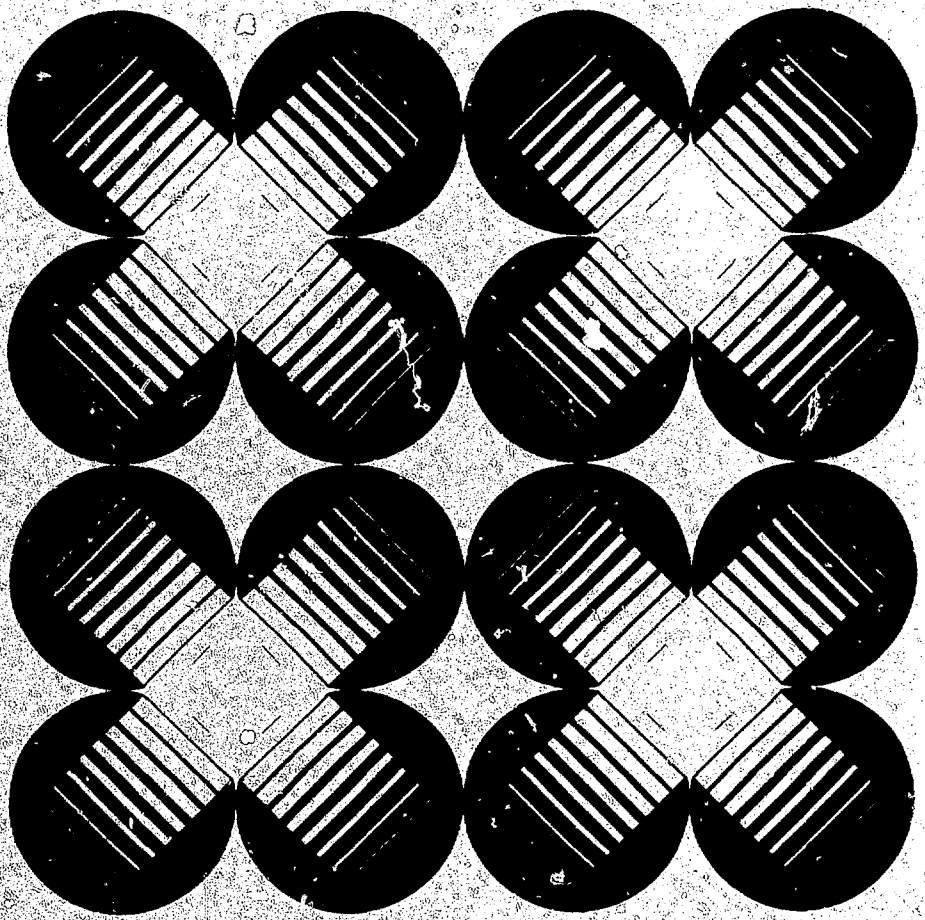
ANL/AA-8

A model for predicting fish impingement at cooling water intakes

Regional Studies Program

Energy/environmental assessments



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REGIONAL STUDIES PROGRAM

A MODEL FOR PREDICTING FISH IMPINGEMENT AT COOLING WATER INTAKES

by

Ishwar P. Murarka

Division of Environmental Impact Studies

January 1977

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

A MODEL FOR PREDICTING FISH IMPINGEMENT AT COOLING WATER INTAKES

by

Ishwar P. Murarka

ABSTRACT

A mathematical model has been developed to predict fish impingement at cooling water intakes at power plants. Conceptual development includes the formulation of mathematical functions that relate environmental factors to fish impingement. Although the impingement simulations shown in this report are theoretical, explicit forms of the component functions are being obtained. The model depends on fish behavior, abundance, water flow rates, and the intake structures. Additional work is necessary to obtain parameter values for various fish species and various environmental conditions.

INTRODUCTION

Most power plants with once-through cooling, and some with closed-cycle systems, draw water from rivers, lakes, and ponds where fish reside. Often a number of fish are killed by impingement on the protective screens of the water-intake structures. Various engineering designs are being developed in efforts to minimize the number of fish killed, but the situation continues to be of serious concern in environmental assessment work. Existing power plants monitor their water supplies and report fish kills, and applicants seeking plant construction permits predict impingement mortality as best they can on the basis of reports of such experience. However, to date not much effort has been devoted to the development of a formal mathematical model for predicting fish impingement. This paper reports the formulation of one such model.

1. FORMULATION OF THE MODEL

1.1 FACTORS AFFECTING FISH IMPINGEMENT

The entrapment of a live fish against a screen by a water velocity sufficient to prevent the fish's escape is the unit occurrence of concern. A systematic analysis of the occurrence leads to identification of the following causes and controlling factors:

- The existence of fish and an impact surface (screen) are necessary conditions.
- The flow of water through the screen with sufficient velocity to impinge fish is a cause.
- The abundance, size, and species of fish near the intake influence the quantity of fish impinged.
- The fish's behavior (swim speed, sensing ability, and other responses) influence the probability of impingement.
- Hydrologic and physical conditions of the intake region are other determinants.
- The location and design of the intake determine to what degree it is an "intensity region" for impingement.
- Obstructions that reduce the probability of a fish reaching the screen act as moderators.

It seems reasonable that a satisfactory first approximation of the impingement rate can be obtained by considering primarily the variables relating to fish abundance, fish behavior, water volume, and water velocity. Let us postpone, or ignore for the present, consideration of the design and location of the intake structure and the installation of devices intended to divert fish from the screens. As yet, intake and obstruction designs are in experimental stages. Their effectiveness is not established, but when it is, it will simply change the probability factor of the principal functions.

1.2 THE MODEL EQUATION

Three principal variables for determining the fish impingement rate were chosen and assembled by logic to form the following equation (model):

$$\dot{I}(t) = \sum_{i=1}^{k} P_i(t) \cdot Q(t) \cdot D_i(t). \qquad (1)$$

where:

$\dot{I}(t)$ = the total fish impingement rate at time t for all species of fish,

$P_i(t)$ = the probability that an individual fish of species i will be impinged on the screen at time t, given that the fish is present in a defined "zone of influence" or "intensity region,"

$Q(t)$ = the volume of the water entering the intake at time t, and

$D_i(t)$ = the number of fish of species i in a unit volume of water in the zone of influence at time t.

In this form the model is simply a probability-weighted product function: i.e., the density of the fish times the volume of the water times a probability element. To obtain the fish impingement rate at any time t, we obtain the rates for each species and add them to get the total for all species.

For a continuous case we can write an integral function of Equation 1 as:

$$I(t) = \int_t \dot{I}(x)dx = \int_t \left[\sum_{i=1}^{k} P_i(x) \cdot Q(x) \cdot D_i(x) \right] dx. \qquad (2)$$

Then, for an interval, say $\Delta t = t_1 - t_0$, a cumulative fish impingement value $[I(\Delta t)]$ is obtained by the integration of Equation 2 for the period t_0 to t_1:

$$I(\Delta t) = I(t_1) - I(t_0) = \int_{t_0}^{t_1} \dot{I}(x)dx$$

$$= \int_{t_0}^{t_1} \left[\sum_{i=1}^{k} \left[P_i(x) \cdot Q(x) \cdot D_i(x) \right] \right] dx.$$

$$= \sum_{i=1}^{k} \left[\int_{t_0}^{t_1} P_i(x) \cdot Q(x) \cdot D_i(x)dx \right]. \qquad (3)$$

In order to use the model, one must know the form of each of the three functions P_i, Q, and D_i. To formulate the functions precisely,

one must know the engineering details of the intake system and the behavioral characteristics of each species of fish involved. Alternatively, approximations based on empirical estimates may be used. Let us examine some explicit forms of these functions.

As for the probability function $P_i(t)$ in Equation 1, it is apparent that individuals of the same species face different degrees of risk at different times of the year. Large fish can swim faster and longer than smaller ones; the fish may be able to swim faster in warm water than in cold, etc. Yet it is possible for this function to be written as a combination of functions of water temperature (T), swimming speed (S), and velocity of the intake water (A) as follows:

$$P_i(t) = G_i(T,S_i,A) \tag{4}$$

Both S and A are continuous variables within certain limits, so we can integrate the function G_i over their domains. And since T is a function of time, we can replace it by an appropriate function f(t). Thus:

$$P_i(t) = \int_S \int_A G_i(T,S_i,A)\,dS\,dA = \int_S \int_A G_i\left[f(t),S_i,A\right] dS\,dA\ , \tag{5}$$

and the result is a time-dependent form of our original function $P_i(t)$. That is,

$$P_i(t) = \int_S \int_A G_i\left[f(t),S_i,A\right] dS\,dA\ . \tag{6}$$

Although we do not know the exact form of this function, we can make some assumptions and/or numerical simulations. A hypothetical form of this function is given in Fig. 1.

An example of Q(t) is given in Fig. 2. This shows water being pumped at a constant rate from time t_0 to t_1, then reduced. The rest of the figure shows four more changes at times t_2, t_3, t_4, and t_5. The function is continuous in time. It is considered typical of power plants if minor drifts and surges of the pumps are ignored.

The third function in Equation 1 is $D_i(t)$, the number of fish of species i per unit of water volume at any given time. It, too, is a function of

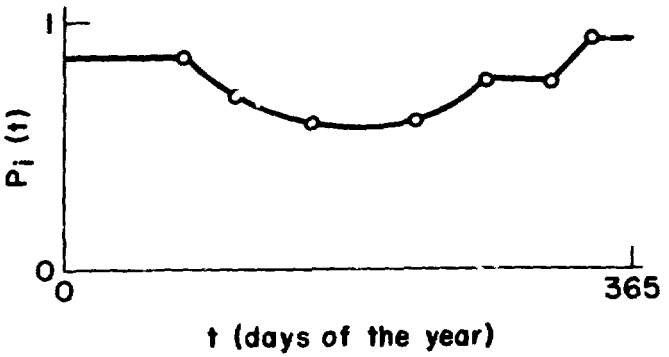

Fig. 1. A Hypothetical Form of $P_i(t)$.

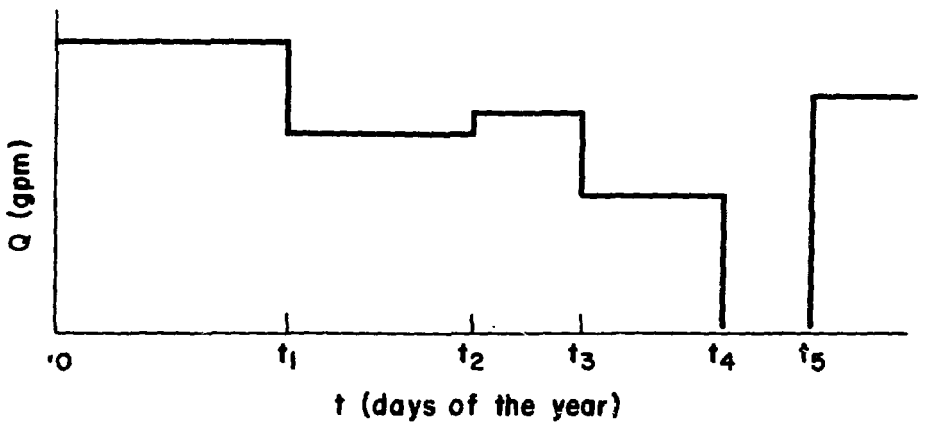

Fig. 2. A Hypothetical Tir -dependent Flow Function.

many variables. Biologists have been studying fish location for a number of years, but our knowledge is still restricted to some very broad generalities. For example, we know the time periods when some fish species (alewives, smelt, etc.) in Lake Michigan migrate toward shore and when they migrate to deep water. Such movements have been related to the temperature of the water, but additional factors, such as spawning drives, food supplies, feeding habits, etc., determine some of the seasonal migrations for a number of species.

An assumption that fish density distribution is a function of temperature does not quite provide a representable mathematical function. For example, once a fish migration toward shore has begun, actual temperature oscillations or temperature changes of a few degrees do not produce corresponding changes in the fish densities.

A reasonable expansion of the density function $D_i(t)$ is shown in the following equation:

$$D_i(t) = F_i(T,t,W,C,H) \ , \tag{7}$$

where T is temperature and is a function of time, i.e., $T = f(t)$,

t is time,

W is water quality parameter for use as circumstances demand,

C is the height of the water column, and

H is a food-supply and feeding-habit parameter for use as circumstances demand.

In this conceptualized form of the fish density function, most of the relationships cannot be expressed by a parsimonious mathematical function. Therefore, approximations can be made by the use of empirical measurements. Because of logistics, economics, and a number of assumptions regarding the measurements, we often have only a poor visualization of the quantitative distribution of the fish. Usually, fish density statistics are based on catch-per-unit-effort data, which have large measurement errors. Further, uncertainty arises from the unknown efficiency of sampling gear and the unknown probability laws that describe the randomness of the quantities and distributions of fish in a water body.

Some approximations and simulations based on Poisson probability functions have been incorporated to provide interpolations between measurements

in separate regions. In the verification stage of the modeling effort, we will look into the modifications of these approximations.

An example of a hypothetical $D_i(t)$ function is shown in Fig. 3.

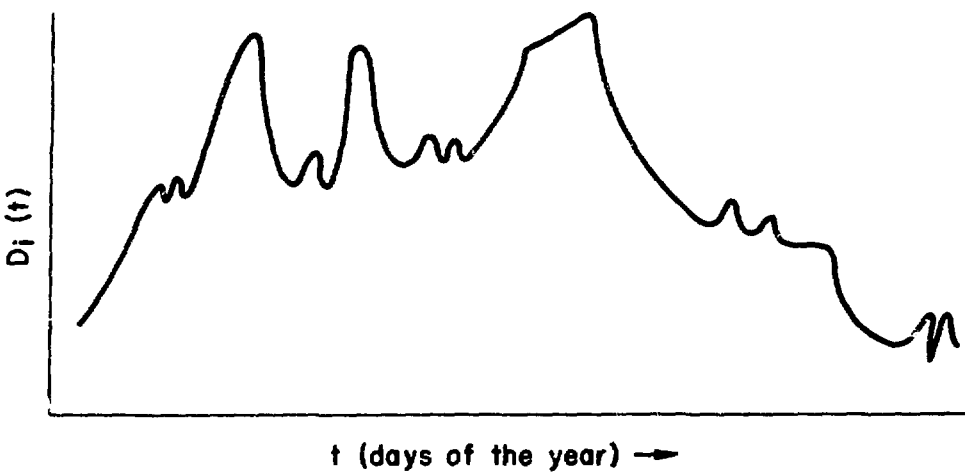

Fig. 3. A Hypothetical Form of the Density Function

1.3 SIMPLIFICATIONS AND GRAPHICAL ANALYSIS

Let us examine the function $\dot{I}(t)$ for various assumptions regarding $P_i(t)$, $Q(t)$, and $D_i(t)$. If we make the assumption that $P_i(t)$ is constant over time, we will get the following reduced form of $\dot{I}(t)$:

$$\dot{I}(t) = \sum_{i=1}^{k} P_i \cdot Q(t) \cdot D_i(t) \ . \tag{8}$$

So,

$$\dot{I}(t) = Q(t) \cdot \sum_{i=1}^{k} P_i \cdot D_i(t) \ . \tag{9}$$

Another assumption, if introduced, can be made to further simplify the equation. This assumption is that P_i's are constant for all species. That is,

$$\dot{I}(t) = P \cdot Q(t) \cdot \sum_{i=1}^{k} D_i(t) \tag{10}$$

Under this second assumption the sum of density functions over all species implies that all we need know is the number of fish per unit volume of water. No breakdown by species is necessary. This can be written as follows:

$$\dot{I}(t) = P \cdot Q(t) \cdot B(t) \ , \tag{11}$$

where

$$B(t) = \sum_{i=1}^{k} D_i(t) \ .$$

Equation 11 can then be written in a multiple linear regression form by making a logarithmic (natural base) transformation on both sides,

i.e., $$\log \dot{I}(t) = \log P + \log Q(t) + \log B(t) \ . \tag{12}$$

However, if we use a multiple regression analysis method, we will have modified the Equation 11 relationship, i.e.,

$$\log \dot{I}(t) = \log P + \beta_1 \log Q(t) + \beta_2 \log B(t) \ . \tag{13}$$

Alternatively, this equation can be written as

$$\dot{I}(t) = P \cdot Q(t)^{\beta_1} \cdot B(t)^{\beta_2} \ . \tag{14}$$

Now, if we make the further assumption that the value of P is equal to 1, we reduce the equation to the following:

$$\dot{I}(t) = Q(t) \cdot B(t) \ . \tag{15}$$

Another assumption--that the quantity of water flowing into the condensers is constant over time--will simply give the following result:

$$\dot{I}(t) = Q \cdot B(t) \ . \tag{16}$$

Hence, to obtain total impingement quantities for a period, say annually, the following mathematical operations will result in a very simple calculation.

$$I(\Delta t) = I(t_{365}) - I(t_0) = \int_{t_0}^{t_{365}} Q \cdot B(x)dx \ . \tag{17}$$

A discrete approximation of Equation 17 will give us the results of Equation 18.

$$I(\Delta t) = I(t_{365}) - I(t_0) = \begin{pmatrix}\text{total water pumped} \\ \text{during the year}\end{pmatrix} \cdot \begin{pmatrix}\text{mean fish density} \\ \text{during the year}\end{pmatrix} . \tag{18}$$

The above discussion involves a sequence of simplifications of the problem of predicting impingement for an entire year. However, the greater the number of assumptions, the greater the uncertainty about the predictive accuracy. The predictive accuracy of Equation 18 depends upon the accuracy of the fish density distribution function and the validity of the foregoing assumptions.

For predictive purposes, an approximate confidence interval under the assumption that mean fish density follows a normal distribution is given as in Equation 19.

$$\text{C.I (at 95\% confidence level)} = I(\Delta t) \pm [2 \cdot \text{S.D. of } I(\Delta t)] \ , \tag{19}$$

and

$$\text{S.D. of } I(\Delta t) = (\text{total water pumped}) \cdot (\text{S.D. of mean fish density}), \tag{20}$$

where S.D. denotes standard deviation.

If the size of the sample used to determine the mean fish-density statistic is large, we can assume from asymptotic theory that the normal probability distribution assumption will hold. Furthermore, with the large sample size the precision of the estimates will be high and the confidence intervals will consequently be smaller.

2. EMPIRICAL ESTIMATION OF THE FUNCTIONS IN THE MODEL

2.1 FLOW FUNCTION

Generally the flow function Q(t) is constant valued for any long period of time. This is particularly true for a base-load nuclear power plant. Depending on the power demand and the nature of the aquatic system, the waterflow for the plant may be regulated at two rates during the course of a year's time. As such, the explicit form of this flow-rate function can be given as:

$$Q(t) = \begin{cases} C_1 \text{ for } t_1 < t \leq t_2 \ , \\ C_2 \text{ for } t_2 < t \leq t_3 \ , \\ 0 \text{ for } t_3 < t \leq t_4 \ , \end{cases} \tag{21}$$

where C_1 and C_2 are constant flow rate values for a given plant in operation. The function Q(t) takes a value of zero when the plant is shut down for repairs, refueling, or any other reason.

2.2 FISH SPECIES DENSITY FUNCTION

As stated earlier, the density of a species of fish is governed by many variables. The explicit forms and the relationships of the biotic, abiotic, and fish distribution variables are not known at present, but an empirical approximation has been developed from a search of the literature.

A Poisson process may be used to model the temporal pattern of a given subpopulation. An extension can be made by means of a compound Poisson distribution that includes spatial distribution. This approach resulted in generating the fish density distribution on a daily basis by a mixture of Poisson random variables. The method is explained below.

Suppose that there are k observations available and that the data points are spread over a one-year period. Then, to obtain the interpolated daily values between successive observations, the formulation below is used. Because of the Poisson variable property, a single value is an unbiased estimate of the mean (μ) and variance (σ^2) of the distribution:

i.e., $$\mu = \lambda \ , \quad \text{and} \qquad (22)$$

$$\sigma^2 = \lambda \ .$$

Additionally, a successive value (for short time periods) would be heavily dependent on the previous observation. Fish density values on a daily basis are given by:

$$D_i(t) = \alpha\left[D_i\left(t_{j-1}\right) + Z_1 \sqrt{D_i\left(t_{j-1}\right)}\right] + (1-\alpha)\left[D_i\left(t_j\right) + Z_2 \sqrt{D_i\left(t_j\right)}\right] \qquad (23)$$

where $t_{j-1} \leq t \leq t_j$,

$0 \leq \alpha \leq 1$ and is equal to: $\left(t_j - t\right) / \left(t_j - t_{j-1}\right)$, and

Z is a uniformly distributed random variable between -1 and 1.

If $Z_1 = Z_2 = 0$, then linear smoothing is implied.

This non-linear smoothing is more effective when the successive observations are not very far apart. A desirable interval between successive observations is approximately a week to ten days. However, this approximation provides a satisfactory smoothing for observations even more than ten days apart. A linear smoothing is not very satisfactory. Comparisons between these two methods are being made by simulation of a number of conditions.

One major limitation of this smoothing procedure, and for that matter of any other smoothing operation, is the inability to predict an episodic event. That is, when a large, drastic change in fish distribution occurs because of some rare process the procedure will not be able to predict it.

2.3 PROBABILITY FUNCTION

The probability function is difficult to formulate explicitly; more research is needed before precise formulation is possible. However, an approximation can be made rather easily.

The probability, or risk function, is a reflection of the behavioral traits of the fishes and the modification of these traits induced by the hydrologic conditions. It is thought that for a first approximation, four factors may be sufficient to approximate the functional form rather closely. These factors are water temperature (T), swimming speed (S), water approach velocity (A), and fish size (L).

A general form of the probability function in these four variables can be written as:

$$P(t) = \left(\frac{T - T_{min}}{T_{max} - T_{min}}\right)\left(\frac{A - A_{min}}{A_{max} - A_{min}}\right)\left(\frac{S - S_{min}}{S_{max} - S_{min}}\right)\left(1 - \frac{L}{L_{max}}\right), \qquad (25)$$

and the value will lie between 0 and 1.

The ranges of the variables are:

$$T_{min} \leq T \leq T_{max}$$

$$\text{if } T < T_{min}, \text{ then } T = T_{min}$$

$$\text{if } T > T_{max}, \text{ then } T = T_{max}$$

$$A_{min} \leq A \leq A_{max}$$

if $A < A_{min}$, then $A = A_{min}$

if $A > A_{max}$, then $A = A_{max}$

$$S_{min} \leq S \leq S_{max}$$

if $S < S_{min}$, then $S = S_{min}$

if $S > S_{max}$, then $S = S_{max}$

$$L_{min} \leq L \leq L_{max}$$

if $L < L_{min}$, then $L = L_{min}$

if $L > L_{max}$, then $L = L_{max}$.

For this investigation, simulations based on assumed probability values have been carried out. More work is in progress which will involve the development of a statistical estimation procedure for generating the probability or risk function.

3. RESULTS AND DISCUSSION

Tables 1 through 4 and Figures 4 through 7 give the results of four simulations carried out utilizing the prediction model. Table 5 gives the set of assumptions for each simulation.

The results have a smooth and well-behaved nature. They are the expected daily values, so the true observations will vary about them. The different sets of assumptions change the predictions markedly. The most sensitive factor is the probability function. Interpolation of fish density measurements remains a gray area in this limited work effort.

Because no actual data were utilized to prepare impingement predictions, the model validation and tests are incomplete. After validation and perhaps some adjustments to function forms, the model could be adopted for prediction in the impact assessment work.

Table 1. Predicted Daily Fish Impingement: Simulation 1.

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
1/ 1/74	200	24	100	1000	0	1324
1/ 2/74	263	46	145	1141	0	1595
1/ 3/74	263	46	145	1141	0	1595
1/ 4/74	263	46	145	1141	0	1595
1/ 5/74	263	46	145	1141	0	1595
1/ 6/74	263	46	145	1141	0	1595
1/ 7/74	263	46	145	1141	0	1595
1/ 8/74	263	46	145	1141	0	1595
1/ 9/74	263	46	145	1141	0	1595
1/10/74	263	46	145	1141	0	1595
1/11/74	263	46	145	1141	0	1595
1/12/74	263	46	145	1141	0	1595
1/13/74	263	46	145	1141	0	1595
1/14/74	263	46	145	1141	0	1595
1/15/74	263	46	145	1141	0	1595
1/16/74	263	46	145	1141	0	1595
1/17/74	263	46	145	1141	0	1595
1/18/74	263	46	145	1141	0	1595
1/19/74	263	46	145	1141	0	1595
1/20/74	263	46	145	1141	0	1595
1/21/74	263	46	145	1141	0	1595
1/22/74	263	46	145	1141	0	1595
1/23/74	263	46	145	1141	0	1595
1/24/74	263	46	145	1141	0	1595
1/25/74	263	46	145	1141	0	1595
1/26/74	263	46	145	1141	0	1595
1/27/74	263	46	145	1141	0	1595
1/28/74	263	46	145	1141	0	1595
1/29/74	263	46	145	1141	0	1595
1/30/74	263	46	145	1141	0	1595
1/31/74	263	46	145	1141	0	1595
2/ 1/74	263	46	145	1141	0	1595
2/ 2/74	339	78	196	1318	0	1931
2/ 3/74	342	80	194	1343	0	1959
2/ 4/74	345	82	192	1369	0	1988
2/ 5/74	347	84	190	1394	0	2015
2/ 6/74	350	86	188	1419	0	2043
2/ 7/74	353	88	186	1445	0	2072
2/ 8/74	356	90	184	1470	0	2100
2/ 9/74	359	92	182	1495	0	2128
2/10/74	362	94	180	1521	0	2157
2/11/74	365	95	178	1546	0	2184
2/12/74	368	97	176	1572	0	2213
2/13/74	371	99	174	1597	0	2241
2/14/74	374	101	172	1622	0	2269
2/15/74	376	103	170	1648	0	2297
2/16/74	379	105	168	1673	0	2325
2/17/74	382	107	166	1698	0	2353

Table 1. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
2/18/74	385	109	164	1724	0	2382
2/19/74	388	111	162	1749	0	2410
2/20/74	391	113	160	1774	0	2438
2/21/74	394	115	158	1800	0	2467
2/22/74	397	117	155	1825	0	2494
2/23/74	400	118	153	1851	0	2522
2/24/74	403	120	151	1876	0	2550
2/25/74	406	122	149	1901	0	2578
2/26/74	408	124	147	1927	0	2606
2/27/74	411	126	145	1952	0	2634
2/28/74	414	128	143	1977	0	2662
3/ 1/74	417	130	141	2003	0	2691
3/ 2/74	420	132	139	2028	0	2719
3/ 3/74	423	134	137	2053	0	2747
3/ 4/74	426	136	135	2079	0	2776
3/ 5/74	429	138	133	2104	0	2804
3/ 6/74	432	140	131	2130	0	2833
3/ 7/74	435	142	129	2155	0	2861
3/ 8/74	438	143	127	2180	0	2888
3/ 9/74	440	145	125	2206	0	2916
3/10/74	443	147	123	2231	0	2944
3/11/74	446	149	121	2256	0	2972
3/12/74	449	151	119	2282	0	3001
3/13/74	452	153	117	2307	0	3029
3/14/74	455	155	114	2333	0	3057
3/15/74	458	157	112	2358	0	3085
3/16/74	461	159	110	2383	0	3113
3/17/74	464	161	108	2409	0	3142
3/18/74	467	163	106	2434	0	3170
3/19/74	470	165	104	2459	0	3198
3/20/74	472	167	102	2485	0	3226
3/21/74	475	168	100	2510	0	3253
3/22/74	478	170	98	2535	0	3281
3/23/74	481	172	96	2561	0	3310
3/24/74	484	174	94	2586	0	3338
3/25/74	487	176	92	2612	0	3367
3/26/74	490	178	90	2637	0	3395
3/27/74	493	180	88	2662	0	3423
3/28/74	496	182	86	2688	0	3452
3/29/74	499	184	84	2713	0	3480
3/30/74	501	186	82	2738	0	3507
3/31/74	504	188	80	2764	0	3536
4/ 1/74	507	190	78	2789	0	3564
4/ 2/74	641	249	120	2995	0	4005
4/ 3/74	674	246	124	2965	0	4009
4/ 4/74	708	244	127	2935	0	4014
4/ 5/74	741	241	131	2905	0	4018
4/ 6/74	774	239	134	2875	0	4022

Table 1. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
4/ 7/74	807	236	138	2845	0	4026
4/ 8/74	840	234	141	2815	0	4030
4/ 9/74	874	231	145	2785	0	4035
4/10/74	907	229	148	2755	0	4039
4/11/74	940	227	152	2725	0	4044
4/12/74	973	224	155	2694	0	4046
4/13/74	1007	222	159	2664	0	4052
4/14/74	1040	215	162	2634	0	4055
4/15/74	1073	217	166	2604	0	4060
4/16/74	1106	214	169	2574	0	4063
4/17/74	1139	212	173	2544	0	4068
4/18/74	1173	209	176	2514	0	4072
4/19/74	1206	207	180	2484	0	4077
4/20/74	1239	204	183	2454	0	4080
4/21/74	1272	202	187	2424	0	4085
4/22/74	1305	199	190	2394	0	4088
4/23/74	1339	197	194	2364	0	4094
4/24/74	1372	194	197	2334	0	4097
4/25/74	1405	192	201	2304	0	4102
4/26/74	1438	190	204	2273	0	4105
4/27/74	1471	187	208	2243	0	4109
4/28/74	1505	185	211	2213	0	4114
4/29/74	1538	182	215	2183	0	4118
4/30/74	1571	180	218	2153	0	4122
5/ 1/74	2246	248	310	2972	0	5776
5/ 2/74	2293	245	315	2930	0	5783
5/ 3/74	2339	241	320	2888	0	5788
5/ 4/74	2386	238	325	2846	0	5795
5/ 5/74	2432	234	330	2804	0	5800
5/ 6/74	2479	231	335	2762	0	5807
5/ 7/74	2525	227	339	2720	0	5811
5/ 8/74	2571	224	344	2678	0	5817
5/ 9/74	2618	221	349	2635	0	5823
5/10/74	2664	217	354	2593	0	5828
5/11/74	2711	214	359	2551	0	5835
5/12/74	2757	210	364	2509	0	5840
5/13/74	2804	207	369	2467	0	5847
5/14/74	2850	203	374	2425	0	5852
5/15/74	2897	200	378	2383	0	5858
5/16/74	2943	196	383	2341	0	5863
5/17/74	2990	193	388	2299	0	5870
5/18/74	3036	190	393	2257	0	5876
5/19/74	3083	186	398	2214	0	5881
5/20/74	3129	183	403	2172	0	5887
5/21/74	3176	179	408	2130	0	5893
5/22/74	3222	176	413	2088	0	5899
5/23/74	3269	172	417	2046	0	5904
5/24/74	3315	169	422	2004	0	5910

Table 1 (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
5/25/74	3362	165	427	1962	0	5916
5/26/74	3408	162	432	1920	0	5922
5/27/74	3455	159	437	1878	0	5929
5/28/74	3501	155	442	1835	0	5933
5/29/74	3548	152	447	1793	0	5940
5/30/74	3594	148	452	1751	0	5945
5/31/74	3641	145	456	1709	0	5951
6/ 1/74	3687	141	461	1667	0	5956
6/ 2/74	3986	205	569	1882	0	6642
6/ 3/74	3964	206	563	1880	0	6613
6/ 4/74	3942	206	556	1878	0	6582
6/ 5/74	3920	207	550	1877	0	6554
6/ 6/74	3897	208	544	1875	0	6524
6/ 7/74	3875	208	538	1874	0	6495
6/ 8/74	3853	209	531	1872	0	6465
6/ 9/74	3830	210	525	1871	0	6436
6/10/74	3808	211	519	1869	0	6407
6/11/74	3786	211	513	1868	0	6378
6/12/74	3764	212	506	1866	0	6348
6/13/74	3741	213	500	1864	0	6318
6/14/74	3719	213	494	1863	0	6289
6/15/74	3697	214	488	1861	0	6260
6/16/74	3675	215	481	1860	0	6231
6/17/74	3652	216	475	1858	0	6201
6/18/74	3630	216	469	1857	0	6172
6/19/74	3608	217	463	1855	0	6143
6/20/74	3585	218	456	1854	0	6113
6/21/74	3563	218	450	1852	0	6083
6/22/74	3541	219	444	1850	0	6054
6/23/74	3519	220	438	1849	0	6026
6/24/74	3496	221	431	1847	0	5995
6/25/74	3474	221	425	1846	0	5966
6/26/74	3452	222	419	1844	0	5937
6/27/74	3430	223	413	1843	0	5909
6/28/74	3407	223	406	1841	0	5877
6/29/74	3385	224	400	1840	0	5849
6/30/74	3363	225	394	1838	0	5820
7/ 1/74	3340	226	388	1837	0	5791
7/ 2/74	3318	226	381	1835	0	5760
7/ 3/74	3296	227	375	1833	0	5731
7/ 4/74	3274	228	369	1832	0	5703
7/ 5/74	3251	228	363	1830	0	5672
7/ 6/74	3229	229	356	1829	0	5643
7/ 7/74	3207	230	350	1827	0	5614
7/ 8/74	3185	231	344	1826	0	5586
7/ 9/74	3162	231	338	1824	0	5555
7/10/74	3140	232	331	1823	0	5526
7/11/74	3118	233	325	1821	0	5497

Table 1. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
7/12/74	3095	233	319	1819	0	5466
7/13/74	3073	234	313	1818	0	5438
7/14/74	3051	235	306	1816	0	5408
7/15/74	3029	236	300	1815	0	5380
7/16/74	3006	236	294	1813	0	5349
7/17/74	2984	237	288	1812	0	5321
7/18/74	2962	238	281	1810	0	5291
7/19/74	2940	238	275	1809	0	5262
7/20/74	2917	239	269	1807	0	5232
7/21/74	2895	240	263	1805	0	5203
7/22/74	2873	241	256	1804	0	5174
7/23/74	2850	241	250	1802	0	5143
7/24/74	2828	242	244	1801	0	5115
7/25/74	2806	243	238	1799	0	5086
7/26/74	2784	243	231	1798	0	5056
7/27/74	2761	244	225	1796	0	5026
7/28/74	2739	245	219	1795	0	4998
7/29/74	2717	246	213	1793	0	4969
7/30/74	2695	246	206	1792	0	4939
7/31/74	2672	247	200	1790	0	4909
8/ 1/74	2650	248	194	1788	0	4880
8/ 2/74	2628	248	188	1787	0	4851
8/ 3/74	2605	249	181	1785	0	4820
8/ 4/74	2583	250	175	1784	0	4792
8/ 5/74	2561	251	169	1782	0	4763
8/ 6/74	2539	251	163	1781	0	4734
8/ 7/74	2516	252	156	1779	0	4703
8/ 8/74	2494	253	150	1778	0	4675
8/ 9/74	2472	253	144	1776	0	4645
8/10/74	2450	254	138	1774	0	4616
8/11/74	2427	255	131	1773	0	4586
8/12/74	2405	256	125	1771	0	4557
8/13/74	2383	256	119	1770	0	4528
8/14/74	2360	257	113	1768	0	4498
8/15/74	2338	258	106	1767	0	4469
8/16/74	2316	258	100	1765	0	4439
8/17/74	2294	259	94	1764	0	4411
8/18/74	2271	260	88	1762	0	4381
8/19/74	2249	261	81	1760	0	4351
8/20/74	2227	261	75	1759	0	4322
8/21/74	2205	262	69	1757	0	4293
8/22/74	2182	263	63	1756	0	4264
8/23/74	2160	263	56	1754	0	4233
8/24/74	2138	264	50	1753	0	4205
8/25/74	2115	265	44	1751	0	4175
8/26/74	2093	266	38	1750	0	4147
8/27/74	2071	266	31	1748	0	4116
8/28/74	2049	267	25	1747	0	4088

Table 1. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
8/29/74	2026	268	19	1745	0	4058
8/30/74	2004	268	13	1743	0	4028
8/31/74	1982	269	6	1742	0	3999
9/ 1/74	1960	270	0	1740	0	3970
9/ 2/74	2199	355	0	1945	0	4499
9/ 3/74	2204	354	0	1929	0	4487
9/ 4/74	2208	353	0	1912	0	4473
9/ 5/74	2213	352	0	1896	0	4461
9/ 6/74	2218	350	0	1880	0	4448
9/ 7/74	2223	349	0	1864	0	4436
9/ 8/74	2228	348	0	1848	0	4424
9/ 9/74	2233	347	0	1831	0	4411
9/10/74	2238	345	0	1815	0	4398
9/11/74	2243	344	0	1799	0	4386
9/12/74	2248	343	0	1783	0	4374
9/13/74	2253	341	0	1767	0	4361
9/14/74	2257	340	0	1750	0	4347
9/15/74	2262	339	0	1734	0	4335
9/16/74	2267	338	0	1718	0	4323
9/17/74	2272	336	0	1702	0	4310
9/18/74	2277	335	0	1686	0	4298
9/19/74	2282	334	0	1669	0	4285
9/20/74	2287	333	0	1653	0	4273
9/21/74	2292	331	0	1637	0	4260
9/22/74	2297	330	0	1621	0	4248
9/23/74	2301	329	0	1604	0	4234
9/24/74	2306	327	0	1588	0	4221
9/25/74	2311	326	0	1572	0	4209
9/26/74	2316	325	0	1556	0	4197
9/27/74	2321	324	0	1540	0	4185
9/28/74	2326	322	0	1523	0	4171
9/29/74	2331	321	0	1507	0	4159
9/30/74	2336	320	0	1491	0	4147
10/ 1/74	2341	319	0	1475	0	4135
10/ 2/74	2345	317	0	1459	0	4121
10/ 3/74	2350	316	0	1442	0	4108
10/ 4/74	2355	315	0	1426	0	4096
10/ 5/74	2360	313	0	1410	0	4083
10/ 6/74	2365	312	0	1394	0	4071
10/ 7/74	2370	311	0	1378	0	4059
10/ 8/74	2375	310	0	1361	0	4046
10/ 9/74	2380	308	0	1345	0	4033
10/10/74	2385	307	0	1329	0	4021
10/11/74	2389	306	0	1313	0	4008
10/12/74	2394	305	0	1297	0	3996
10/13/74	2399	303	0	1280	0	3982
10/14/74	2404	302	0	1264	0	3970
10/15/74	2409	301	0	1248	0	3958

Table 1. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
10/16/74	2414	299	0	1232	0	3945
10/17/74	2419	298	0	1216	0	3933
10/18/74	2424	297	0	1199	0	3920
10/19/74	2429	296	0	1183	0	3908
10/20/74	2433	294	0	1167	0	3894
10/21/74	2438	293	0	1151	0	3882
10/22/74	2443	292	0	1134	0	3869
10/23/74	2448	290	0	1118	0	3856
10/24/74	2453	289	0	1102	0	3844
10/25/74	2458	288	0	1086	0	3832
10/26/74	2463	287	0	1070	0	3820
10/27/74	2468	285	0	1053	0	3806
10/28/74	2473	284	0	1037	0	3794
10/29/74	2477	283	0	1021	0	3781
10/30/74	2482	282	0	1005	0	3769
10/31/74	2487	280	0	989	0	3756
11/ 1/74	2492	279	0	972	0	3743
11/ 2/74	2497	278	0	956	0	3731
11/ 3/74	2502	276	0	940	0	3718
11/ 4/74	2507	275	0	924	0	3706
11/ 5/74	2512	274	0	908	0	3694
11/ 6/74	2517	273	0	891	0	3681
11/ 7/74	2522	271	0	875	0	3668
11/ 8/74	2526	270	0	859	0	3655
11/ 9/74	2531	269	0	843	0	3643
11/10/74	2536	268	0	827	0	3631
11/11/74	2541	266	0	810	0	3617
11/12/74	2546	265	0	794	0	3605
11/13/74	2551	264	0	778	0	3593
11/14/74	2556	262	0	762	0	3580
11/15/74	2561	261	0	746	0	3568
11/16/74	2566	260	0	729	0	3555
11/17/74	2570	259	0	713	0	3542
11/18/74	2575	257	0	697	0	3529
11/19/74	2580	256	0	681	0	3517
11/20/74	2585	255	0	664	0	3504
11/21/74	2590	254	0	648	0	3492
11/22/74	2595	252	0	632	0	3479
11/23/74	2600	251	0	616	0	3467
11/24/74	2605	250	0	600	0	3455
11/25/74	2610	248	0	583	0	3441
11/26/74	2614	247	0	567	0	3428
11/27/74	2619	246	0	551	0	3416
11/28/74	2624	245	0	535	0	3404
11/29/74	2629	243	0	519	0	3391
11/30/74	2634	242	0	502	0	3378
12/ 1/74	1885	172	0	347	0	2404
12/ 2/74	1888	171	0	336	0	2395

Table 1. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
12/ 3/74	1892	170	0	324	0	2386
12/ 4/74	1895	169	0	313	0	2377
12/ 5/74	1899	168	0	301	0	2368
12/ 6/74	1902	167	0	289	0	2358
12/ 7/74	1906	167	0	278	0	2351
12/ 8/74	1909	166	0	266	0	2341
12/ 9/74	1913	165	0	255	0	2333
12/10/74	1916	164	0	243	0	2323
12/11/74	1920	163	0	232	0	2315
12/12/74	1923	162	0	220	0	2305
12/13/74	1927	161	0	208	0	2296
12/14/74	1930	160	0	197	0	2287
12/15/74	1934	159	0	185	0	2278
12/16/74	1937	158	0	174	0	2269
12/17/74	1941	157	0	162	0	2260
12/18/74	1944	157	0	150	0	2251
12/19/74	1948	156	0	139	0	2243
12/20/74	1951	155	0	127	0	2233
12/21/74	1955	154	0	116	0	2225
12/22/74	1958	153	0	104	0	2215
12/23/74	1962	152	0	93	0	2207
12/24/74	1965	151	0	81	0	2197
12/25/74	1969	150	0	69	0	2188
12/26/74	1972	149	0	58	0	2179
12/27/74	1976	148	0	46	0	2170
12/28/74	1979	147	0	35	0	2161
12/29/74	1983	147	0	23	0	2153
12/30/74	1986	146	0	12	0	2144
12/31/74	1990	145	0	0	0	2135

Table 2. Predicted Daily Fish Impingement: Simulation 2.

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
1/ 1/74	100	18	150	1000	0	1268
1/ 2/74	132	34	217	1141	0	1524
1/ 3/74	132	34	217	1141	0	1524
1/ 4/74	132	34	217	1141	0	1524
1/ 5/74	132	34	217	1141	0	1524
1/ 6/74	132	34	217	1141	0	1524
1/ 7/74	132	34	217	1141	0	1524
1/ 8/74	132	34	217	1141	0	1524
1/ 9/74	132	34	217	1141	0	1524
1/10/74	132	34	217	1141	0	1524
1/11/74	132	34	217	1141	0	1524
1/12/74	132	34	217	1141	0	1524
1/13/74	132	34	217	1141	0	1524
1/14/74	132	34	217	1141	0	1524
1/15/74	132	34	217	1141	0	1524
1/16/74	132	34	217	1141	0	1524
1/17/74	132	34	217	1141	0	1524
1/18/74	132	34	217	1141	0	1524
1/19/74	132	34	217	1141	0	1524
1/20/74	132	34	217	1141	0	1524
1/21/74	132	34	217	1141	0	1524
1/22/74	132	34	217	1141	0	1524
1/23/74	132	34	217	1141	0	1524
1/24/74	132	34	217	1141	0	1524
1/25/74	132	34	217	1141	0	1524
1/26/74	132	34	217	1141	0	1524
1/27/74	132	34	217	1141	0	1524
1/28/74	132	34	217	1141	0	1524
1/29/74	132	34	217	1141	0	1524
1/30/74	132	34	217	1141	0	1524
1/31/74	132	34	217	1141	0	1524
2/ 1/74	132	34	217	1141	0	1524
2/ 2/74	169	59	295	1318	0	1841
2/ 3/74	171	60	292	1343	0	1866
2/ 4/74	172	61	289	1369	0	1891
2/ 5/74	174	63	285	1394	0	1916
2/ 6/74	175	64	282	1419	0	1940
2/ 7/74	177	66	279	1445	0	1967
2/ 8/74	178	67	276	1470	0	1991
2/ 9/74	180	69	273	1495	0	2017
2/10/74	181	70	270	1521	0	2042
2/11/74	182	72	267	1546	0	2067
2/12/74	184	73	264	1572	0	2093
2/13/74	185	74	261	1597	0	2117
2/14/74	187	76	258	1622	0	2143
2/15/74	188	77	255	1648	0	2168
2/16/74	190	79	252	1673	0	2194
2/17/74	191	80	249	1698	0	2218

Table 2. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
2/18/74	193	82	246	1724	0	2245
2/19/74	194	83	242	1749	0	2268
2/20/74	196	85	239	1774	0	2294
2/21/74	197	86	236	1800	0	2319
2/22/74	198	87	233	1825	0	2343
2/23/74	200	89	230	1851	0	2370
2/24/74	201	90	227	1876	0	2394
2/25/74	203	92	224	1901	0	2420
2/26/74	204	93	221	1927	0	2445
2/27/74	206	95	218	1952	0	2471
2/28/74	207	96	215	1977	0	2495
3/ 1/74	209	98	212	2003	0	2522
3/ 2/74	210	99	209	2028	0	2546
3/ 3/74	212	100	206	2053	0	2571
3/ 4/74	213	102	202	2079	0	2596
3/ 5/74	214	103	199	2104	0	2620
3/ 6/74	216	105	196	2130	0	2647
3/ 7/74	217	106	193	2155	0	2671
3/ 8/74	219	108	190	2180	0	2697
3/ 9/74	220	109	187	2206	0	2722
3/10/74	222	110	184	2231	0	2747
3/11/74	223	112	181	2256	0	2772
3/12/74	225	113	178	2282	0	2798
3/13/74	226	115	175	2307	0	2823
3/14/74	227	116	172	2333	0	2848
3/15/74	229	118	169	2358	0	2874
3/16/74	230	119	166	2383	0	2898
3/17/74	232	121	162	2409	0	2924
3/18/74	233	122	159	2434	0	2948
3/19/74	235	123	156	2459	0	2973
3/20/74	236	125	153	2485	0	2999
3/21/74	238	126	150	2510	0	3024
3/22/74	239	128	147	2535	0	3049
3/23/74	241	129	144	2561	0	3075
3/24/74	242	131	141	2586	0	3100
3/25/74	243	132	138	2612	0	3125
3/26/74	245	134	135	2637	0	3151
3/27/74	246	135	132	2662	0	3175
3/28/74	248	136	129	2688	0	3201
3/29/74	249	138	126	2713	0	3226
3/30/74	251	139	123	2738	0	3251
3/31/74	252	141	119	2764	0	3276
4/ 1/74	254	142	116	2789	0	3301
4/ 2/74	321	187	181	2995	0	3684
4/ 3/74	337	185	186	2965	0	3673
4/ 4/74	354	183	191	2935	0	3663
4/ 5/74	370	181	196	2905	0	3652
4/ 6/74	387	179	202	2875	0	3643

Table 2. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
4/ 7/74	404	177	207	2845	0	3633
4/ 8/74	420	175	212	2815	0	3622
4/ 9/74	437	174	217	2785	0	3613
4/10/74	453	172	222	2755	0	3602
4/11/74	470	170	228	2725	0	3593
4/12/74	487	168	233	2694	0	3582
4/13/74	503	166	238	2664	0	3571
4/14/74	520	164	243	2634	0	3561
4/15/74	536	162	249	2604	0	3551
4/16/74	553	161	254	2574	0	3542
4/17/74	570	159	259	2544	0	3532
4/18/74	586	157	264	2514	0	3521
4/19/74	603	155	270	2484	0	3512
4/20/74	620	153	275	2454	0	3502
4/21/74	636	151	280	2424	0	3491
4/22/74	653	150	285	2394	0	3482
4/23/74	669	148	290	2364	0	3471
4/24/74	686	146	296	2334	0	3462
4/25/74	703	144	301	2304	0	3452
4/26/74	719	142	306	2273	0	3440
4/27/74	736	140	311	2243	0	3430
4/28/74	752	138	317	2213	0	3420
4/29/74	769	137	322	2183	0	3411
4/30/74	786	135	327	2153	0	3401
5/ 1/74	1123	186	465	2972	0	4746
5/ 2/74	1146	184	472	2930	0	4732
5/ 3/74	1170	181	480	2888	0	4719
5/ 4/74	1193	178	487	2846	0	4704
5/ 5/74	1216	176	494	2804	0	4690
5/ 6/74	1239	173	502	2762	0	4676
5/ 7/74	1263	171	509	2720	0	4663
5/ 8/74	1286	168	516	2678	0	4648
5/ 9/74	1309	165	524	2635	0	4633
5/10/74	1332	163	531	2593	0	4619
5/11/74	1355	160	538	2551	0	4604
5/12/74	1379	158	546	2509	0	4592
5/13/74	1402	155	553	2467	0	4577
5/14/74	1425	153	560	2425	0	4563
5/15/74	1448	150	568	2383	0	4549
5/16/74	1472	147	575	2341	0	4535
5/17/74	1495	145	582	2299	0	4521
5/18/74	1518	142	590	2257	0	4507
5/19/74	1541	140	597	2214	0	4492
5/20/74	1565	137	604	2172	0	4478
5/21/74	1588	134	612	2130	0	4464
5/22/74	1611	132	619	2088	0	4450
5/23/74	1634	129	626	2046	0	4435
5/24/74	1658	127	633	2004	0	4422

Table 2. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
5/25/74	1681	124	641	1962	0	4408
5/26/74	1704	121	648	1920	0	4393
5/27/74	1727	119	655	1878	0	4379
5/28/74	1751	116	663	1835	0	4365
5/29/74	1774	114	670	1793	0	4351
5/30/74	1797	111	677	1751	0	4336
5/31/74	1820	109	685	1709	0	4323
6/ 1/74	1844	106	692	1667	0	4309
6/ 2/74	1993	154	853	1882	0	4882
6/ 3/74	1982	154	844	1880	0	4860
6/ 4/74	1971	155	834	1878	0	4838
6/ 5/74	1960	155	825	1877	0	4817
6/ 6/74	1949	156	816	1875	0	4796
6/ 7/74	1938	156	806	1874	0	4774
6/ 8/74	1926	157	797	1872	0	4752
6/ 9/74	1915	157	788	1871	0	4731
6/10/74	1904	158	778	1869	0	4709
6/11/74	1893	158	769	1868	0	4688
6/12/74	1882	159	759	1866	0	4666
6/13/74	1871	160	750	1864	0	4645
6/14/74	1860	160	741	1863	0	4624
6/15/74	1848	161	731	1861	0	4601
6/16/74	1837	161	722	1860	0	4580
6/17/74	1826	162	713	1858	0	4559
6/18/74	1815	162	703	1857	0	4537
6/19/74	1804	163	694	1855	0	4516
6/20/74	1793	163	684	1854	0	4494
6/21/74	1782	164	675	1852	0	4473
6/22/74	1770	164	666	1850	0	4450
6/23/74	1759	165	656	1849	0	4429
6/24/74	1748	165	647	1847	0	4407
6/25/74	1737	166	638	1846	0	4387
6/26/74	1726	167	628	1844	0	4365
6/27/74	1715	167	619	1843	0	4344
6/28/74	1704	168	609	1841	0	4322
6/29/74	1693	168	600	1840	0	4301
6/30/74	1681	169	591	1838	0	4279
7/ 1/74	1670	169	581	1837	0	4257
7/ 2/74	1659	170	572	1835	0	4236
7/ 3/74	1648	170	563	1833	0	4214
7/ 4/74	1637	171	553	1832	0	4193
7/ 5/74	1626	171	544	1830	0	4171
7/ 6/74	1615	172	534	1829	0	4150
7/ 7/74	1603	172	525	1827	0	4127
7/ 8/74	1592	173	516	1826	0	4107
7/ 9/74	1581	173	506	1824	0	4084
7/10/74	1570	174	497	1823	0	4064
7/11/74	1559	175	488	1821	0	4043

Table 2. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
7/12/74	1548	175	478	1819	0	4020
7/13/74	1537	176	469	1818	0	4000
7/14/74	1525	176	459	1816	0	3976
7/15/74	1514	177	450	1815	0	3956
7/16/74	1503	177	441	1813	0	3934
7/17/74	1492	178	431	1812	0	3913
7/18/74	1481	178	422	1810	0	3891
7/19/74	1470	179	413	1809	0	3871
7/20/74	1459	179	403	1807	0	3848
7/21/74	1448	180	394	1805	0	3827
7/22/74	1436	180	384	1804	0	3804
7/23/74	1425	181	375	1802	0	3783
7/24/74	1414	181	366	1801	0	3762
7/25/74	1403	182	356	1799	0	3740
7/26/74	1392	183	347	1798	0	3720
7/27/74	1381	183	338	1796	0	3698
7/28/74	1370	184	328	1795	0	3677
7/29/74	1358	184	319	1793	0	3654
7/30/74	1347	185	309	1792	0	3633
7/31/74	1336	185	300	1790	0	3611
8/ 1/74	1325	186	291	1788	0	3590
8/ 2/74	1314	186	281	1787	0	3568
8/ 3/74	1303	187	272	1785	0	3547
8/ 4/74	1292	187	263	1784	0	3526
8/ 5/74	1280	188	253	1782	0	3503
8/ 6/74	1269	188	244	1781	0	3482
8/ 7/74	1258	189	234	1779	0	3460
8/ 8/74	1247	190	225	1778	0	3440
8/ 9/74	1236	190	216	1776	0	3418
8/10/74	1225	191	206	1774	0	3396
8/11/74	1214	191	197	1773	0	3375
8/12/74	1203	192	188	1771	0	3354
8/13/74	1191	192	178	1770	0	3331
8/14/74	1180	193	169	1768	0	3310
8/15/74	1169	193	159	1767	0	3288
8/16/74	1158	194	150	1765	0	3267
8/17/74	1147	194	141	1764	0	3246
8/18/74	1136	195	131	1762	0	3224
8/19/74	1125	195	122	1760	0	3202
8/20/74	1113	196	113	1759	0	3181
8/21/74	1102	196	103	1757	0	3158
8/22/74	1091	197	94	1756	0	3138
8/23/74	1080	198	84	1754	0	3116
8/24/74	1069	198	75	1753	0	3095
8/25/74	1058	199	66	1751	0	3074
8/26/74	1047	199	56	1750	0	3052
8/27/74	1035	200	47	1748	0	3030
8/28/74	1024	200	38	1747	0	3009

Table 2. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
8/29/74	1013	201	28	1745	0	2987
8/30/74	1002	201	19	1743	0	2965
8/31/74	991	202	9	1742	0	2944
9/ 1/74	980	202	0	1740	0	2922
9/ 2/74	1099	267	0	1945	0	3311
9/ 3/74	1102	266	0	1929	0	3297
9/ 4/74	1104	265	0	1912	0	3281
9/ 5/74	1107	264	0	1896	0	3267
9/ 6/74	1109	263	0	1880	0	3252
9/ 7/74	1112	262	0	1864	0	3238
9/ 8/74	1114	261	0	1848	0	3223
9/ 9/74	1116	260	0	1831	0	3207
9/10/74	1119	259	0	1815	0	3193
9/11/74	1121	258	0	1799	0	3178
9/12/74	1124	257	0	1783	0	3164
9/13/74	1126	256	0	1767	0	3149
9/14/74	1129	255	0	1750	0	3134
9/15/74	1131	254	0	1734	0	3119
9/16/74	1134	253	0	1718	0	3105
9/17/74	1136	252	0	1702	0	3090
9/18/74	1138	251	0	1686	0	3075
9/19/74	1141	250	0	1669	0	3060
9/20/74	1143	249	0	1653	0	3045
9/21/74	1146	248	0	1637	0	3031
9/22/74	1148	247	0	1621	0	3016
9/23/74	1151	247	0	1604	0	3002
9/24/74	1153	246	0	1588	0	2987
9/25/74	1156	245	0	1572	0	2973
9/26/74	1158	244	0	1556	0	2958
9/27/74	1160	243	0	1540	0	2943
9/28/74	1163	242	0	1523	0	2928
9/29/74	1165	241	0	1507	0	2913
9/30/74	1168	240	0	1491	0	2899
10/ 1/74	1170	239	0	1475	0	2884
10/ 2/74	1173	238	0	1459	0	2870
10/ 3/74	1175	237	0	1442	0	2854
10/ 4/74	1178	236	0	1426	0	2840
10/ 5/74	1180	235	0	1410	0	2825
10/ 6/74	1183	234	0	1394	0	2811
10/ 7/74	1185	233	0	1378	0	2796
10/ 8/74	1187	232	0	1361	0	2780
10/ 9/74	1190	231	0	1345	0	2766
10/10/74	1192	230	0	1329	0	2751
10/11/74	1195	229	0	1313	0	2737
10/12/74	1197	228	0	1297	0	2722
10/13/74	1200	227	0	1280	0	2707
10/14/74	1202	226	0	1264	0	2692
10/15/74	1205	226	0	1248	0	2679

Table 2. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
10/16/74	1207	225	0	1232	0	2664
10/17/74	1209	224	0	1216	0	2649
10/18/74	1212	223	0	1199	0	2634
10/19/74	1214	222	0	1183	0	2619
10/20/74	1217	221	0	1167	0	2605
10/21/74	1219	220	0	1151	0	2590
10/22/74	1222	219	0	1134	0	2575
10/23/74	1224	218	0	1118	0	2560
10/24/74	1227	217	0	1102	0	2546
10/25/74	1229	216	0	1086	0	2531
10/26/74	1231	215	0	1070	0	2516
10/27/74	1234	214	0	1053	0	2501
10/28/74	1236	213	0	1037	0	2486
10/29/74	1239	212	0	1021	0	2472
10/30/74	1241	211	0	1005	0	2457
10/31/74	1244	210	0	989	0	2443
11/ 1/74	1246	209	0	972	0	2427
11/ 2/74	1249	208	0	956	0	2413
11/ 3/74	1251	207	0	940	0	2398
11/ 4/74	1253	206	0	924	0	2383
11/ 5/74	1256	205	0	908	0	2369
11/ 6/74	1258	204	0	891	0	2353
11/ 7/74	1261	204	0	875	0	2340
11/ 8/74	1263	203	0	859	0	2325
11/ 9/74	1266	202	0	843	0	2311
11/10/74	1268	201	0	827	0	2296
11/11/74	1271	200	0	810	0	2281
11/12/74	1273	199	0	794	0	2266
11/13/74	1275	198	0	778	0	2251
11/14/74	1278	197	0	762	0	2237
11/15/74	1280	196	0	746	0	2222
11/16/74	1283	195	0	729	0	2207
11/17/74	1285	194	0	713	0	2192
11/18/74	1288	193	0	697	0	2178
11/19/74	1290	192	0	681	0	2163
11/20/74	1293	191	0	664	0	2148
11/21/74	1295	190	0	648	0	2133
11/22/74	1297	189	0	632	0	2118
11/23/74	1300	188	0	616	0	2104
11/24/74	1302	187	0	600	0	2089
11/25/74	1305	186	0	583	0	2074
11/26/74	1307	185	0	567	0	2059
11/27/74	1310	184	0	551	0	2045
11/28/74	1312	183	0	535	0	2030
11/29/74	1315	183	0	519	0	2017
11/30/74	1317	182	0	502	0	2001
12/ 1/74	942	129	0	347	0	1418
12/ 2/74	944	128	0	336	0	1408

Table 2. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
12/ 3/74	946	128	0	324	0	1398
12/ 4/74	948	127	0	313	0	1388
12/ 5/74	949	126	0	301	0	1376
12/ 6/74	951	126	0	289	0	1366
12/ 7/74	953	125	0	278	0	1356
12/ 8/74	955	124	0	266	0	1345
12/ 9/74	956	124	0	255	0	1335
12/10/74	958	123	0	243	0	1324
12/11/74	960	122	0	232	0	1314
12/12/74	962	122	0	220	0	1304
12/13/74	963	121	0	208	0	1292
12/14/74	965	120	0	197	0	1282
12/15/74	967	119	0	185	0	1271
12/16/74	969	119	0	174	0	1262
12/17/74	970	118	0	162	0	1250
12/18/74	972	117	0	150	0	1239
12/19/74	974	117	0	139	0	1230
12/20/74	976	116	0	127	0	1219
12/21/74	977	115	0	116	0	1208
12/22/74	979	115	0	104	0	1198
12/23/74	981	114	0	93	0	1188
12/24/74	983	113	0	81	0	1177
12/25/74	984	113	0	69	0	1166
12/26/74	986	112	0	58	0	1156
12/27/74	988	111	0	46	0	1145
12/28/74	990	111	0	35	0	1136
12/29/74	991	110	0	23	0	1124
12/30/74	993	109	0	12	0	1114
12/31/74	995	109	0	0	0	1104

Table 3. Predicted Daily Fish Impingement: Simulation 3.

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
1/ 1/74	200	12	100	1000	0	1312
1/ 2/74	257	23	141	1117	0	1538
1/ 3/74	251	23	137	1094	0	1505
1/ 4/74	244	23	133	1071	0	1471
1/ 5/74	238	23	129	1048	0	1438
1/ 6/74	233	23	125	1026	0	1407
1/ 7/74	227	23	121	1005	0	1376
1/ 8/74	222	22	117	984	0	1345
1/ 9/74	216	22	114	964	0	1316
1/10/74	211	22	110	945	0	1288
1/11/74	206	22	107	925	0	1260
1/12/74	202	22	103	907	0	1234
1/13/74	197	22	100	889	0	1208
1/14/74	193	22	97	872	0	1184
1/15/74	188	22	93	855	0	1158
1/16/74	184	22	90	838	0	1134
1/17/74	180	22	87	823	0	1112
1/18/74	177	22	84	807	0	1090
1/19/74	173	22	81	793	0	1069
1/20/74	169	22	78	778	0	1047
1/21/74	166	22	75	765	0	1028
1/22/74	163	22	72	752	0	1009
1/23/74	160	22	70	739	0	991
1/24/74	157	22	67	727	0	973
1/25/74	154	22	64	715	0	955
1/26/74	152	22	62	704	0	940
1/27/74	149	21	59	693	0	922
1/28/74	147	21	57	683	0	908
1/29/74	145	21	54	673	0	893
1/30/74	143	21	52	664	0	880
1/31/74	141	21	50	655	0	867
2/ 1/74	139	21	47	647	0	854
2/ 2/74	177	36	61	737	0	1011
2/ 3/74	177	37	58	743	0	1015
2/ 4/74	177	38	55	748	0	1018
2/ 5/74	177	39	51	754	0	1021
2/ 6/74	177	39	48	760	0	1024
2/ 7/74	177	40	45	767	0	1029
2/ 8/74	178	41	42	774	0	1035
2/ 9/74	178	42	40	781	0	1041
2/10/74	179	43	37	788	0	1047
2/11/74	180	43	35	796	0	1054
2/12/74	181	44	32	804	0	1061
2/13/74	183	45	30	813	0	1071
2/14/74	184	46	28	822	0	1080
2/15/74	186	47	26	831	0	1090
2/16/74	187	47	24	841	0	1099
2/17/74	189	48	22	852	0	1111

Table 3. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
2/18/74	192	49	20	863	0	1124
2/19/74	194	50	18	875	0	1137
2/20/74	197	51	17	887	0	1152
2/21/74	199	52	15	899	0	1165
2/22/74	202	52	14	913	0	1181
2/23/74	206	53	12	927	0	1198
2/24/74	209	54	11	941	0	1215
2/25/74	212	55	10	957	0	1234
2/26/74	216	56	9	973	0	1254
2/27/74	220	56	8	989	0	1273
2/28/74	224	57	7	1006	0	1294
3/ 1/74	229	58	6	1024	0	1317
3/ 2/74	233	59	5	1043	0	1340
3/ 3/74	238	60	5	1063	0	1366
3/ 4/74	243	60	4	1083	0	1390
3/ 5/74	248	61	3	1104	0	1416
3/ 6/74	254	62	3	1126	0	1445
3/ 7/74	259	63	2	1149	0	1473
3/ 8/74	265	64	2	1172	0	1503
3/ 9/74	271	65	1	1196	0	1533
3/10/74	277	65	1	1221	0	1564
3/11/74	284	66	1	1247	0	1598
3/12/74	291	67	0	1274	0	1632
3/13/74	297	68	0	1302	0	1667
3/14/74	305	69	0	1331	0	1705
3/15/74	312	70	0	1360	0	1742
3/16/74	320	70	0	1390	0	1780
3/17/74	327	71	0	1422	0	1820
3/18/74	335	72	0	1454	0	1861
3/19/74	344	73	0	1487	0	1904
3/20/74	352	74	0	1521	0	1947
3/21/74	361	75	0	1556	0	1992
3/22/74	370	76	0	1592	0	2038
3/23/74	379	77	0	1629	0	2085
3/24/74	388	77	0	1667	0	2132
3/25/74	398	78	0	1706	0	2182
3/26/74	408	79	0	1746	0	2233
3/27/74	418	80	0	1787	0	2285
3/28/74	428	81	0	1829	0	2338
3/29/74	438	82	0	1872	0	2392
3/30/74	449	83	1	1916	0	2449
3/31/74	460	84	1	1961	0	2506
4/ 1/74	471	85	1	2007	0	2564
4/ 2/74	607	111	2	2186	0	2906
4/ 3/74	650	110	2	2195	0	2957
4/ 4/74	694	109	3	2203	0	3009
4/ 5/74	740	108	3	2212	0	3063
4/ 6/74	787	107	4	2220	0	3118

Table 3. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
4/ 7/74	835	106	5	2228	0	3174
4/ 8/74	885	105	6	2236	0	3232
4/ 9/74	936	104	6	2244	0	3290
4/10/74	989	103	7	2252	0	3351
4/11/74	1043	102	8	2259	0	3412
4/12/74	1098	101	9	2266	0	3474
4/13/74	1155	100	10	2272	0	3537
4/14/74	1214	99	11	2278	0	3602
4/15/74	1274	98	13	2284	0	3669
4/16/74	1335	97	14	2289	0	3735
4/17/74	1398	96	15	2294	0	3803
4/18/74	1462	95	17	2299	0	3873
4/19/74	1528	94	18	2303	0	3943
4/20/74	1596	93	20	2306	0	4015
4/21/74	1665	92	22	2309	0	4088
4/22/74	1735	91	23	2312	0	4161
4/23/74	1808	90	25	2314	0	4237
4/24/74	1881	89	27	2315	0	4312
4/25/74	1957	88	29	2316	0	4390
4/26/74	2033	87	31	2316	0	4467
4/27/74	2112	86	33	2316	0	4547
4/28/74	2192	85	36	2315	0	4628
4/29/74	2273	84	38	2313	0	4708
4/30/74	2357	83	41	2311	0	4792
5/ 1/74	3418	115	60	3231	0	6824
5/ 2/74	3539	114	64	3225	0	6942
5/ 3/74	3662	113	68	3219	0	7062
5/ 4/74	3787	111	72	3212	0	7182
5/ 5/74	3915	110	76	3204	0	7305
5/ 6/74	4045	108	80	3195	0	7428
5/ 7/74	4177	107	85	3184	0	7553
5/ 8/74	4311	106	89	3173	0	7679
5/ 9/74	4447	104	94	3160	0	7805
5/10/74	4586	103	99	3147	0	7935
5/11/74	4726	102	104	3132	0	8064
5/12/74	4869	100	109	3116	0	8194
5/13/74	5014	99	114	3099	0	8326
5/14/74	5161	97	120	3081	0	8459
5/15/74	5311	96	125	3062	0	8594
5/16/74	5462	94	131	3042	0	8729
5/17/74	5616	93	137	3020	0	8866
5/18/74	5771	92	143	2997	0	9003
5/19/74	5929	90	149	2973	0	9141
5/20/74	6089	89	155	2948	0	9281
5/21/74	6250	87	161	2921	0	9419
5/22/74	6414	86	168	2894	0	9562
5/23/74	6580	84	175	2865	0	9704
5/24/74	6747	83	181	2834	0	9845

Table 3. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
5/25/74	6917	82	189	2803	0	9991
5/26/74	7088	80	196	2770	0	10134
5/27/74	7262	79	203	2736	0	10280
5/28/74	7437	77	210	2701	0	10425
5/29/74	7614	76	218	2665	0	10573
5/30/74	7793	74	226	2627	0	10720
5/31/74	7973	73	234	2588	0	10868
6/ 1/74	8155	71	242	2548	0	11016
6/ 2/74	8903	103	305	2902	0	12213
6/ 3/74	8939	104	308	2926	0	12277
6/ 4/74	8974	105	312	2949	0	12340
6/ 5/74	9007	105	315	2973	0	12400
6/ 6/74	9039	106	318	2996	0	12459
6/ 7/74	9070	107	321	3019	0	12517
6/ 8/74	9099	108	324	3043	0	12574
6/ 9/74	9126	108	327	3065	0	12626
6/10/74	9153	109	329	3088	0	12679
6/11/74	9177	110	332	3110	0	12729
6/12/74	9201	111	334	3133	0	12779
6/13/74	9222	111	336	3155	0	12824
6/14/74	9243	112	339	3177	0	12871
6/15/74	9261	113	340	3198	0	12912
6/16/74	9278	114	342	3219	0	12953
6/17/74	9294	114	344	3241	0	12993
6/18/74	9308	115	345	3261	0	13029
6/19/74	9321	116	347	3282	0	13066
6/20/74	9332	117	348	3302	0	13099
6/21/74	9341	118	349	3322	0	13130
6/22/74	9349	118	350	3342	0	13159
6/23/74	9356	119	350	3362	0	13187
6/24/74	9360	120	351	3381	0	13212
6/25/74	9363	121	351	3400	0	13235
6/26/74	9365	122	352	3419	0	13258
6/27/74	9365	123	352	3437	0	13277
6/28/74	9363	123	352	3455	0	13293
6/29/74	9360	124	351	3473	0	13308
6/30/74	9355	125	351	3490	0	13321
7/ 1/74	9348	126	350	3507	0	13331
7/ 2/74	9340	127	350	3524	0	13341
7/ 3/74	9330	128	349	3540	0	13347
7/ 4/74	9319	129	348	3556	0	13352
7/ 5/74	9306	130	346	3572	0	13354
7/ 6/74	9291	131	345	3587	0	13354
7/ 7/74	9275	131	343	3602	0	13351
7/ 8/74	9257	132	342	3617	0	13348
7/ 9/74	9237	133	340	3631	0	13341
7/10/74	9216	134	338	3645	0	13333
7/11/74	9193	135	335	3658	0	13321

Table 3. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
7/12/74	9169	136	333	3671	0	13309
7/13/74	9143	137	330	3684	0	13294
7/14/74	9115	138	328	3696	0	13277
7/15/74	9086	139	325	3708	0	13258
7/16/74	9055	140	321	3719	0	13235
7/17/74	9023	141	318	3730	0	13212
7/18/74	8989	142	315	3741	0	13187
7/19/74	8953	143	311	3751	0	13158
7/20/74	8916	144	307	3760	0	13127
7/21/74	8877	145	303	3770	0	13095
7/22/74	8836	146	299	3778	0	13059
7/23/74	8794	147	295	3787	0	13023
7/24/74	8751	148	290	3794	0	12983
7/25/74	8706	150	286	3802	0	12944
7/26/74	8659	151	281	3809	0	12900
7/27/74	8611	152	276	3815	0	12854
7/28/74	8561	153	271	3821	0	12806
7/29/74	8510	154	265	3826	0	12755
7/30/74	8458	155	260	3831	0	12704
7/31/74	8404	156	254	3836	0	12650
8/ 1/74	8348	157	249	3839	0	12593
8/ 2/74	8291	158	243	3843	0	12535
8/ 3/74	8233	160	237	3846	0	12476
8/ 4/74	12595	161	230	3848	0	16834
8/ 5/74	12495	162	224	3850	0	16731
8/ 6/74	12395	163	217	3851	0	16626
8/ 7/74	12292	164	211	3852	0	16519
8/ 8/74	12189	166	204	3852	0	16411
8/ 9/74	12084	167	197	3851	0	16299
8/10/74	11978	168	190	3850	0	16186
8/11/74	11870	169	182	3849	0	16070
8/12/74	11762	170	175	3847	0	15954
8/13/74	11652	172	167	3844	0	15835
8/14/74	11540	173	160	3841	0	15714
8/15/74	11428	174	152	3837	0	15591
8/16/74	11314	175	144	3832	0	15465
8/17/74	11199	177	136	3827	0	15339
8/18/74	11083	178	127	3822	0	15210
8/19/74	10966	179	119	3815	0	15079
8/20/74	10848	181	111	3809	0	14949
8/21/74	10729	182	102	3801	0	14814
8/22/74	10608	183	93	3793	0	14677
8/23/74	10487	185	84	3784	0	14540
8/24/74	10364	186	75	3775	0	14400
8/25/74	10241	187	66	3765	0	14259
8/26/74	10116	189	57	3754	0	14116
8/27/74	9991	190	48	3743	0	13972
8/28/74	9865	192	39	3731	0	13827

Table 3. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
8/29/74	9738	193	29	3718	0	13678
8/30/74	9610	194	19	3705	0	13528
8/31/74	9481	196	10	3691	0	13378
9/ 1/74	9351	197	0	3677	0	13225
9/ 2/74	10465	261	0	4095	0	14821
9/ 3/74	10460	261	0	4047	0	14768
9/ 4/74	10452	262	0	3999	0	14713
9/ 5/74	10444	262	0	3949	0	14655
9/ 6/74	10433	262	0	3899	0	14594
9/ 7/74	10421	262	0	3849	0	14532
9/ 8/74	10407	263	0	3798	0	14468
9/ 9/74	10392	263	0	3747	0	14402
9/10/74	10374	263	0	3695	0	14332
9/11/74	10355	264	0	3643	0	14262
9/12/74	10334	264	0	3591	0	14189
9/13/74	10311	264	0	3538	0	14113
9/14/74	10287	264	0	3484	0	14035
9/15/74	10260	265	0	3430	0	13955
9/16/74	10232	265	0	3376	0	13873
9/17/74	10201	265	0	3322	0	13788
9/18/74	10169	265	0	3267	0	13701
9/19/74	10134	266	0	3211	0	13611
9/20/74	10098	266	0	3156	0	13520
9/21/74	10059	266	0	3100	0	13425
9/22/74	10019	266	0	3044	0	13329
9/23/74	9976	267	0	2988	0	13231
9/24/74	9931	267	0	2931	0	13129
9/25/74	9884	267	0	2874	0	13025
9/26/74	9835	267	0	2817	0	12919
9/27/74	9784	267	0	2760	0	12811
9/28/74	9730	268	0	2702	0	12700
9/29/74	9674	268	0	2645	0	12587
9/30/74	9616	268	0	2587	0	12471
10/ 1/74	9555	268	0	2529	0	12352
10/ 2/74	9493	269	0	2471	0	12233
10/ 3/74	9427	269	0	2413	0	12109
10/ 4/74	9359	269	0	2355	0	11983
10/ 5/74	9289	269	0	2297	0	11855
10/ 6/74	9217	269	0	2239	0	11725
10/ 7/74	9141	269	0	2181	0	11591
10/ 8/74	9064	270	0	2123	0	11457
10/ 9/74	8983	270	0	2065	0	11318
10/10/74	8901	270	0	2007	0	11178
10/11/74	12905	270	0	1949	0	15124
10/12/74	12826	270	0	1891	0	14987
10/13/74	12743	270	0	1834	0	14847
10/14/74	12658	271	0	1776	0	14705
10/15/74	12570	271	0	1719	0	14560

Table 3. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
10/16/74	12479	271	0	1662	0	14412
10/17/74	12386	271	0	1605	0	14262
10/18/74	12289	271	0	1548	0	14108
10/19/74	12190	271	0	1492	0	13953
10/20/74	12088	271	0	1436	0	13795
10/21/74	11983	272	0	1380	0	13635
10/22/74	11875	272	0	1325	0	13472
10/23/74	11764	272	0	1270	0	13306
10/24/74	11650	272	0	1215	0	13137
10/25/74	11532	272	0	1161	0	12965
10/26/74	11412	272	0	1107	0	12791
10/27/74	11289	272	0	1053	0	12614
10/28/74	11162	272	0	1001	0	12435
10/29/74	11032	272	0	948	0	12252
10/30/74	10899	272	0	896	0	12067
10/31/74	10763	272	0	845	0	11880
11/ 1/74	10623	272	0	795	0	11690
11/ 2/74	10480	273	0	745	0	11498
11/ 3/74	10334	273	0	695	0	11302
11/ 4/74	10184	273	0	647	0	11104
11/ 5/74	10031	273	0	599	0	10903
11/ 6/74	9874	273	0	551	0	10698
11/ 7/74	9714	273	0	505	0	10492
11/ 8/74	9551	273	0	459	0	10283
11/ 9/74	9383	273	0	414	0	10070
11/10/74	9213	273	0	370	0	9856
11/11/74	9038	273	0	327	0	9638
11/12/74	8860	273	0	285	0	9418
11/13/74	8678	273	0	243	0	9194
11/14/74	8492	273	0	203	0	8968
11/15/74	8303	273	0	164	0	8740
11/16/74	8110	273	0	125	0	8508
11/17/74	7913	272	0	88	0	8273
11/18/74	12120	272	0	52	0	12444
11/19/74	11923	272	0	17	0	12212
11/20/74	11723	272	0	0	0	11995
11/21/74	11518	272	0	0	0	11790
11/22/74	11310	272	0	0	0	11582
11/23/74	11097	272	0	0	0	11369
11/24/74	10880	272	0	0	0	11152
11/25/74	10659	272	0	0	0	10931
11/26/74	10434	272	0	0	0	10706
11/27/74	10205	272	0	0	0	10477
11/28/74	9971	271	0	0	0	10242
11/29/74	9733	271	0	0	0	10004
11/30/74	9491	271	0	0	0	9762
12/ 1/74	6603	194	0	0	0	6797
12/ 2/74	6423	193	0	0	0	6616

Table 3. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
12/ 3/74	6241	193	0	0	0	6434
12/ 4/74	6055	193	0	0	0	6248
12/ 5/74	5866	193	0	0	0	6059
12/ 6/74	5674	193	0	0	0	5867
12/ 7/74	5478	193	0	0	0	5671
12/ 8/74	5279	193	0	0	0	5472
12/ 9/74	5077	192	0	0	0	5269
12/10/74	4871	192	0	0	0	5063
12/11/74	4662	192	0	0	0	4854
12/12/74	4449	192	0	0	0	4641
12/13/74	4233	192	0	0	0	4425
12/14/74	4014	191	0	0	0	4205
12/15/74	3791	191	0	0	0	3982
12/16/74	3564	191	0	0	0	3755
12/17/74	6656	191	0	0	0	6847
12/18/74	6428	191	0	0	0	6619
12/19/74	6197	190	0	0	0	6387
12/20/74	5961	190	0	0	0	6151
12/21/74	5723	190	0	0	0	5913
12/22/74	5480	190	0	0	0	5670
12/23/74	5233	189	0	0	0	5422
12/24/74	4983	189	0	0	0	5172
12/25/74	4729	189	0	0	0	4918
12/26/74	4471	188	0	0	0	4659
12/27/74	4209	188	0	0	0	4397
12/28/74	3943	188	0	0	0	4131
12/29/74	3674	188	0	0	0	3862
12/30/74	3400	187	0	0	0	3587
12/31/74	3122	187	0	0	0	3309

Table 4. Predicted Daily Fish Impingement: Simulation 4.

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
1/ 1/74	4	5	79	0	0	88
1/ 2/74	17	11	92	0	0	120
1/ 3/74	33	17	99	0	0	149
1/ 4/74	51	23	107	1	0	182
1/ 5/74	72	31	114	1	0	218
1/ 6/74	97	40	121	1	1	260
1/ 7/74	126	50	128	2	1	307
1/ 8/74	158	61	134	2	1	356
1/ 9/74	194	74	139	3	1	411
1/10/74	234	88	144	3	1	470
1/11/74	248	96	155	5	2	506
1/12/74	250	97	156	5	3	511
1/13/74	252	98	157	5	3	515
1/14/74	254	99	158	5	3	519
1/15/74	255	100	159	6	3	523
1/16/74	257	101	160	6	3	527
1/17/74	259	102	161	6	4	532
1/18/74	261	103	162	6	4	536
1/19/74	263	104	162	6	4	539
1/20/74	265	105	163	6	4	543
1/21/74	280	114	175	9	6	584
1/22/74	282	116	176	9	6	589
1/23/74	284	117	177	9	7	594
1/24/74	286	118	178	9	7	598
1/25/74	288	119	179	9	7	602
1/26/74	290	120	180	10	7	607
1/27/74	291	121	181	10	8	611
1/28/74	293	122	182	10	8	615
1/29/74	295	123	183	10	8	619
1/30/74	297	124	184	10	8	623
1/31/74	299	126	185	11	9	630
2/ 1/74	301	127	186	11	9	634
2/ 2/74	303	128	187	11	9	638
2/ 3/74	305	129	188	11	10	643
2/ 4/74	307	130	189	12	10	648
2/ 5/74	309	131	190	12	10	652
2/ 6/74	311	132	191	12	10	656
2/ 7/74	313	134	192	12	11	662
2/ 8/74	314	135	193	12	11	665
2/ 9/74	316	136	194	13	11	670
2/10/74	318	137	195	13	12	675
2/11/74	320	138	196	13	12	679
2/12/74	322	140	197	13	12	684
2/13/74	324	141	198	14	12	689
2/14/74	326	142	199	14	13	694
2/15/74	328	143	199	14	13	697
2/16/74	330	144	200	14	13	701
2/17/74	332	146	201	15	14	708

Table 4. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
2/18/74	333	147	202	15	14	711
2/19/74	335	148	203	15	14	715
2/20/74	337	149	204	16	15	721
2/21/74	339	151	205	16	15	726
2/22/74	341	152	206	16	15	730
2/23/74	343	153	207	16	16	735
2/24/74	345	154	208	17	16	740
2/25/74	347	156	209	17	16	745
2/26/74	367	169	223	21	21	801
2/27/74	369	171	224	22	21	807
2/28/74	371	172	225	22	21	811
3/ 1/74	373	173	226	22	22	816
3/ 2/74	375	175	227	23	22	822
3/ 3/74	377	176	228	23	23	827
3/ 4/74	379	178	229	23	23	832
3/ 5/74	381	179	230	24	23	837
3/ 6/74	383	180	231	24	24	842
3/ 7/74	385	182	232	24	24	847
3/ 8/74	387	183	233	25	25	853
3/ 9/74	389	185	234	25	25	858
3/10/74	390	186	235	26	26	863
3/11/74	392	188	236	26	26	868
3/12/74	394	189	236	26	26	871
3/13/74	396	191	237	27	27	878
3/14/74	398	192	238	27	27	882
3/15/74	400	194	239	28	28	889
3/16/74	402	195	240	28	28	893
3/17/74	404	197	241	28	29	899
3/18/74	406	198	242	29	29	904
3/19/74	408	200	243	29	30	910
3/20/74	410	201	244	30	30	915
3/21/74	412	203	244	30	31	920
3/22/74	414	204	245	30	31	924
3/23/74	416	206	246	31	32	931
3/24/74	418	207	247	31	32	935
3/25/74	420	209	248	32	32	941
3/26/74	421	210	249	32	33	945
3/27/74	423	212	250	33	33	951
3/28/74	425	213	250	33	34	955
3/29/74	427	215	251	34	34	961
3/30/74	429	217	252	34	35	967
3/31/74	431	218	253	34	35	971
4/ 1/74	433	220	254	35	36	978
4/ 2/74	435	221	255	35	37	983
4/ 3/74	437	223	255	36	37	988
4/ 4/74	438	225	256	36	38	993
4/ 5/74	440	226	257	37	38	998
4/ 6/74	442	228	258	37	39	1004

Table 4. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
4/ 7/74	444	229	258	38	39	1008
4/ 8/74	446	231	259	38	40	1014
4/ 9/74	448	233	260	39	40	1020
4/10/74	449	234	261	39	41	1024
4/11/74	451	236	262	40	41	1030
4/12/74	453	238	262	40	42	1035
4/13/74	455	239	263	41	42	1040
4/14/74	457	241	264	41	43	1046
4/15/74	459	243	265	42	44	1053
4/16/74	460	244	265	42	44	1055
4/17/74	462	246	266	43	45	1062
4/18/74	464	248	267	43	45	1067
4/19/74	466	249	267	44	46	1072
4/20/74	468	251	268	45	46	1078
4/21/74	469	253	269	45	47	1083
4/22/74	471	255	270	46	48	1090
4/23/74	473	256	270	46	48	1093
4/24/74	475	258	271	47	49	1100
4/25/74	476	260	272	47	49	1104
4/26/74	478	261	272	48	50	1109
4/27/74	480	263	273	49	51	1116
4/28/74	482	265	274	49	51	1121
4/29/74	483	267	274	50	52	1126
4/30/74	485	269	275	50	52	1131
5/ 1/74	681	378	386	71	74	1590
5/ 2/74	684	381	387	72	75	1599
5/ 3/74	686	383	388	73	76	1606
5/ 4/74	686	386	388	74	77	1613
5/ 5/74	691	389	389	75	78	1622
5/ 6/74	693	391	390	76	79	1629
5/ 7/74	695	394	391	76	80	1636
5/ 8/74	698	396	392	77	81	1644
5/ 9/74	700	399	393	78	82	1652
5/10/74	702	401	394	79	82	1658
5/11/74	705	404	394	80	83	1666
5/12/74	707	406	395	81	84	1673
5/13/74	709	409	396	82	85	1681
5/14/74	711	412	397	83	86	1689
5/15/74	714	414	398	84	87	1697
5/16/74	716	417	398	85	88	1704
5/17/74	718	420	399	86	89	1712
5/18/74	720	422	400	87	90	1719
5/19/74	722	425	401	88	91	1727
5/20/74	725	427	401	89	92	1734
5/21/74	727	430	402	90	93	1742
5/22/74	729	433	403	91	94	1750
5/23/74	731	436	403	92	95	1757
5/24/74	733	438	404	93	96	1764

Table 4. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
5/25/74	735	441	405	94	97	1772
5/26/74	737	444	406	95	98	1780
5/27/74	740	446	406	96	99	1787
5/28/74	742	449	407	97	100	1795
5/29/74	744	452	408	98	101	1803
5/30/74	746	455	408	99	102	1810
5/31/74	748	457	409	100	103	1817
6/ 1/74	750	460	409	101	104	1824
6/ 2/74	752	463	410	102	105	1832
6/ 3/74	754	466	411	103	106	1840
6/ 4/74	756	469	411	104	107	1847
6/ 5/74	758	471	412	105	108	1854
6/ 6/74	760	474	412	106	109	1861
6/ 7/74	762	477	413	108	110	1870
6/ 8/74	764	480	413	109	112	1878
6/ 9/74	766	483	414	110	113	1886
6/10/74	767	486	415	111	114	1893
6/11/74	769	488	415	112	115	1899
6/12/74	771	491	416	113	116	1907
6/13/74	773	494	416	114	117	1914
6/14/74	775	497	417	116	118	1923
6/15/74	777	500	417	117	119	1930
6/16/74	779	503	418	118	120	1938
6/17/74	780	506	418	119	122	1945
6/18/74	782	509	418	120	123	1952
6/19/74	784	512	419	122	124	1961
6/20/74	786	515	419	123	125	1968
6/21/74	787	518	420	124	126	1975
6/22/74	789	521	420	125	127	1982
6/23/74	791	524	421	127	128	1991
6/24/74	792	526	421	128	130	1997
6/25/74	794	529	421	129	131	2004
6/26/74	796	532	422	130	132	2012
6/27/74	797	536	422	132	133	2020
6/28/74	799	539	422	133	134	2027
6/29/74	801	542	423	134	136	2036
6/30/74	802	545	423	136	137	2043
7/ 1/74	804	548	423	137	138	2050
7/ 2/74	805	551	424	138	139	2057
7/ 3/74	807	554	424	140	140	2065
7/ 4/74	808	557	424	141	142	2072
7/ 5/74	810	560	425	142	143	2080
7/ 6/74	811	563	425	144	144	2087
7/ 7/74	813	566	425	145	145	2094
7/ 8/74	814	569	425	146	147	2101
7/ 9/74	816	572	426	148	148	2110
7/10/74	817	576	426	149	149	2117
7/11/74	818	579	426	151	150	2124

Table 4. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
7/12/74	820	582	426	152	152	2132
7/13/74	821	585	426	153	153	2138
7/14/74	822	588	427	155	154	2146
7/15/74	824	591	427	156	155	2153
7/16/74	825	595	427	158	157	2162
7/17/74	826	598	427	159	158	2168
7/18/74	828	601	427	161	159	2176
7/19/74	829	604	427	162	161	2183
7/20/74	830	607	427	164	162	2190
7/21/74	831	611	427	165	163	2197
7/22/74	832	614	428	167	165	2206
7/23/74	834	617	428	168	166	2213
7/24/74	835	620	428	170	167	2220
7/25/74	836	624	428	171	169	2228
7/26/74	837	627	428	173	170	2235
7/27/74	838	630	428	174	171	2241
7/28/74	839	634	428	176	173	2250
7/29/74	840	637	428	178	174	2257
7/30/74	841	640	428	179	175	2263
7/31/74	842	643	428	181	177	2271
8/ 1/74	843	647	428	182	178	2278
8/ 2/74	844	650	428	184	180	2286
8/ 3/74	845	654	428	185	181	2294
8/ 4/74	846	657	428	187	182	2300
8/ 5/74	847	660	428	189	184	2308
8/ 6/74	848	664	428	191	185	2316
8/ 7/74	849	667	427	192	187	2322
8/ 8/74	849	670	427	194	188	2328
8/ 9/74	850	674	427	196	189	2336
8/10/74	851	677	427	197	191	2343
8/11/74	852	681	427	199	192	2351
8/12/74	852	684	427	201	194	2358
8/13/74	853	688	427	202	195	2365
8/14/74	854	691	426	204	197	2372
8/15/74	855	695	426	206	198	2380
8/16/74	855	698	426	208	199	2386
8/17/74	856	702	426	210	201	2395
8/18/74	856	705	426	211	202	2400
8/19/74	857	709	425	213	204	2408
8/20/74	858	712	425	215	205	2415
8/21/74	858	716	425	217	207	2423
8/22/74	859	719	425	219	208	2430
8/23/74	859	723	424	220	210	2436
8/24/74	859	726	424	222	211	2442
8/25/74	860	730	424	224	213	2451
8/26/74	860	733	424	226	214	2457
8/27/74	861	737	423	228	216	2465
8/28/74	861	741	423	230	218	2473

Table 4. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
8/29/74	861	744	423	232	219	2479
8/30/74	862	748	422	234	221	2487
8/31/74	862	751	422	235	222	2492
9/ 1/74	862	755	421	237	224	2499
9/ 2/74	863	759	421	239	225	2507
9/ 3/74	863	762	421	241	227	2514
9/ 4/74	863	766	420	243	228	2520
9/ 5/74	863	770	420	245	230	2528
9/ 6/74	863	773	419	247	232	2534
9/ 7/74	863	777	419	249	233	2541
9/ 8/74	863	781	418	251	235	2548
9/ 9/74	863	784	418	253	236	2554
9/10/74	863	788	418	255	238	2562
9/11/74	863	792	417	257	240	2569
9/12/74	863	795	417	259	241	2575
9/13/74	863	799	416	262	243	2583
9/14/74	863	803	415	264	244	2589
9/15/74	863	807	415	266	246	2597
9/16/74	863	811	414	268	248	2604
9/17/74	863	814	414	270	249	2610
9/18/74	863	818	413	272	251	2617
9/19/74	863	822	413	274	253	2625
9/20/74	862	826	412	276	254	2630
9/21/74	862	830	411	278	256	2637
9/22/74	862	833	411	281	258	2645
9/23/74	861	837	410	283	259	2650
9/24/74	861	841	410	285	261	2658
9/25/74	861	845	409	287	263	2665
9/26/74	860	849	408	289	264	2670
9/27/74	860	853	408	292	266	2679
9/28/74	859	856	407	294	268	2684
9/29/74	859	860	406	296	269	2690
9/30/74	858	864	405	298	271	2696
10/ 1/74	858	868	405	301	273	2705
10/ 2/74	857	872	404	303	275	2711
10/ 3/74	857	876	403	305	276	2717
10/ 4/74	856	880	402	308	278	2724
10/ 5/74	855	884	402	310	280	2731
10/ 6/74	855	888	401	312	281	2737
10/ 7/74	854	892	400	315	283	2744
10/ 8/74	853	896	399	317	285	2750
10/ 9/74	852	900	398	319	287	2756
10/10/74	852	904	398	322	289	2765
10/11/74	851	908	397	324	290	2770
10/12/74	850	912	396	327	292	2777
10/13/74	849	916	395	329	294	2783
10/14/74	848	920	394	332	296	2790
10/15/74	847	924	393	334	297	2795

Table 4. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
10/16/74	846	928	392	336	299	2801
10/17/74	845	932	391	339	301	2808
10/18/74	844	936	391	341	303	2815
10/19/74	843	940	390	344	305	2822
10/20/74	842	944	389	346	306	2827
10/21/74	778	874	353	307	279	2591
10/22/74	777	878	352	309	280	2596
10/23/74	775	881	351	311	282	2600
10/24/74	774	885	350	314	284	2607
10/25/74	773	889	349	316	285	2612
10/26/74	771	893	348	318	287	2617
10/27/74	770	897	347	321	289	2624
10/28/74	768	900	346	323	290	2627
10/29/74	767	904	345	325	292	2633
10/30/74	765	908	344	328	294	2639
10/31/74	763	912	343	330	296	2644
11/ 1/74	762	916	342	333	297	2650
11/ 2/74	760	920	341	335	299	2655
11/ 3/74	758	923	339	337	301	2658
11/ 4/74	757	927	338	340	303	2665
11/ 5/74	755	931	337	342	304	2669
11/ 6/74	753	935	336	345	306	2675
11/ 7/74	751	939	335	347	308	2680
11/ 8/74	750	943	334	350	310	2687
11/ 9/74	748	947	332	352	311	2690
11/10/74	746	951	331	355	313	2696
11/11/74	682	876	298	313	284	2453
11/12/74	680	880	296	315	286	2457
11/13/74	678	883	295	317	287	2460
11/14/74	676	887	294	319	289	2465
11/15/74	674	890	293	322	291	2470
11/16/74	672	894	291	324	292	2473
11/17/74	669	898	290	326	294	2477
11/18/74	667	901	289	329	296	2482
11/19/74	665	905	288	331	297	2486
11/20/74	662	909	286	333	299	2489
11/21/74	660	912	285	336	301	2494
11/22/74	658	916	284	338	302	2498
11/23/74	655	920	282	340	304	2501
11/24/74	653	923	281	343	306	2506
11/25/74	650	927	280	345	307	2509
11/26/74	648	931	278	347	309	2513
11/27/74	645	934	277	350	311	2517
11/28/74	642	938	276	352	312	2520
11/29/74	640	942	274	355	314	2525
11/30/74	637	945	273	357	316	2528
12/ 1/74	453	678	194	257	227	1809
12/ 2/74	451	681	193	259	228	1812

Table 4. (Contd)

DATE	SPECIES CODE NUMBER 1	2	3	4	5	TOTAL IMPINGMENT
12/ 3/74	449	683	192	260	229	1813
12/ 4/74	447	686	191	262	230	1816
12/ 5/74	445	689	190	264	232	1820
12/ 6/74	443	691	189	266	233	1822
12/ 7/74	441	694	188	268	234	1825
12/ 8/74	439	697	187	269	235	1827
12/ 9/74	437	699	186	271	237	1830
12/10/74	434	702	185	273	238	1832
12/11/74	432	705	183	275	239	1834
12/12/74	430	707	182	277	240	1836
12/13/74	428	710	181	279	242	1840
12/14/74	425	713	180	281	243	1842
12/15/74	423	716	179	282	244	1844
12/16/74	381	653	158	246	220	1658
12/17/74	381	653	158	246	220	1658
12/18/74	381	652	158	246	220	1657
12/19/74	380	652	158	245	219	1654
12/20/74	380	651	157	245	219	1652
12/21/74	380	651	157	245	219	1652
12/22/74	379	650	157	244	219	1649
12/23/74	379	650	157	244	219	1649
12/24/74	379	649	157	244	218	1647
12/25/74	378	649	157	244	218	1646
12/26/74	378	648	156	243	218	1643
12/27/74	378	648	156	243	218	1643
12/28/74	377	647	156	243	218	1641
12/29/74	377	647	156	242	217	1639
12/30/74	377	646	156	242	217	1638
12/31/74	376	646	156	242	217	1637

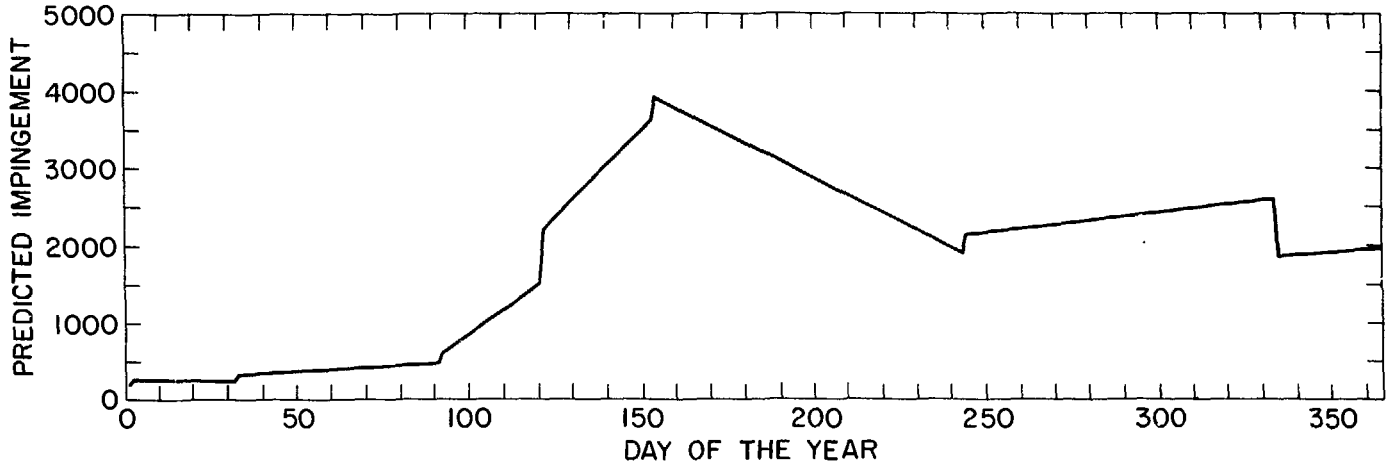

Fig. 4. Predicted Daily Fish Impingement: Simulation 1.

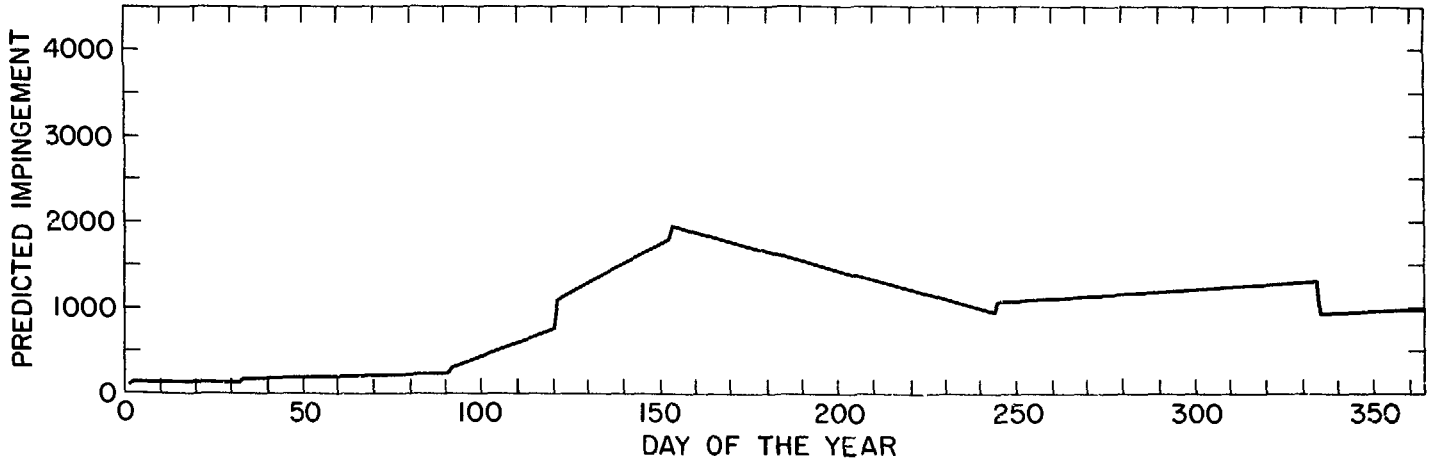

Fig. 5. Predicted Daily Fish Impingement: Simulation 2.

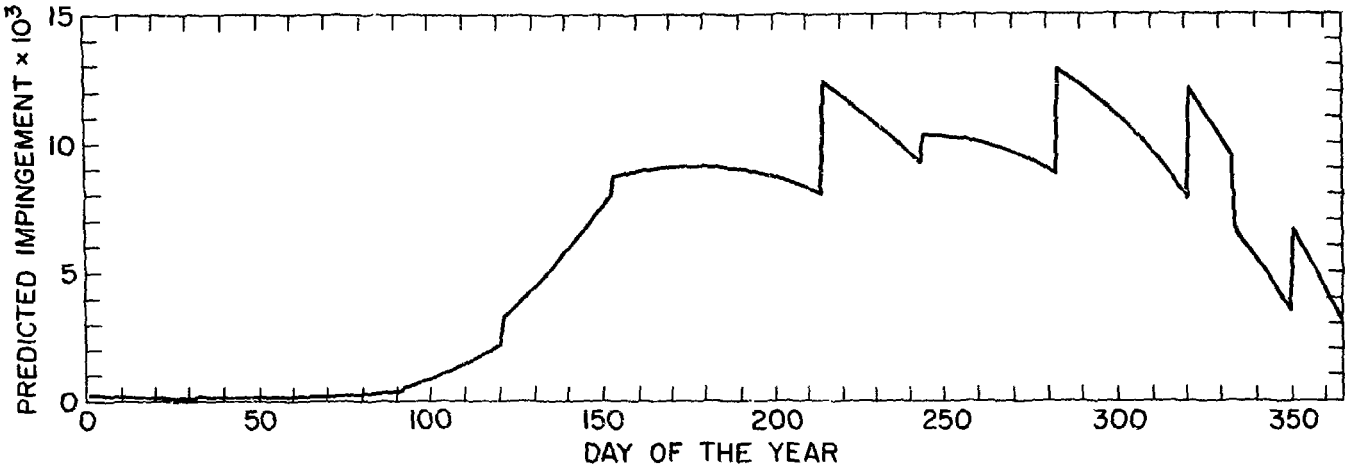

Fig. 6. Predicted Daily Fish Impingement: Simulation 3.

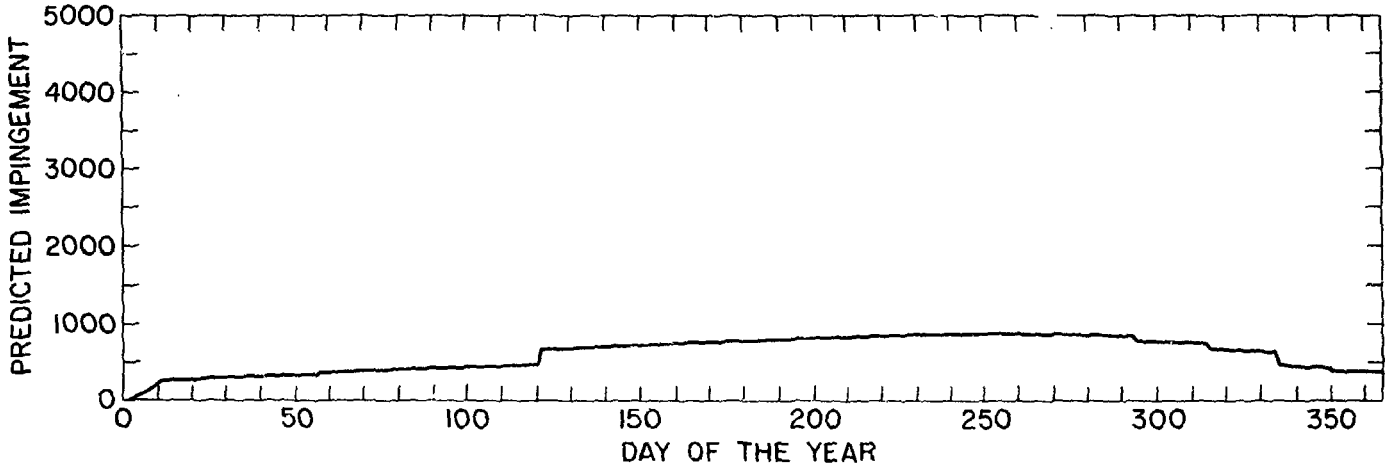

Fig. 7. Predicted Daily Fish Impingement: Simulation 4.

Table 5. Assumptions in Simulated Impingement Values for the Four Conditions

Function	Assumption
Flow function	Constant at the rate of 144 million gallons per day during the months of May through November. Constant at the rate of 100 million gallons per day during the months December through April.
Fish density	Assumed density values available at an interval of one month from April through November.
Probability or function	For Simulation One: Constant value of 0.2 used for all species and for the entire year.
	For Simulation Two: Constant value for each of the five species but different between species. Used values 0.1 for species 1, 0.15 for species 2, 0.3 for species 3, 0.2 for species 4, and 0.25 for species 5.
	For Simulation Three: Probability values variable over time: linearly decreasing from April to July, constant from August to September, linearly increasing from October to January, and constant for February to March.
	For Simulation Four: Probability values variable over time and between species: One species having highest impingement probability from April through July, another species having highest impingement probabilities during October through November.

4. CONCLUSIONS AND RECOMMENDATIONS

This simple model has incorporated the biological and physical conditions for determining expected daily fish impingements. It promises to be of value in environmental assessment work. At this stage the model-development process is complete through its first iteration. To complete the work further, several steps are recommended:

(1) That validation, testing, and modification be carried out and completed in the near future;

(2) That the model be expanded to incorporate age-specific impingement structure;

(3) That the model be corrected by expanding it with a fish population dynamics model, thereby enabling one to predict and evaluate the impact

(4) That empirical estimation be given further attention so that statistically reliable methods can be utilized in generating the various components of the model;

(5) That studies and investigations regarding the fish impingement probabilities be carried out.