
May	67	many	0	many	num.	0	num.	0
June	72	many	0	many	0	0	few	0
July	78	0	0	40	0	1	many	0
August	76	0	0	many	0	0	few	0
September	81	few	few	many	many	0	many	many
October	76	many	many	many	few	0	many	many
November	72	few	few	many	0	0	many	many
December	66	many	many	many	0	0	0	0

TABLE III—Monthly Fouling Incidence in 1942 (cont.)

Month	Water Temp. on 20th in °F	MOLLUSCA: Anomia simplex D'Orbigny	Mytilus hamatus Say	Ostrea virginica Gmelin	ANNELIDA Serpulidae	COELENTERATA Tubularia sp.	CHORDATA Tunicata	Silt
January	68	0	few	0	0	9	0	mod.
February	61	0	0	0	0	10	0	trace
March	58	0	0	0	2	trace	1	0
April	60	few	0	0	0	13	1	light
May	67	many	few	0	many	trace	0	trace
June	72	hundreds	0	hundreds	hundreds	0	0	trace
July	78	0	0	0	num.	trace	0	light
August	76	0	0	0	many	0	0	trace
September	81	0	0	0	many	0	0	trace
October	76	0	0	0	0	trace	0	trace
November	72	0	0	0	0	light	0	light
December	66	0	0	0	few	light	0	light

Key: 0 Organism absent.
z specimens identified.
§ count approximated.

trace or few 1–15 specimens.
moderate or numerous 16–40 specimens.
heavy or many 41–100 specimens.

TABLE IV—Comparative Intensity of Monthly Fouling Attachment

Month	Teredinidae	Pholadidae	*Limnoria lignorum* White	*Balanus*	*Other Mollusca*	*Bryozoa*		*Annelida*	*Hydrozoa*	*Tunicata*	*Silt*	*Misc.**
						Encrusting	*Filamentous*					
January	0	0	x	xxxxx	x	0	0	0	x	0	xx	x
February	0	0	x	xxxxx	0	0	0	0	x	0	x	xxx
March	x	0	xx	xxxxx	0	x	x	x	x	x	0	xxx
April	x	0	xxxx	xxxxx	x	xxx	xx	0	x	x	x	x
May	xxxxx	0	xxx	xxxx	xxx	xx	xxx	xxx	x	0	x	x
June	xxxx	0	xxx	xxxx	xxxx	x	xxx	xxxx	0	0	x	x
July	x	0	xxxx	xxxx	0	xxx	xxx	xx	x	0	x	xx
August	0	0	x	xxxxx	0	x	xxx	xxx	0	0	x	0
September	xxxx	x	x	xxxxx	0	xxx	xxx	xxx	0	0	x	xxx
October	x	0	xx	xxxx	0	xxx	xxx	0	x	0	x	xx
November	x	0	xx	xxxxx	0	xxx	xxx	0	x	0	x	xxx
December	x	0	xxx	xxxx	0	0	xxx	x	x	0	x	x

Key: 0 Organism absent. (x) Organisms per panel: 1–30; (xx) 31–60; (xxx) 61–100; (xxxx) 101–500; (xxxxx) 501–up.

* This group includes shrimp, starfish, flatworms etc. which enter fouled regions on the panels as mature, motile organisms.

to be a well-defined growth peak for the Cirripedia (*Balanus*) beginning in November and extending through February. A secondary set apparently took place in August.

There appear to be two seasonal peaks for the bryozoans: one is the period May through July; the second is the period September through November, and into December for certain of the species. Mollusks are apparent only during May and June. Annelids (tube-worms) are very prevalent in the period May through September.

Dwarf hydroids (Tubularia) are present only during the period October through April. However, the active presence of these growths during the summer months has been demonstrated further north, at Wilmington, North Carolina. This suggests that summer water temperatures at Daytona may be too high for hydroid survival there.

The data in Tables II and III have been condensed in Table IV, and are shown schematically in order to facilitate comparisons of growth intensity and uniformity. It is apparent that the heaviest and most uniform fouling is by *Balanus*, as would be expected. The next most prevalent organisms are filamentous bryozoans which are rather uniformly present from March through December. Encrusting bryozoans are also present for the greater part of the year.

SUMMARY

A preliminary fouling and borer survey of the North Florida Test Service marine exposure location has demonstrated the active presence of at least three identified species of *Balanus*, six identified species of bryozoans—both encrusting and filamentous, three identified species of mollusks, of annelids, and of dwarf hydroids. At least three types of boring organisms are actively present, of which the very destructive and rapidly growing *Bankia gouldi* (Bartsch) is the most prevalent. (Attack by this organism resulted in complete destruction of continuously-exposed test boards in 8 months.)

While the expected seasonal variations in intensity are found, the general growth picture is one insuring fouling conditions during every month of the year—a desirable condition for exposure test purposes. The station appears to offer an excellent compromise between middle Atlantic and semitropical conditions as well as a desirable location from the standpoint of marine testing.

Studies of this marine location are being continued and detailed findings will be reported subsequently.

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