Jack 3.4

OFFSHORE PROFILE DESCRIPTION USING THE POWER CURVE FIT
PART I: EXPLANATION AND DISCUSSION

by

James H. Balsillie

Analysis/Research Section
Bureau of Coastal Data Acquisition
Division of Beaches and Shores
Florida Department of Natural Resources

BEACHES AND SHORES
TECHNICAL AND DESIGN MEMORANDUM NO. 82-1-I

October 1982

Reviewed by

Beaches and Shores Resource Center
Institute of Science and Public Affairs
Florida State University
and
Florida Office of Coastal Management
Florida Department of Environmental Regulation

Funded by

A grant from the U. S. Office of Coastal Zone Management
National Oceanic and Atmospheric Administration
(under the Coastal Zone Management Act of 1972, as amended)
through
Florida Office of Coastal Management
Florida Department of Environmental Regulation
and
Florida Department of Natural Resources

FOREWORD

This work provides the basic bathymetric data necessary to support two-dimensional nearshore hydraulic transformation models of the Division of Beaches and Shores. The work constitutes partial fulfillment of contractural obligations with the Federal Coastal Zone Management Program (Coastal Zone Management Act of 1972, as amended) through the Florida Office of Coastal Management subject to provisions of contract CM-37 entitled "Engineering Support Enhancement Program" (DNR contract no. C0037). The work has been adopted as a Beaches and Shores Technical and Design Memorandum in accordance with provisions of Chapter 16B-33, F. A. C.

At the time of submission for contractural compliance, James H. Balsillie was the Contract Manager, and Administrator of the Analysis/Research Section, Hal N. Bean was Acting Chief of the Bureau of Coastal Data Acquisition, Deborah E. Athos was Director of the Division of Beaches and Shores, and Dr. Elton J. Gissendanner was Executive Director of the Department of Natural Resources.

Deborah E. Athos

Deborah E. Athos, Director
Division of Beaches and Shores

CONTENTS

LIST OF TABLES AND FIGURE

OFFSHORE PROFILE DESCRIPTION USING THE POWER CURVE FIT
PART I: EXPLANATION AND DESCRIPTION

by

James H. Balsillie

Analysis and Research Section, Bureau of Coastal Data Acquisition, Division of Beaches and Shores, Florida Department of Natural Resources.

INTRODUCTION

The "*Shore and Beach Preservation Act*" of the *State of Florida* (*ss.* 161.053, F. *S.*) requires identification of that portion of the beach and coast that will be impacted by an engineering design event designated as the 100-year hurricane (i.e., the hurricane that has a 1 per cent chance of occurring in any given single year). In order to determine the width of the impact zone (measured from the shoreline as referenced to Florida Department of Natural Resouces reference monuments placed once every 1000 feet along coastal Florida), certain basic data are required to support "state-of-the-art", highly sophisticated and rigorous scientific numerical prediction modeling techniques (e.g., Dean and Chiu, 1981a, 1981b, 1982).

Basic support data collected by the Bureau of Coastal Data Acquisition (BCDA) are described by Sensabaugh, Balsillie and Bean (1977). Included in this effort is the measurement of offshore profile data at 3000-foot intervals along coastal Florida. Offshore profiles usually extend 3000 feet seaward of the shoreline with sounding and distance measurements made at an average distance of every 100 feet. A count reveals that if all counties within jurisdiction of the "Shore and Beach Preservation Act" are completed once, a total of 72,600 data points (i.e., elevations and distances) describing the offshore are available. Noting that the Division of Beaches and Shores must periodically review Florida's shoreline status on a county-by-county basis (tentatively set at 5 counties per year, appropriately substituting if a hurricane strikes) and must tesselate such data formats to facilitate multiple and interactive administrative and scientific/engineering needs in support of statute requirements, then the management of the offshore profile data, alone, must be considered as significant.

In addition, it is recognized that the complexity of realizing coastal engineering solutions is demanding, and that acceptable methods which can simplify the approach are desirable to attain. The need for simplicity is particularly apparent in a regulatory program where the quickness of response time is important (i.e., in Florida subject to provisions of administractive procedures law.....Chapter 120, F. S.). The goal of this work is to provide an acceptable but simplified data base describing offshore profile geometry for Florida coastal waters. Further discussion justifying such an approach and identification of additional application of the data base, follows.

THE OFFSHORE PROFILE MODEL

The offshore profile might be more nearly described as the "nearshore profile" which extends from the shoreline of interest to just outside the zone of shore-breaking wave activity in what is commonly termed the "littoral zone".

The configuration of the nearshore profile has been considered to be primarily a function of the incident wave climate which has acted on the profile long enough to alter its shape, and on the characteristics of the sediment comprising the profile. If a wave climate (i.e., connotating a consistent incidence of wave energy arrival) acts on the profile long enough, then the profile should attain an equilibrium shape.

Bruun (1954) initially addressed the nearshore profile equilibrium shape concept using profile data from the North Sea coast of Denmark and California, and suggested that it may be quantified by:

$$d = a x^{b} \tag{1}$$

where d is the local water depth measured from the still water level (i.e., SWL; see Galvin, 1969 for the definition), a is the "shape coefficient", b is the "scale coefficient", and x is the distance offshore.

Dean (1977) again addressed the concept using 502 profiles from the U. S. east coast and the Gulf of Mexico. Additionally, he provided both physical and theoretical supportive reasoning for equation (1), and suggested that the value of the scale coefficient, b, may be a constant of 2/3.

Hughes (1978), and Hughes and Chiu (1978) conducted additional research (sponsored by the, then, Bureau of Beaches and Shores) to assess the relevancy of equation (1) as it applies to nearshore profiles of Florida.

CURVE FITTING PROCEDURES

Following the work of Dean (1977), Hughes (1978), Hughes and Chiu (1978), and Moore (1982), power curves are fitted to Beaches and Shores offshore profile data using least squares curve fitting methods. These are:

<u>Method 1. Exponent (b) Not Fixed</u>:

$$b = \frac{(\Sigma \ln x)(\Sigma \ln d) - n\Sigma\left((\ln d)\ \ln x\right)}{(\Sigma \ln x)^2 - n\Sigma(\ln x)^2} \qquad (2)$$

$$a = e^{\left[\frac{(\Sigma \ln x)\left(\Sigma\left[(\ln x)\ \ln d\right]\right) - (\Sigma \ln x)\Sigma \ln d}{(\Sigma \ln x)^2 - n\Sigma(\ln x)^2}\right]} \qquad (3)$$

<u>Method 2. Exponent (b) Fixed at 2/3.</u>

Method 2a. Direct Fit.

$$a = \frac{\Sigma d\ x^{2/3}}{\Sigma x^{4/3}} \qquad (4)$$

Method 2b. Logarithmic Fit.

$$a = \mathrm{EXP}\left((1/n)\ \left[(\Sigma \ln d) - (2/3\ \Sigma \ln x)\right]\right) \qquad (5)$$

<u>Assessment of Fitted Curves</u>

The goodness of fit is given by the Pierson product-moment correlation coefficient which may be found in any standard statistics text, and by the root-mean-square-error, e_{rms}, given by:

$$e_{rms} = \sqrt{(1/n) \Sigma (d_{comp} - d)^2} \qquad (6)$$

where d_{comp} is the computed value of d from equation (1).

RESULTS AND DISCUSSION

Presentation of Results

Offshore power curve results are compiled on a county-by-county basis in tabular form in ".....PART II. STANDARD FLORIDA OFFSHORE PROFILE TABLES." A portion of the data for Indian River county is shown in Table 1 to illustrate the format of the standard tables.

The standardized tables are compiled under separate cover since they will be periodically updated as new surveys are completed. In addition, there are data available for surveys made during the period 1970 to 1980 which were not consistently formatted. The Analysis/Research Section is currently reformatting all data to produce a consistent data base. The status of available information used to provide power curve fits, as of this report, is listed in Table 2.

The Natural Resources Management Systems and Services data processing center of the Department of Natural Resources is supporting the production of information such as that resulting from this effort. Included is APL ..... i.e., "A Programming Language"..... especially suited to scientific,

Table 1. Example of Power Curve Data Tabulation.

OFFSHORE PROFILE POWER CURVE FITS

INDIAN RIVER, 1972

Offshore Survey Dates (day,mo,yr): 281172 to 291172.
b = exponent; a = shape coefficient; r = correlation coefficient
(r for the fixed exp data applies to both direct and log methods);
e_{rms} = RMS error.

DNR Ref Mon No	Zero NGVD Dist from Monu	EXPONENT NOT FIXED				EXPONENT FIXED AT 2/3				
						Direct Method			Log Method	
		b	a	e_{rms}	r	a	e_{rms}	r	a	e_{rms}
R-1	348.0	0.313	1.281	1.427	0.99	0.115	2.11	0.998	0.122	2.209
R-3	238.6	0.611	0.239	2.243	0.979	0.177	1.743	0.985	0.17	1.848
R-6	184.4	0.582	0.309	2.672	0.982	0.186	2.188	0.989	0.186	2.188
R-9	127.1	0.581	0.33	2.7	0.983	0.196	2.049	0.99	0.196	2.049
R-12	100.0	0.526	0.453	3.647	0.975	0.196	2.503	0.989	0.195	2.504
R-15	160.3	0.478	0.497	3.629	0.966	0.161	2.457	0.988	0.156	2.489
R-18	147.6	0.624	0.208	2.821	0.983	0.154	2.824	0.987	0.162	2.888
R-21	190.3	0.525	0.426	2.913	0.974	0.164	3.091	0.988	0.176	3.25
R-24	184.6	0.553	0.342	2.949	0.982	0.162	3.044	0.991	0.172	3.144
R-27	196.8	0.558	0.321	3.086	0.978	0.156	3.234	0.988	0.17	3.397
R-30	147.9	0.592	0.223	3.042	0.984	0.131	3.175	0.99	0.144	3.321
R-33	175.8	0.451	0.528	2.475	0.971	0.127	2.782	0.99	0.145	3.099
R-36*	243.4	0.597	0.234	2.78	0.983	0.142	2.937	0.989	0.156	3.127.
R-39	225.9	0.446	0.619	3.855	0.972	0.135	4.584	0.991	0.168	5.273
R-42	182.9	0.53	0.326	1.355	0.98	0.134	1.19	0.991	0.145	1.457
R-45*	263.4	0.435	0.627	0.772	0.975	0.131	1.409	0.992	0.159	2.586
R-48	193.4	0.49	0.414	1.917	0.975	0.117	2.497	0.991	0.147	3.445
R-51	174.5	0.423	0.601	1.076	0.976	0.115	1.665	0.993	0.14	2.556
R-54	126.4	0.464	0.553	2.243	0.978	0.14	2.864	0.992	0.163	3.36
R-57	190.8	0.506	0.43	1.771	0.975	0.146	2.156	0.99	0.169	2.759
R-63	213.3	0.486	0.489	1.302	0.972	0.144	1.807	0.989	0.163	2.374
R-66	232.5	0.446	0.579	1.062	0.977	0.126	1.839	0.993	0.15	2.753
R-69	217.7	0.482	0.483	1.288	0.981	0.135	1.968	0.993	0.156	2.606
R-72*	290.6	0.586	0.269	1.819	0.985	0.156	2.075	0.99	0.169	2.271
R-75	297.3	0.649	0.212	1.885	0.989	0.182	1.894	0.99	0.192	2.029
R-78	171.1	0.56	0.325	2.236	0.987	0.163	2.363	0.993	0.173	2.484
R-81	490.9	0.51	0.366	1.742	0.973	0.124	2.221	0.989	0.142	2.663
R-84	298.3	0.396	0.79	2.395	0.972	0.124	3.381	0.992	0.149	3.913
R-87	228.6	0.447	0.489	1.979	0.973	0.113	2.077	0.991	0.124	2.266
R-90	475.9	0.67	0.179	2.019	0.991	0.176	1.898	0.991	0.183	1.987
R-93	295.9	0.709	0.137	1.403	0.99	0.182	1.279	0.986	0.179	1.321
R-96*	259.5	0.609	0.284	1.604	0.988	0.197	1.581	0.992	0.2	1.603
R-99*	289.1	0.574	0.35	2.474	0.985	0.185	2.762	0.991	0.2	3.023
R-102	429.3	0.477	0.571	2.354	0.975	0.153	3.2	0.99	0.191	4.304

Table 2. Inventory of Beaches and Shores Offshore Profile Data.

COUNTY	SURVEY DATES	NUMBER OF OFFSHORE PROFILES	DATA REFORMATTED AND AVAILABLE ?
	UPPER EAST COAST		
Nassau	Feb 1974	28	yes
"	Oct 1981	36	yes
Duval	Mar 1974	27	no
St. Johns	Aug 1972	67	yes
Flagler	Aug 1972	34	no
Volusia	Jun 1972	79	no
Brevard	Oct 1972	74	no
	LOWER EAST COAST		
Indian River	Nov 1972	39	yes
St. Lucie	Jun 1972	37	no
Martin	Jan 1972	43	no
"	Feb 1976	34	no
"	Feb-Mar 1982	37	yes
Palm Beach	Dec 1974-Jan 1975	76	no
Broward	Oct-Dec 1976	40	no
"	Nov 1978	93	no
Dade	1979	38	no
	LOWER GULF COAST		
Pinellas	Oct-Nov 1974	65	no
Manatee	Aug 1974	22	yes
Sarasota	Jun-Jul 1974	63	yes
"	Nov 1978	21	no
Charlotte	Jun 1974	23	yes
Lee	Feb 1974	80	no
Collier	Mar 1973	46	yes
	PANHANDLE COAST		
Franklin	Jun-Jul 1973	51	yes
"	Apr 1976	15	yes
"	Jul 1981	119	yes
Gulf	Jul-Sep 1973	55	no
Bay	Sep-Oct 1975	49	no
Walton	Oct 1973	43	yes
"	Oct 1975	42	yes
"	May 1981	87	yes
Okaloosa	Dec 1973	17	no
"	Mar 1976	16	no
Escambia	Dec 1973-Feb 1974	72	no

task-oriented endeavors, from which software has been developed to produce the tabulations. APL programming in support of the effort is documented in the Appendix.

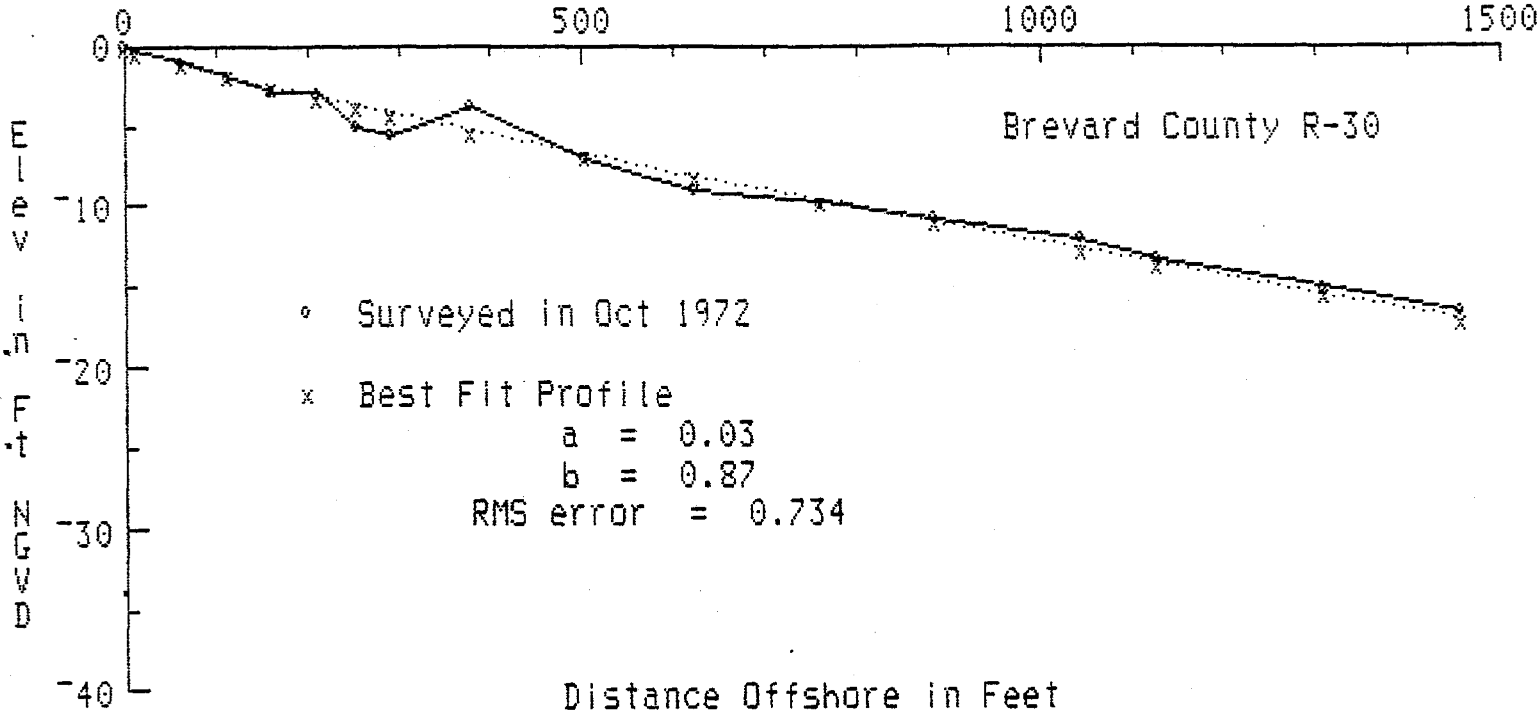
Selection of the Method to Apply

The lowest value of e_{rms} usually identifies the best method to use. Note, however, that the correlation coefficient should be of sufficiently high magnitude (i.e., $r > 0.9500$). Low values of e_{rms} (i.e., $e_{rms} < 1.5$) generally represent non- to low-barred profiles, and moderate values of e_{rms} (i.e., $1.5 < e_{rms} < 4.0$) generally represent well formed, barred profiles. Where e_{rms} is greater than about 4.0, the applicability of the fit may be suspect, and should be checked against the actual Beaches and Shores profile plot. For instance, profiles located in or near inlets generally have high error values for which none of the methods may be applicable. Additionally, Hughes (1978) and Hughes and Chiu (1978) found that equation (1) is applicable to about 1200 feet offshore. This restriction holds for the tabulated information of this report.

Examples of profile fits to Beaches and Shores profile data are presented in the Figure.

Usefulness of the Approach

It has been previously noted that the amount of offshore profile data, comprising only a fraction of the total data collected by the Bureau of Coastal Data Acquisition (i.e., does not include onshore beach and coast profile information), constitutes a significant data management effort on its own.



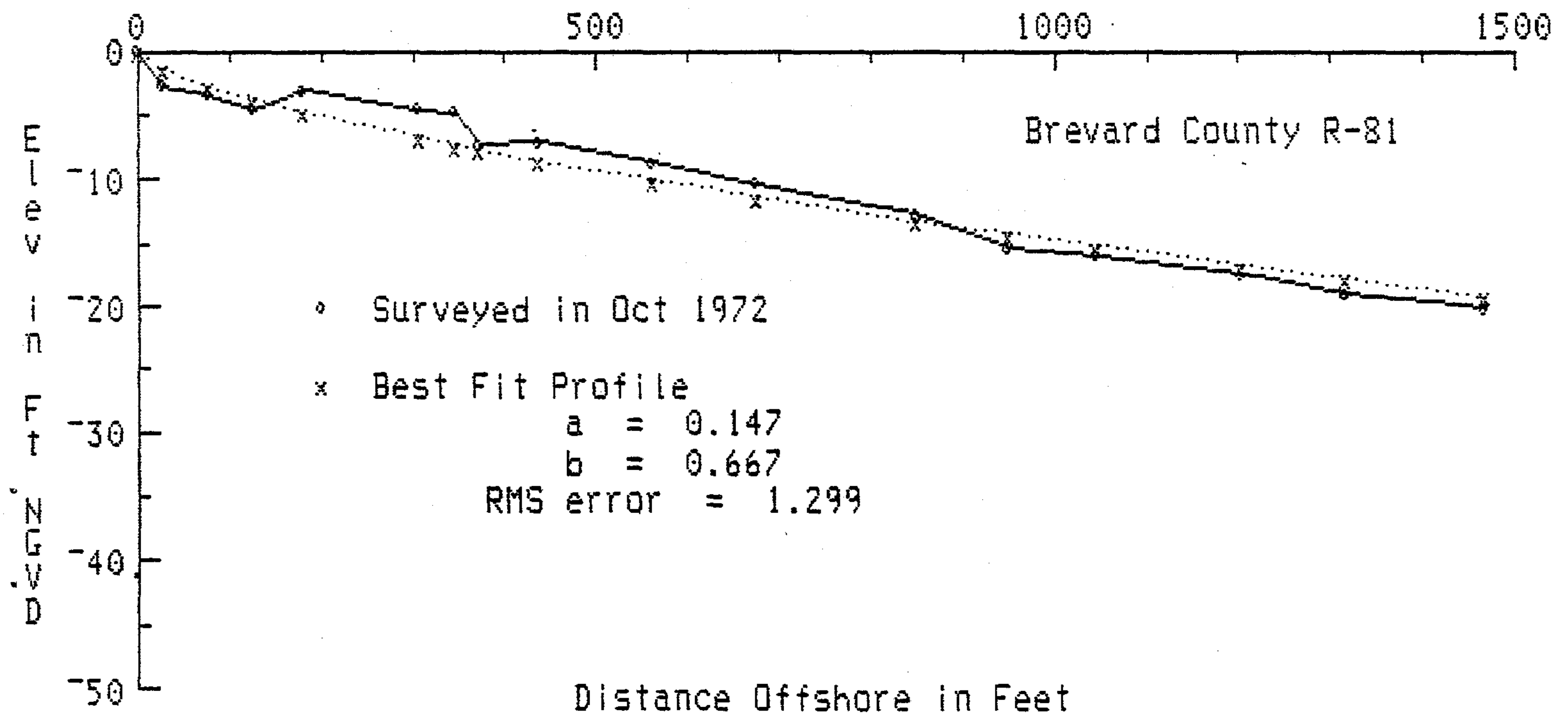
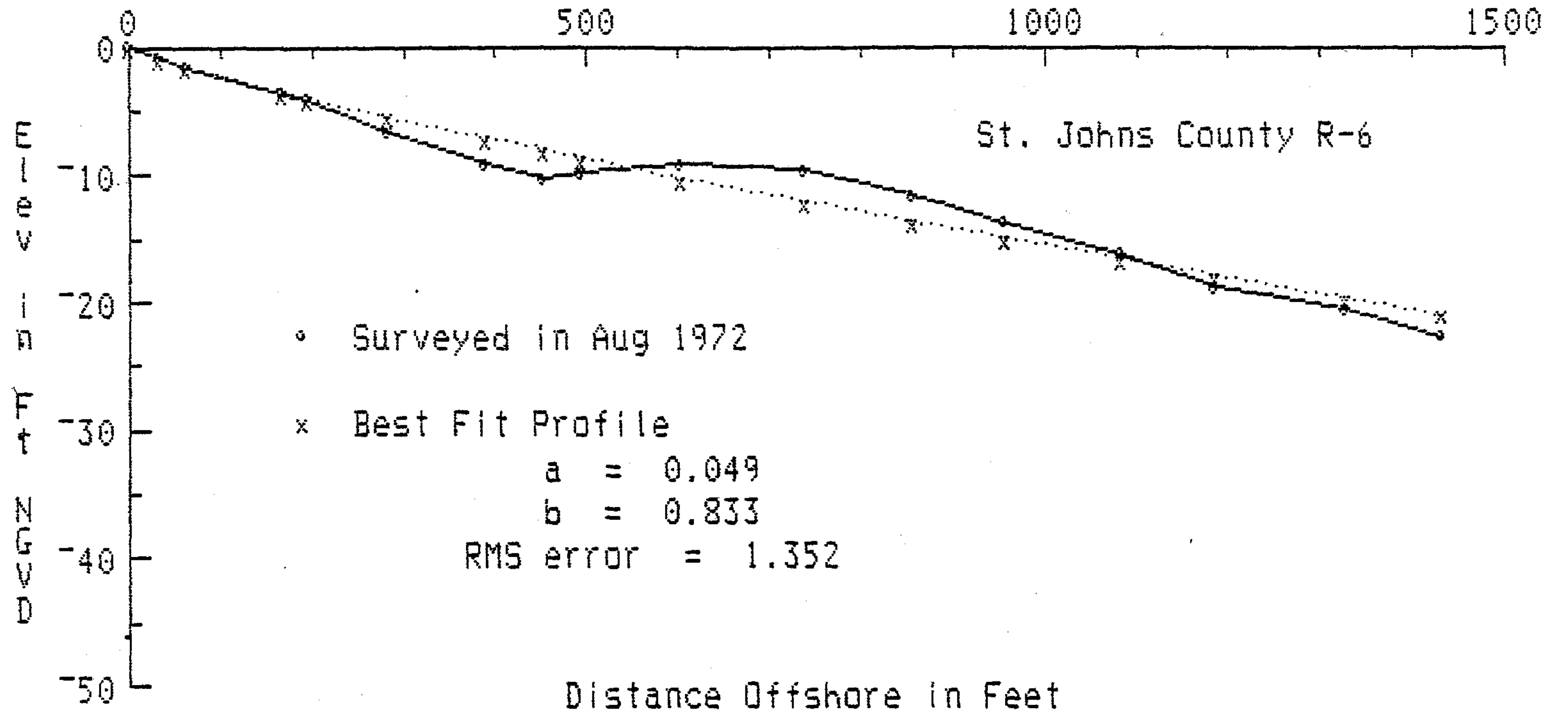


Figure. Random examples of power curve fits.


0
500
1000
1500
0
-10
-20
-30
-40
-50
Elev in Ft NGVD
St. Johns County R-6
Surveyed in Aug 1972
Best Fit Profile
a = 0.049
b = 0.833
RMS error = 1.352
Distance Offshore in Feet

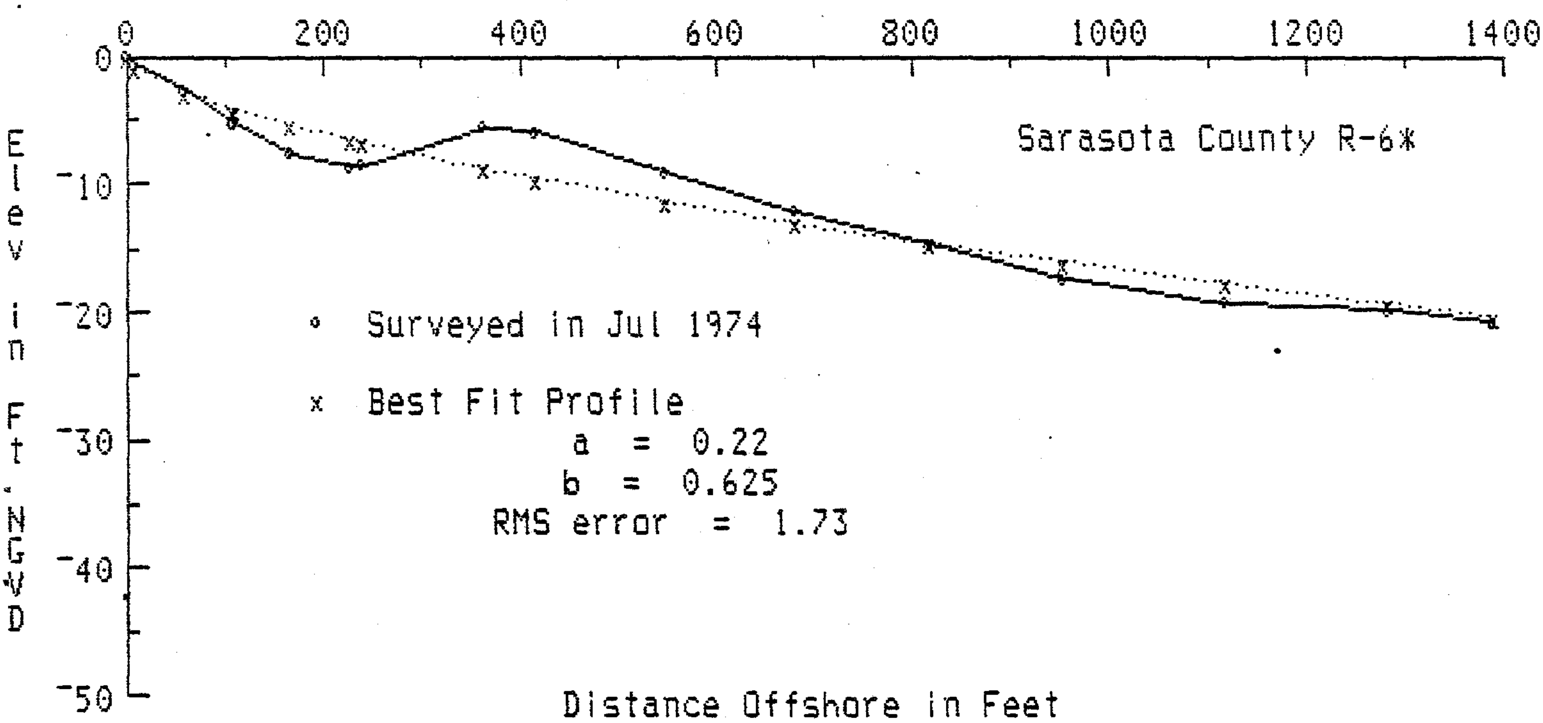
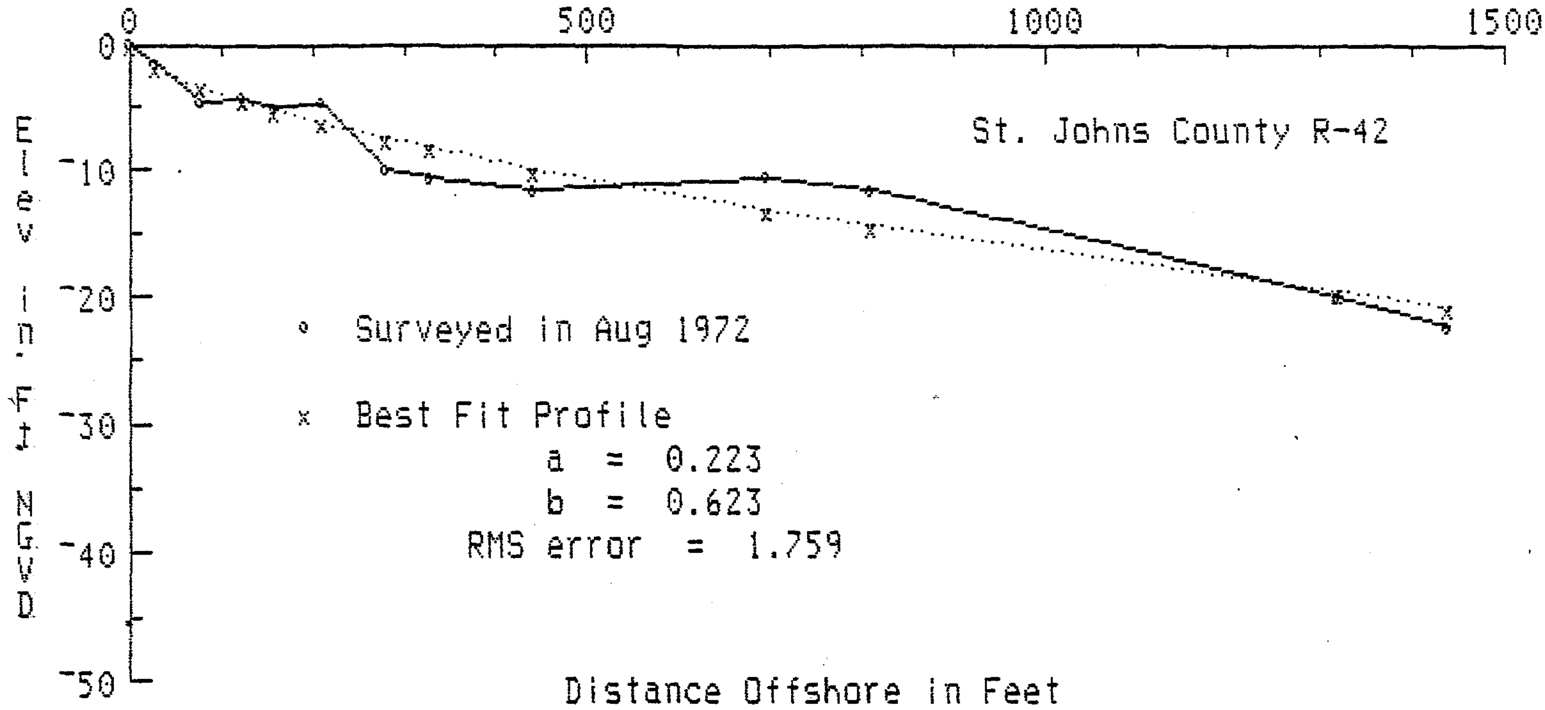

0
200
400
600
800
1000
1200
1400
0
-10
-20
-30
-40
-50
Elev in Ft NGVD
Sarasota County R-6*
Surveyed in Jul 1974
Best Fit Profile
a = 0.22
b = 0.625
RMS error = 1.73
Distance Offshore in Feet

Figure (cont.)


0
500
1000
1500
0
-10
-20
-30
-40
-50
Elev in Ft NGVD
St. Johns County R-42
Surveyed in Aug 1972
Best Fit Profile
a = 0.223
b = 0.623
RMS error = 1.759
Distance Offshore in Feet

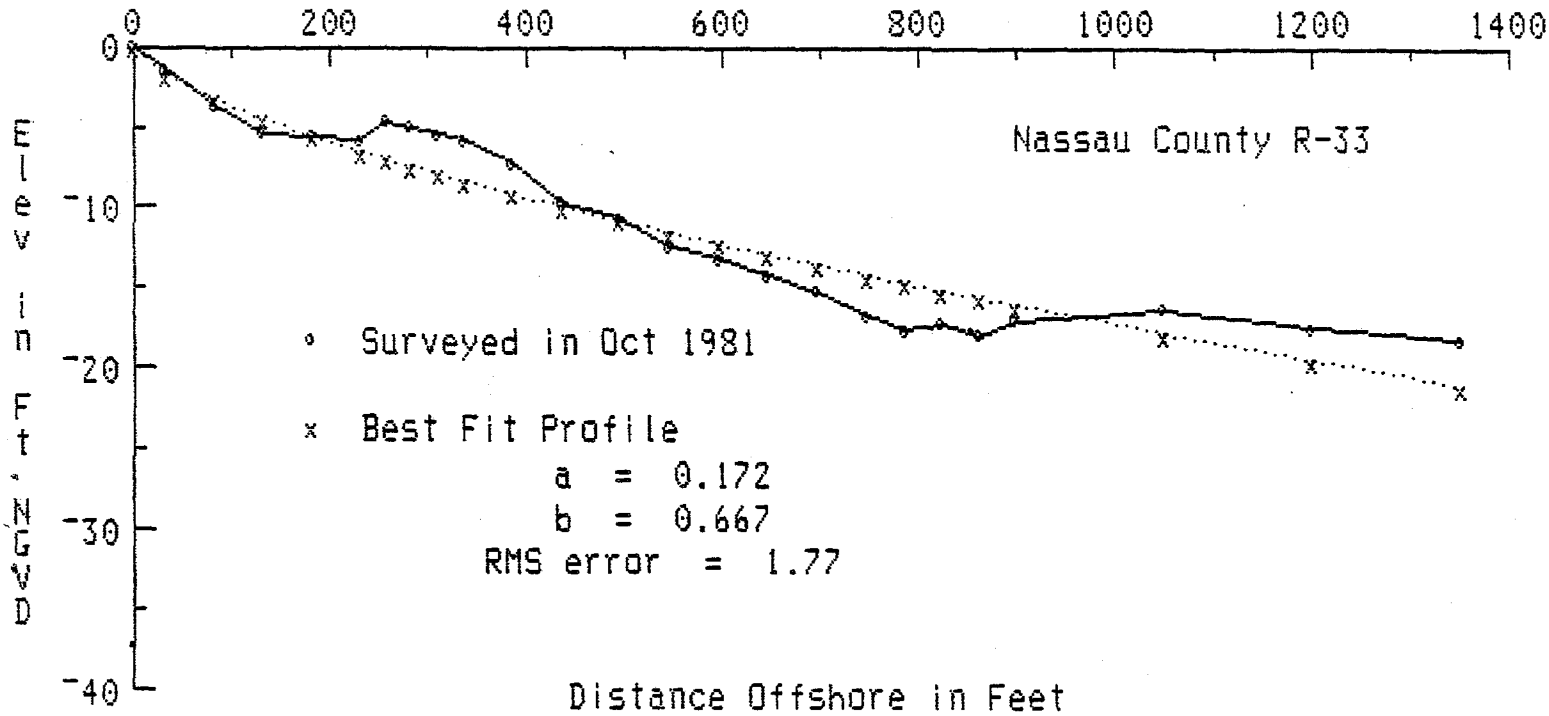
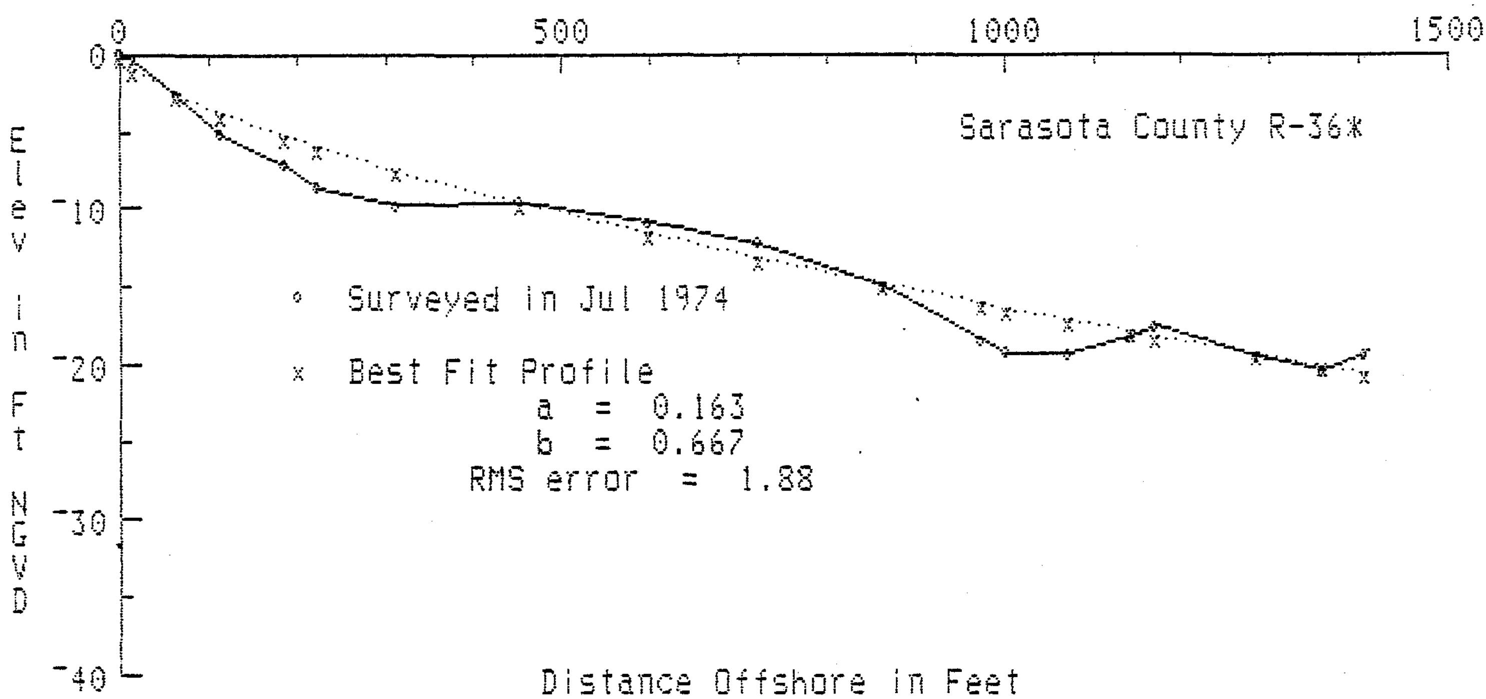

0
200
400
600
800
1000
1200
1400
0
-10
-20
-30
-40
Elev in Ft NGVD
Nassau County R-33
Surveyed in Oct 1981
Best Fit Profile
a = 0.172
b = 0.667
RMS error = 1.77
Distance Offshore in Feet

Figure (cont.)


0
500
1000
1500
0
-10
-20
-30
-40
Elev in Ft NGVD
Sarasota County R-36*
Surveyed in Jul 1974
Best Fit Profile
a = 0.163
b = 0.667
RMS error = 1.88
Distance Offshore in Feet

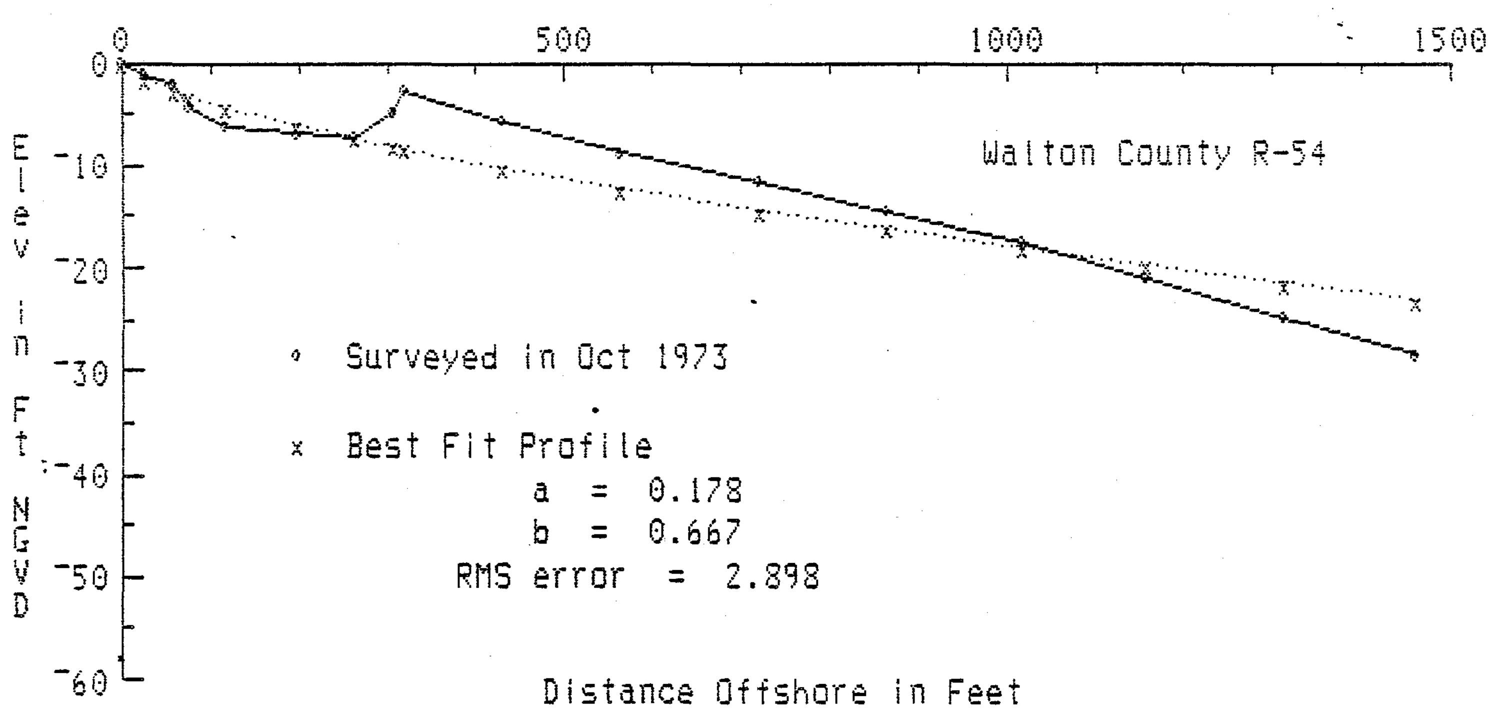
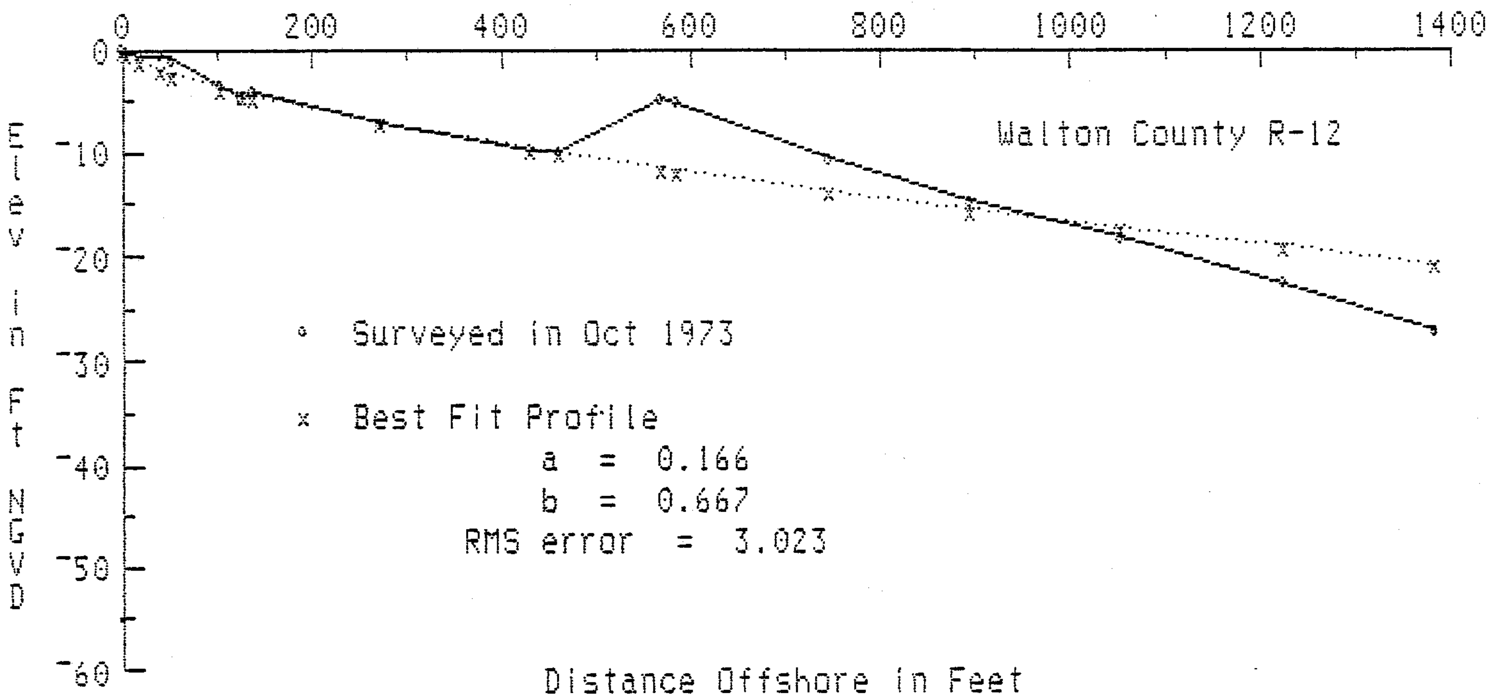

0
500
1000
1500
0
-10
-20
-30
-40
-50
-60
Elev in Ft NGVD
Walton County R-54
Surveyed in Oct 1973
Best Fit Profile
a = 0.178
b = 0.667
RMS error = 2.898
Distance Offshore in Feet

Figure (cont.)


0
200
400
600
800
1000
1200
1400
0
-10
-20
-30
-40
-50
-60
Elev in Ft NGVD
Walton County R-12
Surveyed in Oct 1973
Best Fit Profile
a = 0.166
b = 0.667
RMS error = 3.023
Distance Offshore in Feet

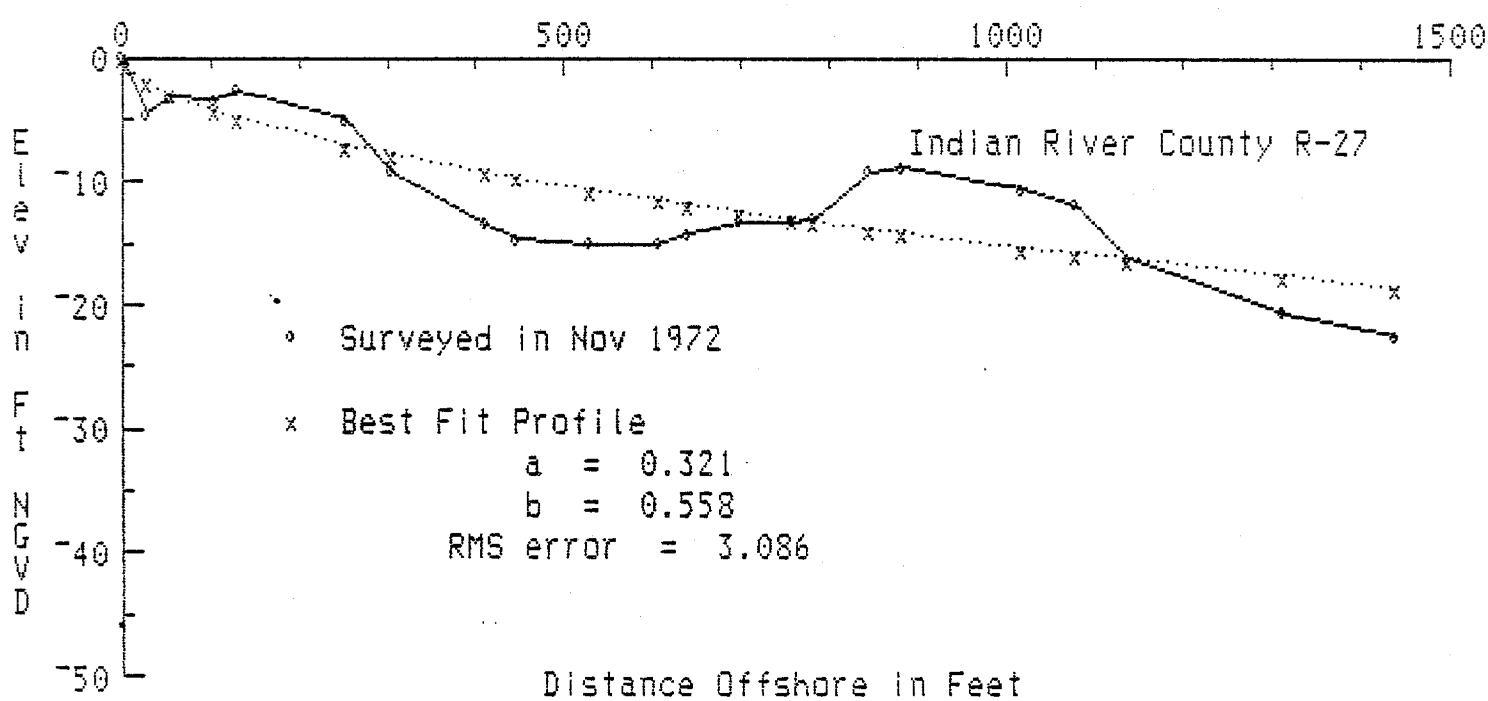
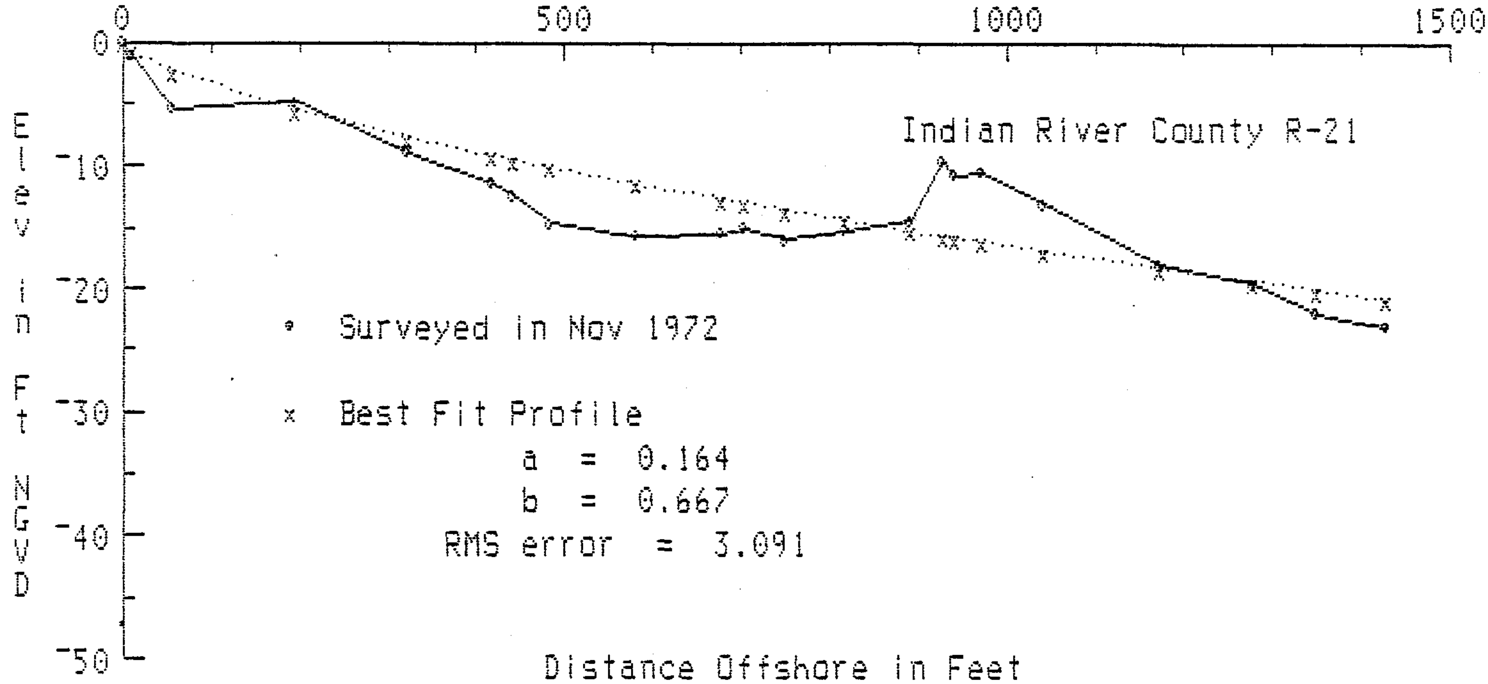

0
500
1000
1500
0
-10
-20
-30
-40
-50
Elev in Ft NGVD
Indian River County R-27
Surveyed in Nov 1972
Best Fit Profile
a = 0.321
b = 0.558
RMS error = 3.086
Distance Offshore in Feet

Figure (cont.)


0
500
1000
1500
Elev in Ft NGVD
0
-10
-20
-30
-40
-50
Indian River County R-21
Surveyed in Nov 1972
Best Fit Profile
a = 0.164
b = 0.667
RMS error = 3.091
Distance Offshore in Feet

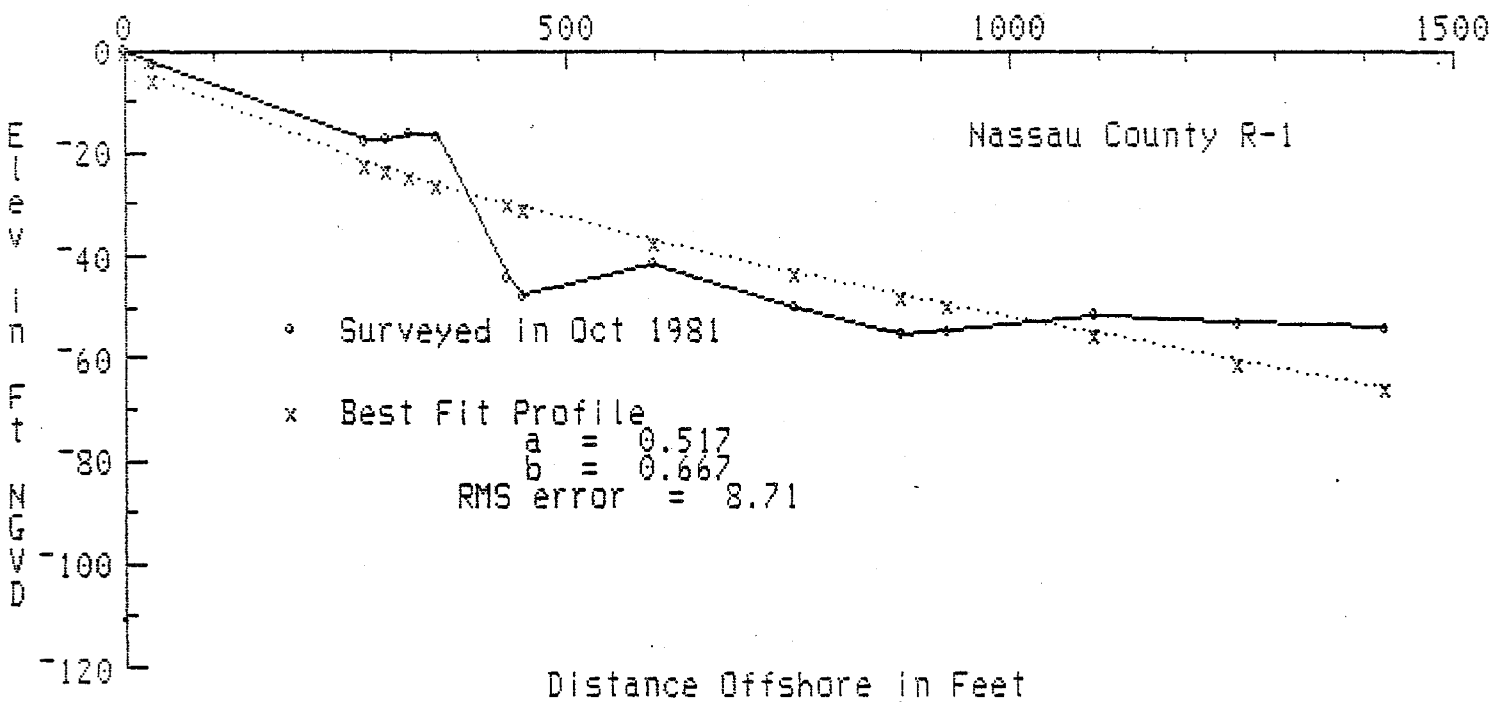

0
500
1000
1500
Elev in Ft NGVD
0
-20
-40
-60
-80
-100
-120
Nassau County R-1
Surveyed in Oct 1981
Best Fit Profile
a = 0.517
b = 0.667
RMS error = 8.71
Distance Offshore in Feet

Figure (cont.)

That the description of an offshore profile can be quantified by one or two parameters rather than 60 data points (on the average) would appear to be desirable.

The results are of particular usefulness in field applications. Because of the simplicity of the approach only a hand-held calculator would be required.

Even in the office where the computer is available to process the original profile data for coastal engineering applications, the use of the power curve nearshore profile remains highly useful. Original profile data often may contain negative slopes (e.g., such as those found on the landward slopes of submerged longshore bars), which introduces, in some important cases, intractible complexities in the shoreward transformation of certain types of hydraulic behavior. Power curve profiles, however, always have positive values which may be used in state-of-the-art coastal engineering numerical procedures.

CLOSURE

It is the purpose of this work to provide a systematic method for the compilation of power curve nearshore profile data for Florida ocean-fronting coastal waters. A certain amount of such information has been compiled on a county-by-county basis (see Table 2) which is available for use in coastal engineering applications.

Additional uses are also evident; for instance, the identification of consistent coastal units and trends, and the behavior of profile change through time.

Such data will most likely provide important data on which to base management decisions. Such applications, however, will have to await compilation of a complete data base for Florida.

REFERENCES

Bruun, Per, 1954, Coast erosion and the development of beach profiles: U. S. Army, Beach Erosion Board, Tech. Memo No. 44.

Dean, R. G., 1977, Equilibrium beach profiles: U. S. Atlantic and Gulf of Mexico coasts: Ocean Engineering Report No. 12, Department of Civil Engineering, University of Delaware.

Dean, R. G., and Chiu, T. Y., 1982, Walton County storm surge model study: Beaches and Shores Resource Center, Institute of Science and Public Affairs, Florida State University, for the Department of Natural Resources, Division of Beaches and Shores.

Dean, R. G., and Chiu, T. Y., 1981a, Dade County storm surge model study: Department of Coastal and Oceanographic Engineering, University of Florida, for the Department of Natural Resources, Division of Beaches and Shores.

Dean, R. G., and Chiu, T. Y., 1981b, Broward County storm surge model study: Department of Coastal and Oceanographic Engineering, University of Florida, for the Department of Natural Resources, Division of Beaches and Shores.

Galvin, C. J., Jr., 1969, Breaker travel and choice of design wave height: Journal of the Waterway and Harbors Division, A. S. C. E., v. 95, no. WW2, p. 175-200.

Hughes, S. A., 1978, The variations in beach profiles when approximated by a theoretical curve: M. S. Thesis, University of Florida.

Hughes, S. A., and Chiu, T. Y., 1978, The variations in beach profiles when approximated by a theoretical curve: Tech. Report No. 039, Department of Coastal and Oceanographic Engineering, University of Florida.

Moore, B. D., 1982, Beach profile evolution in response to changes in water level and wave height: M. S. Thesis, Department of Civil Engineering, University of Delaware.

Sensabaugh, W. M., Balsillie, J. H., and Bean H. N., 1977, A program of coastal data acquisition: Coastal Sediments '77, A. S. C. E., p. 1073-1085.

APPENDIX

APL Programming

(APL functions and variables listed in full have been written by the author. All other functions and variables are copyrighted property of IBM and are not listed.)

```
      HOW
Enter ....GETDATA.....to access the Beaches and Shores profile data
file.  Obtain the FILE NAME, FILE TYPE, and FILE MODE of interest
and exit the CMS file by the PF3 key.  Type....SHAPE....and
enter the FILE NAME, TYPE, and MODE as requested.  When the computed
data compilation is complete clear the screen and type....RESULTS.
Note that the programs are written to be used in the APL Full Screen
mode, where the COPY ON ID FILENAME must be executed just before
....RESULTS....is initiated (be sure to COPY OFF before the )OFF HOLD
command).
```

```
      )FNS
ABSTRACT        AND     BOX     CHECKNAME       CLOSE   CLOSEALL        CMS
COIBM   CORR    CP      DOUBLE  GET     GETDATA GETFILE GETPEG  HOW     LINEAR
MEMBER  MSG     OBLANKS OPEN    PLO1    PREPARSE        PROC    PUT     PUTFILE
RESULTS RETRACT RNG     SHAPE   SHARES  SORTALF SORTALFV        TRANSDATE
TYPE    UCTRANS VCAT    XBLANKS
```

```
      )VARS
AA      ALPHA   ALPHANUM        BB      BRE72C  BRE72D  COLL73C D       DAT
DATA    DATE    DATF    DAY     DD      ID      II      IND72C  IND72D  L
MONTH   OPENFILES       PROCACC RNGNO   STJ82C  STJ82D  TABL    TITL    UCTI
WAL81C  WAL81D  X       X1      Y       YEAR    Y1      ΔPAI    ΔPCMD   ΔPDSK
ΔPQSAM  COLL    ERRDATA MSGW    RCODE
```

```
      ∇SHAPE[⎕]∇
      ∇ SHAPE;A1;A2;A3;B1;C;C6;E1;E2;E3;FN;FT;I;J;K;N;NOF;P;PRO;PROF;R1;R2;R3;S
        TR;Z1;CHK;CHK1
[1]   ⍝GET THE PROFILE DATA FROM THE CMS FILE AND FIND THE OFFSHORE DATA ONLY.
[2]    CLOSEALL
[3]    TABL←ID←P←DD←DATE←RNGNO←⍳0
[4]    'FILE NAME:'
[5]    FN←⍞
[6]    'FILE TYPE AND MODE:'
[7]    FT←⍞
[8]    FN OPEN FT,'(FIX 370'
[9]    TITL←GET FN
[10]  L3:P←(GET FN),(GET FN)
[11]   P←(80↓P),80↑P
[12]   PROF←PRO←CHK1←⍳0
[13]   I←1
[14]   NOF←⌈0.2×⍎N←P[105 106 107]
[15]   P[⍳8]
[16]  L1:PRO←PRO,GET FN
[17]   PRO←⌽5↓⌽PRO
[18]   I←I+1
[19]   →L1×⍳I<NOF+2
[20]   PRO←75↓PRO
[21]   J←1
[22]  L2:PROF←PROF,(⍎PRO[⍳7]),(⍎PRO[8+⍳7])
[23]   PRO←15↓PRO
[24]   J←J+1
[25]   →L2×⍳J<(⍎N)+1
[26]   DATA←(((⍴PROF)÷2),2)⍴PROF
```

```
[27]  CHK←DATA[;2]>0
[28]  L←1
[29] L4:CHK1←CHK1,CHK[L]×CHK[L+1]
[30]  L←L+1
[31]  →L4×⍳L≤((⍴CHK)-1)
[32]  X←(K←+/(+/CHK1)+1)↓DATA[;1]
[33]  Y←K↓DATA[;2]
[34]  X1←DATA[;1]
[35]  →L3×⍳(⍴X1)=K
[36]  Y1←DATA[;2]
[37]  (Y1[K],Y1[K+1]) LINEAR(X1[K],X1[K+1])
[38]  X←X-AA
[39]  X←1E¯6+(⌽(K←+/(X)1500))↓⌽X)
[40]  →L3×⍳(1↑⌽X)<800
[41]  Y←1E¯10+(|⌽K↓⌽Y)
[42] ⍝A = shape coeff.; B = exp.; R = corr. coeff.
[43] ⍝METHOD 1 -- EXPONENT NOT FIXED, REGULAR POWER CURVE FIT.
[44]  C←(+/⍟X),(+/((⍟X)*2)),(+/((⍟X)×(⍟Y))),(+/⍟Y),(+/((⍟Y)*2))
[45]  A1←*C6←((C[1]×C[3])-(C[2]×C[4]))÷((C[1]*2)-((⍴X)×C[2]))
[46]  B1←((C[1]×C[4])-((⍴X)×C[3]))÷((C[1]*2)-((⍴X)×C[2]))
[47]  Z1←A1×X*B1
[48]  R1←X CORR Z1
[49]  E1←((1÷⍴X)×(+/(Z1-Y)*2))*0.5
[50] ⍝METHOD 2 -- EXPONENT IS FIXED [I.E., EXP = 2/3]
[51] ⍝METHOD 2A -- DIRECT METHOD
[52]  A2←(+/(Y×(X*(2÷3))))÷(+/(X*(4÷3)))
[53]  Z1←A2×X*2÷3
[54]  R2←X CORR Z1
[55]  E2←((1÷⍴X)×(+/(Z1-Y)*2))*0.5
[56] ⍝METHOD 2B -- LOG METHOD
[57]  A3←*((C[4]-(C[1]×2÷3))÷⍴X)
[58]  Z1←A3×X*2÷3
[59]  R3←X CORR Z1
[60]  E3←((1÷⍴X)×(+/(Z1-Y)*2))*0.5
[61]  ⎕PP←4
[62]  STR←(⍎(5↑⍕B1)),(⍎(5↑⍕A1)),(⍎(5↑⍕E1)),(⍎(5↑⍕R1)),(⍎(5↑⍕A2)),(⍎(5↑⍕E2)),(⍎(
      5↑⍕R2)),(⍎(5↑⍕A3)),(⍎(5↑⍕E3))
[63]  TABL←TABL,STR
[64]  ID←ID,P[⍳8]
[65]  DD←DD,AA
[66]  DAY←P[96+⍳2]
[67]  MONTH←TRANSDATE P[98+⍳3]
[68]  YEAR←P[101+⍳2]
[69]  DATE←DATE,⍎(DAY,MONTH,YEAR)
[70]  RNGNO←RNGNO,RNG P[⍳8]
[71]  →L3
      ∇


      ∇GETDATA[⎕]∇
      ∇ GETDATA
[1]   CP 'LINK BEACHES 195 195 RR RBCHES'
[2]   CMS 'ACCESS 195 B'
[3]   CMS 'FLIST * * B'
      ∇


      ∇GETPEG[⎕]∇
      ∇ GETPEG
```

```
[1]   CP 'LINK PRP 191 193 RR RPEG'
[2]   CMS 'ACCESS 193 C'
[3]   CMS 'FLIST * * C'
      ∇


      ∇LINEAR[⎕]∇
      ∇ X LINEAR Y;Y;X
[1]   X←X
[2]   Y←Y
[3]   BB←(+/((X-((+/X)÷ρX))×Y))÷(+/((X-((+/X)÷ρX))*2))
[4]   AA←((+/Y)÷ρY)-(BB×((+/X)÷ρX))
      ∇


      ∇CORR[⎕]∇
      ∇ R←X CORR Y;A1;A2;A3;X;Y
[1]   A1←(+/(X×Y))-(((+/X)×(+/Y))÷ρX)
[2]   A2←(+/(X*2))-(((+/X)*2)÷ρX)
[3]   A3←(+/(Y*2))-(((+/Y)*2)÷ρX)
[4]   R←A1÷((A2×A3)*0.5)
      ∇


      ∇RNG[⎕]∇
      ∇ R←RNG N;L;B;C;I;A;STR
[1]   ⎕IO←1
[2]   A←STR← 10 1 ρ'0123456789'
[3]   L←ρN
[4]   I←1
[5]  L1:STR←STR,[2] A
[6]   I←I+1
[7]   →L1×ι(1↓ρSTR)<L
[8]   R←(10,L)ρN
[9]   B←R=STR
[10]  B←+/⍉B
[11]  I←Bι1
[12]  C←((I↓B)ι0)
[13]  R←C↑(I-1)↓N
[14]  R←⍎R
      ∇


      ∇TRANSDATE[⎕]∇
      ∇ MON←TRANSDATE X;N1;MOS;MON;X
[1]   N1←0
[2]   MOS←'JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC   '
[3]   →6×ι(+/X=MOS[N1+(1 2 3)])=3
[4]   N1←N1+1
[5]   →3
[6]   MON←⍕((N1+3)÷3))
      ∇


      ∇RESULTS[⎕]∇
      ∇ RESULTS;J;I;K;INTRO;DATA1;DATA2;DATA3;DATA4;DATA5;DATA6;DATA7;DATA8;DAT
        A9;DAT1;MAXDATE;MINDATE
[1]   J←1+I←II←0
[2]   K←(ρTABL)÷9
```

```
      ⎕PP←10
      DAT1←DATE÷1000000
      →L10×⍳(⍴DAT1)=0
      DAT1←DAT1[⍋DAT1]
     L5:'                OFFSHORE PROFILE POWER CURVE FITS'
      ''
      TITL
      MAXDATE←⍕DAT1[⍴DAT1]
      MINDATE←⍕DAT1[1]
      'Offshore Survey Dates (mo,day,yr):  ',⍕MINDATE[2+⍳6],' to ',⍕MAXDATE[2+⍳6],'.'
      'b = exponent; a = shape coefficient; r = correlation coefficient'
      '(r for the fixed exp data applies to both direct and log methods);'
      'e    = RMS error.'
      ' rms'
      '-----------------------------------------------------------------------'
      '|        |Zero |  EXPONENT NOT FIXED    |     EXPONENT FIXED AT 2/3     |'
      '|  DNR   |NGVD |                        |                               |'
      '|  Ref   |Dist |                        |Direct Method |  Log Method    |'
      '|  Mon   |from |   b     a     e      r |  a     e      r      a     e  |'
      '|  No    |Monu |              rms       |       rms                 rms |'
      '-----------------------------------------------------------------------'
      →L4×⍳(I≠0)∧((K-I)<5)
      →L1×⍳I≠0
      DATA←(K,9)⍴TABL
      INTRO←((K,8)⍴ID),[2]((⍕(K,1)⍴DD)[;⍳6])
      DATA1←(⍕(K,1)⍴DATA[;1])[;⍳6]
      DATA2←(⍕(K,1)⍴DATA[;2])[;⍳6]
      DATA3←(⍕(K,1)⍴DATA[;3])[;⍳6]
      DATA4←(⍕(K,1)⍴DATA[;4])[;⍳6]
      DATA5←(⍕(K,1)⍴DATA[;5])[;⍳6]
      DATA6←(⍕(K,1)⍴DATA[;6])[;⍳6]
      DATA7←(⍕(K,1)⍴DATA[;7])[;⍳6]
      DATA8←(⍕(K,1)⍴DATA[;8])[;⍳6]
      DATA9←(⍕(K,1)⍴DATA[;9])[;⍳6]
      DATF←INTRO,[2] DATA1,[2] DATA2,[2] DATA3,[2] DATA4,[2] DATA5,[2] DATA6,[2] DATA7,[2] DATA8,[2] DATA9
      →L4×⍳(K-I)<5
     L1:DATF[I+⍳5;]
      →L3×⍳I=(II+(30×J))
      ''
      I←I+5
      →L1×⍳I<(5×⌊K÷5)
      →L4×⍳I<K
      →0×⍳I=(5×⍳⌊K÷5)
     L4:I←I+1
     L2:DATF[I;]
      I←I+1
      →L2×⍳I≤K
     L3:J←J+1
      I←I+5
      II←II+5
      ''
      ''
      →L5×⍳I<K
      →0
     L10:'THERE IS NO OFFSHORE PROFILE DATA FOR THIS SURVEY'
      ∇
```

GETPLOT

In order to produce a plot of the surveyed profile and the superimposed best fit power curve profile, invoke program PLOTT and provide the needed input. Once PLOTT is completed save the results. Then)LOAD 2 GRAPHPAK and)COPY PROFILE X Y PLO. Execute PLO and provide the requested input. Put the plot in a CMS file as required by GRAPHPAK.

```
      ∇PLOTT[⎕]∇
      ∇ PLOTT;A1;A2;A3;B1;C;C6;E1;E2;E3;FN;FT;I;J;K;N;NOF;P;PRO;PROF;R1;R2;R3;S
        TR;Z1;CHK;CHK1
[1]   ⍝GET THE PROFILE DATA FROM THE CMS FILE AND FIND THE OFFSHORE DATA ONLY.
[2]    CLOSEALL
[3]    TABL←ID←P←DD←DATE←RNGNO←⍳0
[4]    'FILE NAME:'
[5]    FN←⍞
[6]    'FILE TYPE AND MODE:'
[7]    FT←⍞
[8]    'WHICH RANGE MONUMENT NUMBER DO YOU WANT?'
[9]    RNGNO←⎕
[10]   FN OPEN FT,'(FIX 370'
[11]   TITL←GET FN
[12]  L3:P←(GET FN),(GET FN)
[13]   P←(80↓P),80↑P
[14]   PROF←PRO←CHK1←⍳0
[15]   I←1
[16]   NOF←⌈0.2×⍎N←P[105 106 107]
[17]   P[⍳8]
[18]  L1:PRO←PRO,GET FN
[19]   PRO←⌽5↓⌽PRO
[20]   I←I+1
[21]   →L1×⍳I<NOF+2
[22]   PRO←75↓PRO
[23]   J←1
[24]  L2:PROF←PROF,(⍎PRO[⍳7]),(⍎PRO[8+⍳7])
[25]   PRO←15↓PRO
[26]   J←J+1
[27]   →L2×⍳J<(⍎N)+1
[28]   DATA←(((⍴PROF)÷2),2)⍴PROF
[29]   CHK←DATA[;2]>0
[30]   L←1
[31]  L4:CHK1←CHK1,CHK[L]×CHK[L+1]
[32]   L←L+1
[33]   →L4×⍳L≤((⍴CHK)-1)
[34]   X←(K←+/(+/CHK1)+1)↓DATA[;1]
[35]   Y←K↓DATA[;2]
[36]   X1←DATA[;1]
[37]   →L3×⍳(⍴X1)=K
[38]   Y1←DATA[;2]
[39]   (Y1[K],Y1[K+1]) LINEAR(X1[K],X1[K+1])
[40]   X←X-AA
[41]   X←1E¯6+(⌽(K←+/(X)1500))↓⌽X)
[42]   →L3×⍳(1↑⌽X)<800
[43]   Y←1E¯10+(|⌽K↓⌽Y)
[44]   →L3×⍳RNGNO≠(RNG P[⍳8])
[45]   ID←P[⍳8]
```

```
∇

∇PLO[⎕]∇
∇ PLO
[1]   'ENTER ALL REQUESTED INFO IN THE LOWER CASE MODE.'
[2]   'COUNTY NAME:'
[3]   CN←⍞
[4]   'SURVEY DATE:'
[5]   DATE←⍞
[6]   'RANGE ID:'
[7]   ID←⍞
[8]   'SCALE COEFF (I.E., A):'
[9]   A←⎕
[10]  'SHAPE COEFF (I.E., EXP):'
[11]  B←⎕
[12]  'RMS ERROR:'
[13]  RMS←⎕
[14]  ERASE
[15]  RESTORE
[16]  Y←0,¯1×Y
[17]  YA←0,¯1×A×X*B
[18]  X←0,X
[19]  PC←'∘x.'
[20]  SVP← 10 3 96 45
[21]  PA←STYLE 1 9 ,COLOR 7 7
[22]  PLOT(Y VS X) AND(YA VS X) AND(Y[⍴Y]×2) VS 0
[23]  'P' SPLOT(Y VS X) AND(YA VS X) AND(Y[⍴Y]×2) VS 0
[24]  1 ANNX 'Distance Offshore in Feet'
[25]  ¯100 ANNY 'Elev in Ft NGVD'
[26]  (((X[⍴X])×0.8),((Y[⍴Y])×0.3)) TITLE(CN,' County ',ID)
[27]  (((X[⍴X])×0.3),(Y[⍴Y])) TITLE('∘  Surveyed in ',DATE)
[28]  (((X[⍴X])×0.3),((Y[⍴Y])×1.3)) TITLE('x  Best Fit Profile     ')
[29]  (((X[⍴X])×0.4),((Y[⍴Y])×1.45)) TITLE 'a  =  ',⍕A
[30]  (((X[⍴X])×0.4),((Y[⍴Y])×1.6)) TITLE 'b  =  ',⍕B
[31]  (((X[⍴X])×0.4),((Y[⍴Y])×1.75)) TITLE 'RMS error  =  ',⍕RMS
[32]  VIEW
∇
```