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Quantitative Statistical Analysis for Problem Solving And Decision Making Project

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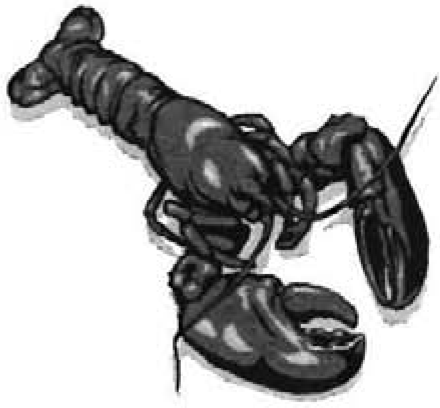
And Decision Making Project

12 Nov 00

By Anthony E. Baker

Johnson and Wales University MBA Program

Instructor: Martin W. Sivula Ph.D.



A Comparative Analysis of Government Regulations, Fishing Effort,

And Outside Influences on Lobster Landings for

The State of Rhode Island

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Thanks and Acknowledgements to the following people:

John H. Nagle, Supervisory Policy Analyst, Operations Group, Sustainable Fisheries Division, Northeast Regional Office, National Marine Fisheries Service who responding quickly and on his own time to my request for Federal Permit Data.

____________, Head Librarian at Johnson and Wales University reference library who tirelessly and diligently assisted me in located required rainfall and temperature data.

Bob Smith, Former President of the RI Lobsterman's Association who gave me guidance on where to search and whom to speak with in my efforts to locate data.

Margaret McGrath, Administrative Officer, Rhode Island Department of Environmental Management for responding quickly to my request for data on RI Lobster Licenses.

Donna Prout, friend and colleague who took the time to edit and critique my work before submission.

Quantative Statistical Analysis for Problem Solving Project Proposal
12 Nov 00
By Anthony E. Baker
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A) Background Information:
The National Marine Fisheries Service (NMFS) contends that increased regulation is required to save dwindling American Lobster stocks (Homarus Americanus) in the North Atlantic Region. Members of various trade organizations contend that the stocks are at the very least stable and probably growing. That cyclical rises and falls in the total biomass is a natural function and is altered more by pollution and habitat degradation than commercial fishing.

I intend to give an alternate theory through the use of research and statistical analysis as regards to harvest within the Rhode Island waters. These waters being defined as those within the Northeast and Southwest boundaries of NMFS Management Areas 2 and 3 that are covered by both state and federal jurisdiction.

B) The Stated Problem:
To what extent was [IV] **Lobster Production (1988-98)** in a given area altered by [I] Commercial Fishing Pressures, [II] Government Regulation, [III] Outside influences both natural and manmade?

C) Methodology:
1. I will first research **three sub-cases** gathering data from federal and state agency sources.
2. This data will be collated into data sets organized over time. (1988-98)
3. Each data set will have a corresponding histogram and time series plot created to display univariate relationships between data points within a data set.
4. These data sets will be compared to one another by overlaying the time series plots and using Pearson's Correlation scatter plots to determine what degree of correlation exists on a bivariate level.
5. The independent variable data sets stated in section **(D)** will be compared with the dependant variable data set **Lobster Landings in Pounds.**
6. I will then use the results of these **three sub-cases** as independent variables versus the dependent variable **Median Lobster Production (1988-98)** for the **objective case.**
7. These data sets will be compared to one another by overlaying the time series plots and using Pearson's Correlation scatter plots to determine what degree of correlation exists on a multivariate level.
8. A descriptive data set will be created to derive the coefficients, median, mean etc.
9. I will then create a linear model using a correlation matrix and r squared to draw inferences as to what extent all of the independent variables had on affecting the **Lobster Production (1988-98)** in the Rhode Island waters.
10. *Data will be entered hierarchical (chronologically) or step wise depending on the plots.

D) Cases:

I. Commercial Fishing Pressure 1988–98
Dependent Variable – **<u>Lobster Landings in Pounds (LL)</u>**
Independent Variables – Number of Federal Fishing Permits (FP)
Number of Traps Fished (TF)
Market Value of Catch (MV)

II. Government Regulation on Commercial Fishing 1988-98
Dependent Variable – **<u>Lobster Landings in Pounds (LL)</u>**
Independent Variables – Number of Traps Fished (TF)
State Licenses/Total Number of Fisherman (SL)
Government Regulation Value Factors (GR)

III. Outside Influences both Manmade and Natural 1988–98
Dependent Variable – **<u>Lobster Landings in Pounds (LL)</u>**
Independent Variables – Toxic Waste Released into the Water (TW)
Average Seasonal Air Temperature (AT)
Average Annual Rainfall (RF)

IV. The Effects of Cases I, II, III had on Lobster Production in RI 1988-98
Dependent Variable – **<u>Median Lobster Production in Pounds</u>**
Independent Variables – Commercial Fishing Pressure
Government Regulations
Outside Influences

E) Data Sources:
I intend to use some of and possibly all of the following sources. It is my professional belief that these sources are the most accurate and creditable.
- National Marine Fisheries Service
- Environmental Protection Agency
- The Northeast Fisheries Science Center
- New England Fisheries Management Council
- The National Climatic Data Center
- The National Oceanographic and Atmospheric Administration
- Rhode Department of Environmental Management
- Independent Surveys I Conduct

F) Criteria:
For the purpose of this study I have outlined general criteria to be followed so as to be able to have set parameters as benchmarks.
- All numeric data will be rounded to the nearest hundred or hundredth
- All sources of data will come from (E) Data Source list
- When two opposing sets of data or data points exist a mean or average will be determined and used.
- Documents and interviews will be cited in accordance with APA standards

Narrative:

The purpose of this project is to provide a first step in questioning the justification used for governmental intervention in the Lobster Fishing Industry. This justification being, "The decline in lobster stocks along the North Atlantic Coast".[1]

This project is NOT an exclusive scientific study. This project is NOT an exclusive socioeconomic study of the lobster industry. It does not use advanced models commonly used in either discipline. This project is a basic statistical study, which uses data provided by governmental agencies of both a scientific and economic nature and independent surveys I conducted. Using basic statistical analysis methods it compares the various data sets then draws basic logical inferences from the observations.

Steps:

1. I will first research **three sub-cases** gathering data from federal and state agency sources.
2. This data will be collated into data sets organized over time. (1988-98)
3. Each data set will have a corresponding histogram and time series plot created to display univariate relationships between data points within a data set.
4. These data sets will be compared to one another by overlaying the time series plots and using Pearson's Correlation scatter plots to determine what degree of correlation exists on a bivariate level.
5. The independent variable data sets stated in section **(D)** will be compared with the dependant variable data set **Lobster Landings in Pounds.**
6. I will then use the results of these **three sub-cases** as independent variables versus the dependent variable **Median Lobster Production (1988-98)** for the **objective case.**
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8. A descriptive data set will be created to derive the coefficients, median, mean etc.
9. I will then create a linear model using a correlation matrix and r squared to draw inferences as to what extent all of the independent variables had on affecting the **Lobster Production (1988-98)** in the Rhode Island waters.
10. *Data will be entered hierarchical (chronologically) or step wise depending on the plots.

Hypothesis To Be Tested:

The amount of lobsters being harvested in the State of RI is too great. The end result being the long-term decline in lobster stocks and in turn the overall lobsters landings. Therefore government regulations are required to control the number of lobsters harvested through measures such as permit/license limits, minimum size of lobsters legally harvested and overall fishing effort through the reduction of traps fished.

[1] Paraphrased from statements made by federal NMFS and NOAA officials at various hearings from 1996 to 1999 conducted with lobster fishing trade associations.

Background on Hypothesis:
Data is currently accumulated by federal sources[2] and used in federal models to predict the health of lobster stocks through random sampling. These models show a decline in lobster stocks over time leading to a prediction that the trend will continue unless actions are taken. Therefore it is the position of the NMFS that regulations are required to control fishing effort. These are taking place in the form of the curtailment of new lobster license issuance, the control and decrease in the number of traps fished, and the minimum size of lobsters allowed to be harvested.

Relations and Conclusions:
While it would be easy to draw conclusions from this study, the ability to show a direct causal relationship would require in depth scientific study drawing on various disciplines within the scientific community. Also, to increase the validity of this type of study it would require encompassing all the lobster producing states and the Canadian provinces as well as more detailed and in-depth data collection that time does not allow. The intent of this project is to give ***question*** to accepted governmental theories through the use of basic research and statistical analysis. If ***plausible*** alternate possibilities do exist, demonstrate ***possible*** other scenarios not considered by the governing authorities and scientific community. This in turn may bring into question the validity of the results produced by current models used by these various scientific and government organizations in order to justify the ramping up of regulations starting in 1994.

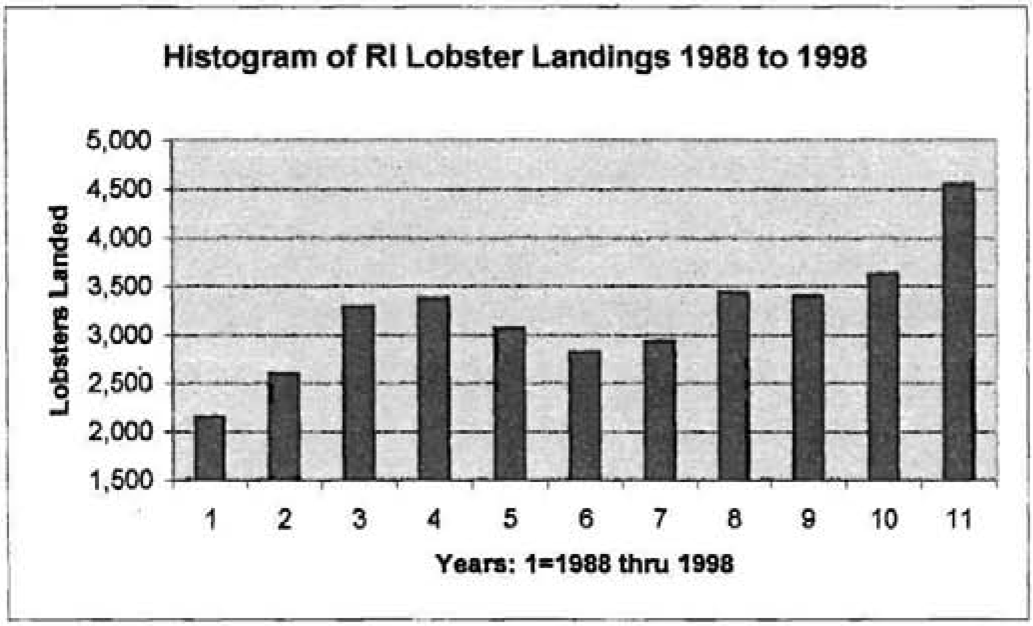
Assumptions:

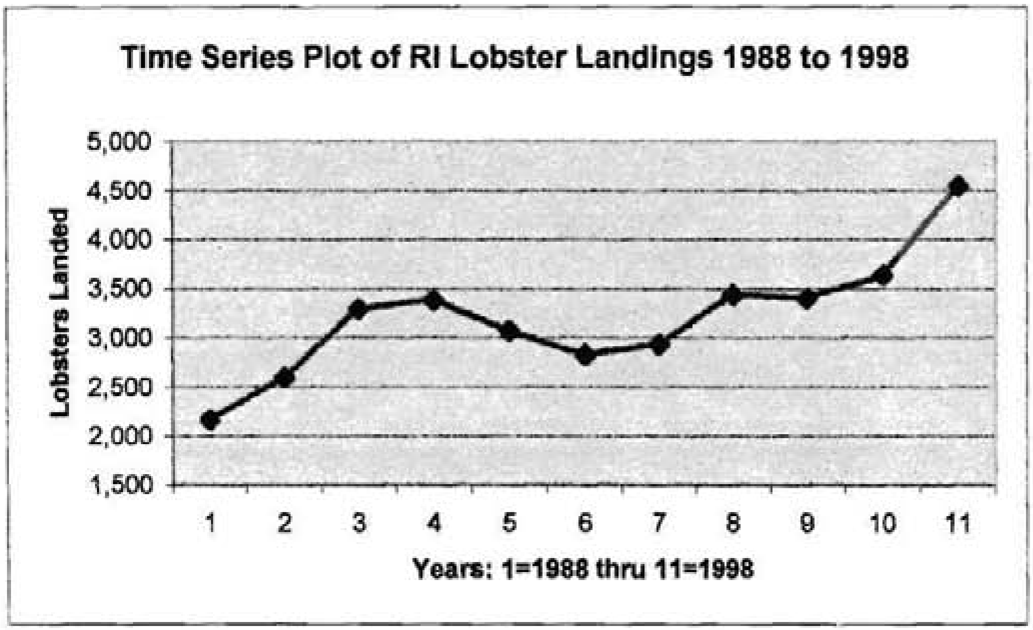
1) The sample data from agencies will be as accurate as the referring agencies deem necessary.
2) Surveys will have a margin of error based on the memory and records kept by the surveyed parties.
3) Surveys will be based on 10% sample size of a total population.
4) The interpretations are based on my 10 years industry experience utilizing basic accepted statistical analysis methods.

[2] This same data is used in this study.

Dependent Data - RI Lobster Landings In Metric Tons 1988 to 1998

Years	Metric Tons of Lobsters
1988	2,159
1989	2,597
1990	3,292
1991	3,377
1992	3,067
1993	2,825
1994	2,936
1995	3,433
1996	3,402
1997	3,631
1998	4,548





Statistics gathered from the National Marine Fisheries Service Website:
www.st.nmfs.gov/webplcomm/plsql/webstl.MF_ANNUAL_LANDINGS.RESULTS

Independent Data Sets Used for Comparative Analysis

Independent Data	
Years	**Total # State Licenses**
1988	0
1989	214
1990	230
1991	275
1992	472
1993	1006
1994	980
1995	1317
1996	1143
1997	1102
1998	1597

Independent Data	
Years	**Metric Tons of Toxic Waste**
1988	10,646,338
1989	7,706,507
1990	6,031,507
1991	5,438,400
1992	6,383,857
1993	6,673,430
1994	7,152,425
1995	3,409,326
1996	2,402,424
1997	2,207,449
1998	1,751,380

Independent Data	
Years	**Total Rainfall in Inches**
1988	38.37
1989	56.06
1990	44.78
1991	45.69
1992	47.48
1993	42.16
1994	44.69
1995	38.24
1996	38.06
1997	37.97
1998	52.70

Independent Data	
Years	**Air Temperatures**
1988	64.40
1989	65.30
1990	65.42
1991	66.70
1992	63.50
1993	66.00
1994	64.87
1995	65.78
1996	62.54
1997	63.93
1998	64.20

Independent Data	
Years	**Total Number of Permits**
1988	34
1989	31
1990	285
1991	324
1992	368
1993	346
1994	289
1995	185
1996	221
1997	236
1998	239

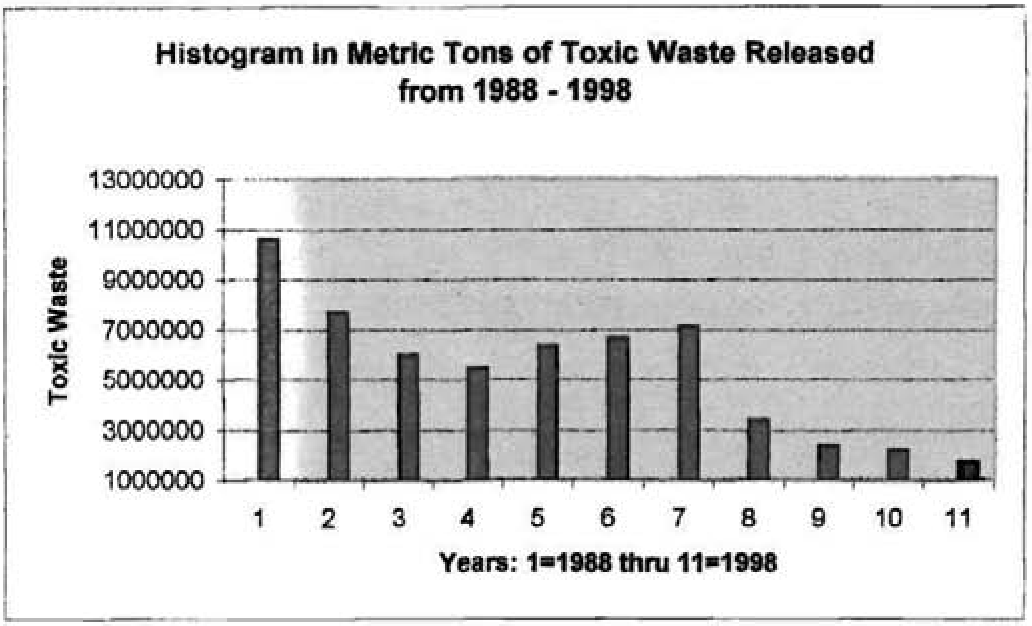
Independent Data	
Years	**Market Value US $**
1988	15,268,937
1989	17,530,523
1990	19,824,539
1991	20,392,490
1992	21,198,027
1993	18,843,769
1994	20,953,220
1995	17,842,002
1996	18,358,391
1997	20,125,993
1998	20,013,415

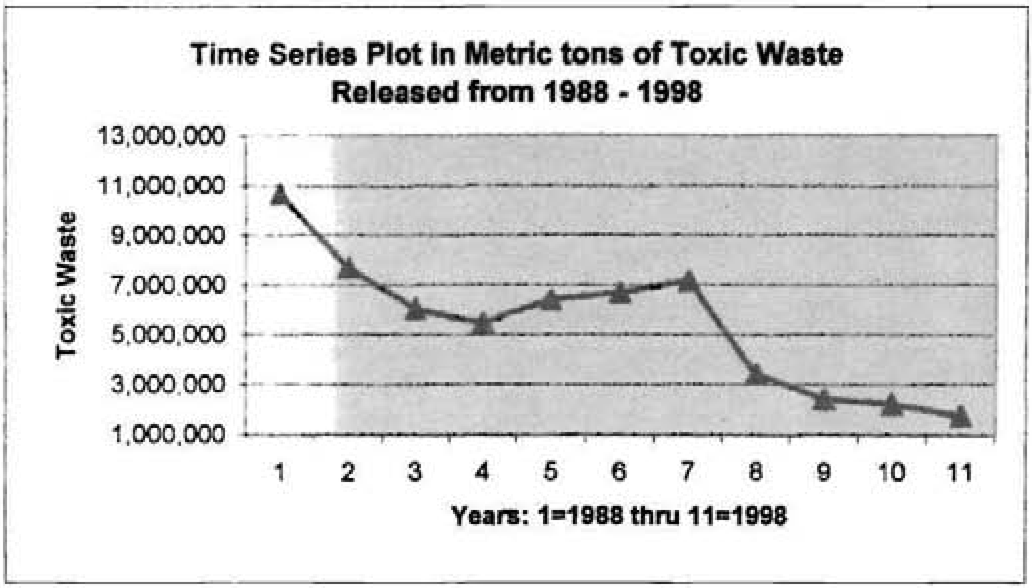
Independent Data	
Years	**Est. # of Traps Fished**
1988	458
1989	473
1990	544
1991	602
1992	692
1993	742
1994	771
1995	846
1996	942
1997	994
1998	1038

Independent Data	
Years	**Values of REG Increase**
1988	0
1989	2
1990	0
1991	0
1992	0
1993	1
1994	4
1995	2
1996	2
1997	2
1998	2

Independant Data - RI Rate of Toxic Waste Releases in Metric Tons from 1988 to 1998

Years	Metric Tons of Pollution
1988	10,646,338
1989	7,706,507
1990	6,031,507
1991	5,438,400
1992	6,383,857
1993	6,673,430
1994	7,152,425
1995	3,409,326
1996	2,402,424
1997	2,207,449
1998	1,751,380

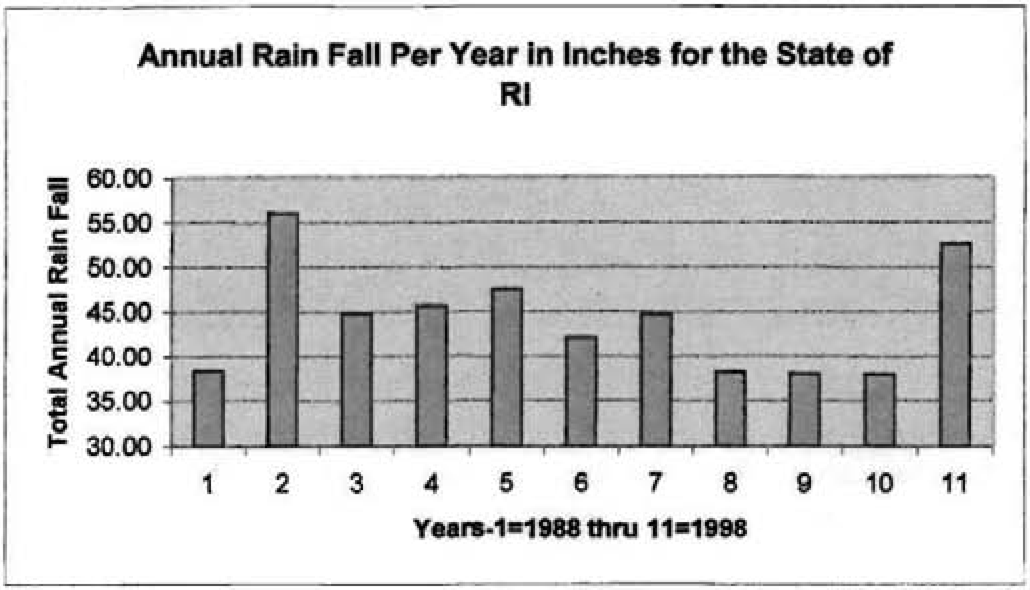


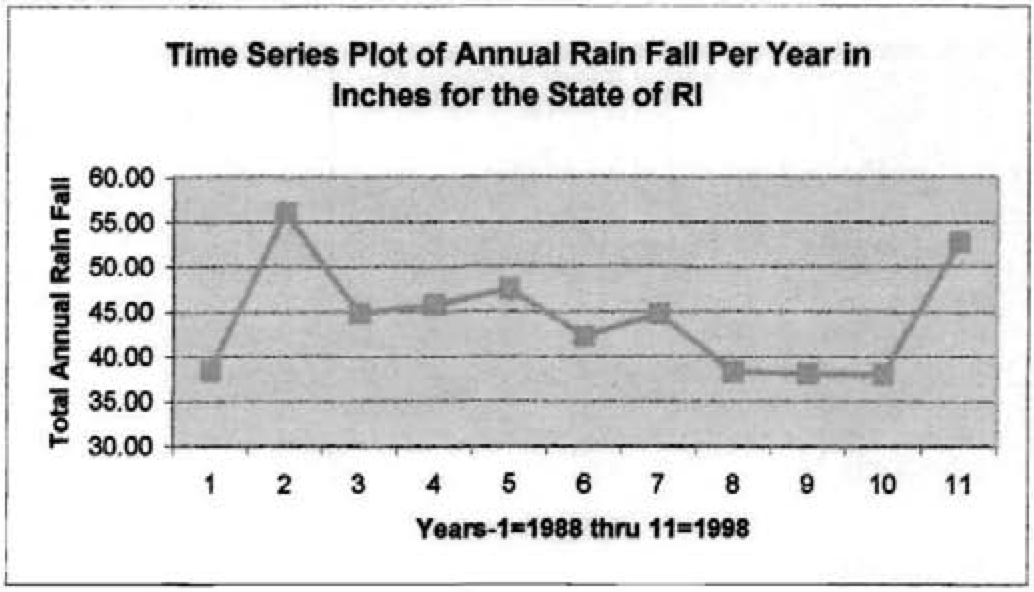


Statistic gathered from Environmental Protection Agency New England Region Website under "Toxic Release Inventory": www.epa.gov/region01/steward/emerplan/toxic.html

Independent Data - RI Annual Rain Fall in Inches from 1988 thru 1998

Years	Inches of Rain Fall
1988	38.37
1989	56.06
1990	44.78
1991	45.69
1992	47.48
1993	42.16
1994	44.69
1995	38.24
1996	38.06
1997	37.97
1998	52.70

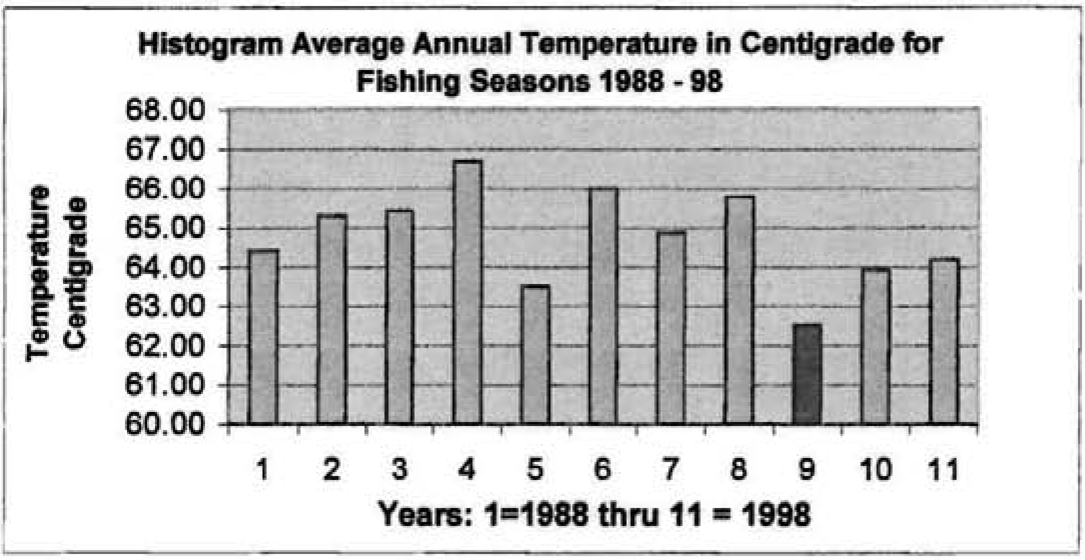


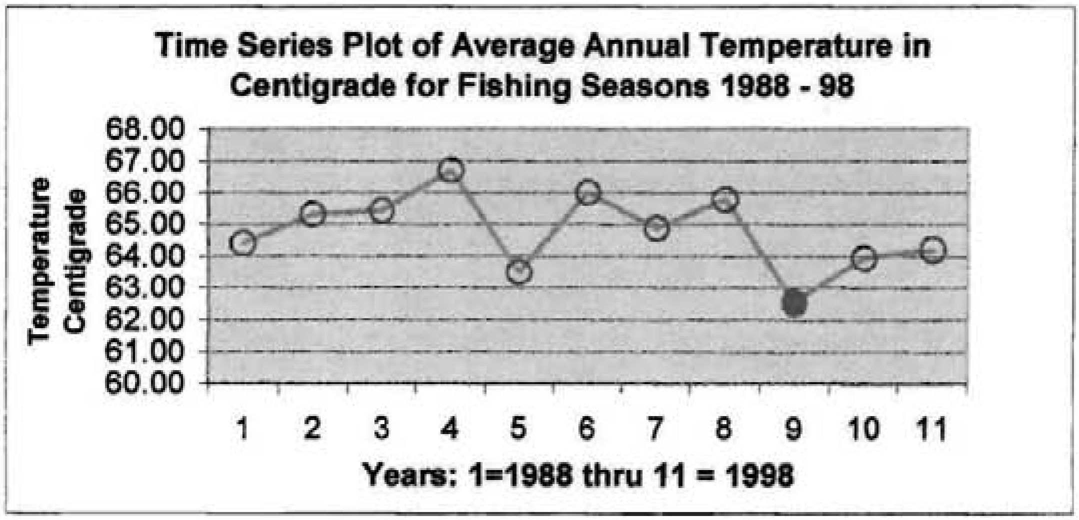


Statistics gathered from the "Weather Almanac-9th Edition" and the Climatilogical National Annual Survey. The city of Providence, RI was the measuring point.

Independent Data- RI Average Seasonal Air Temperature in Centigrade from 1988 to 1998

Years	Air Temperature	
1988	64.40	
1989	65.30	
1990	65.42	
1991	66.70	
1992	63.50	
1993	66.00	
1994	64.87	
1995	65.78	
1996	*62.54*	**Missing 1 month of data*
1997	63.93	
1998	64.20	

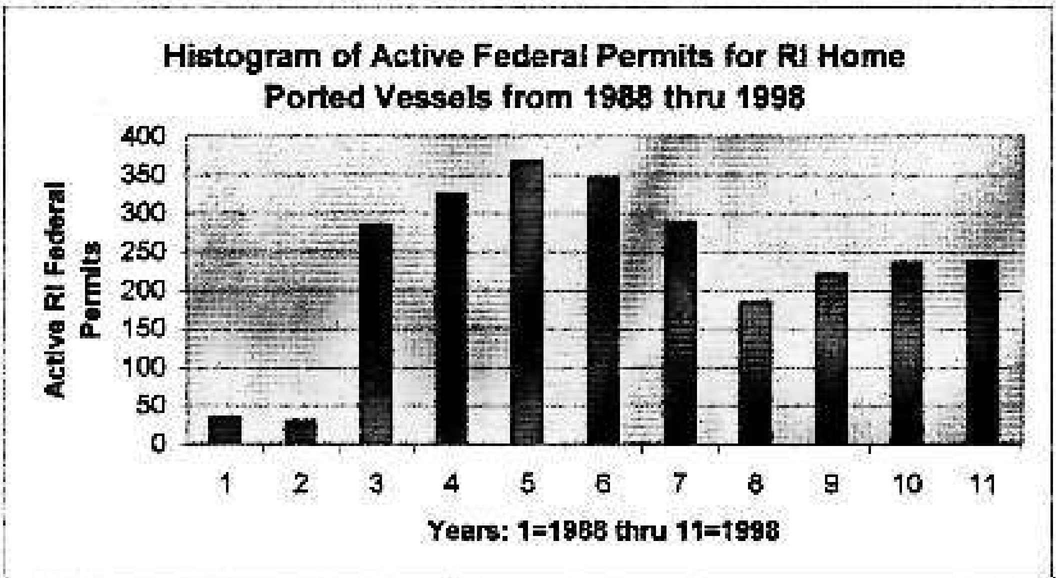


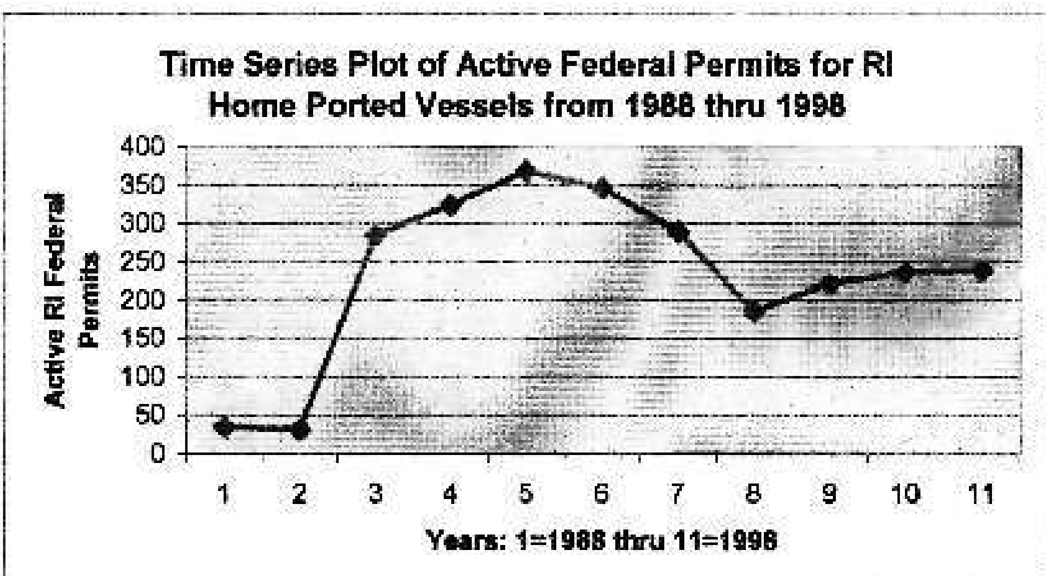


Statistics gathered from the "Weather Alamanac-9th Edition" and the Climatiligical National Annual Survey. The city of Providence, RI was the measuring point.

Independent Data - Active RI Federal Lobster Permits 1988 to 1998

Years	Total # of Federal Permits
1988	34
1989	31
1990	285
1991	324
1992	368
1993	346
1994	289
1995	185
1996	221
1997	236
1998	239

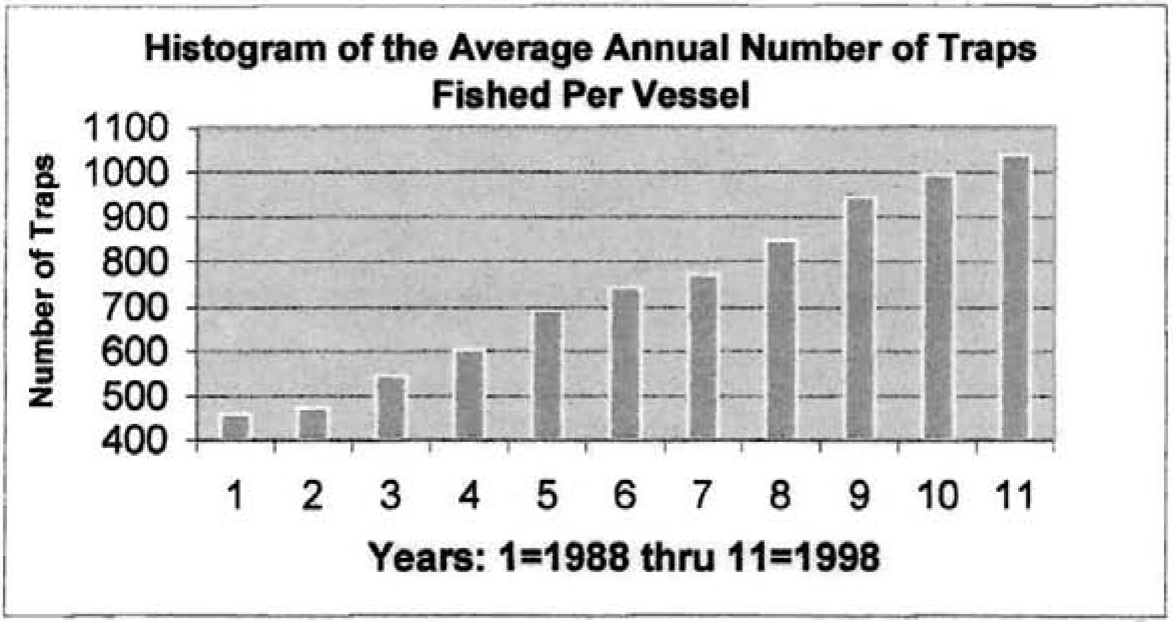


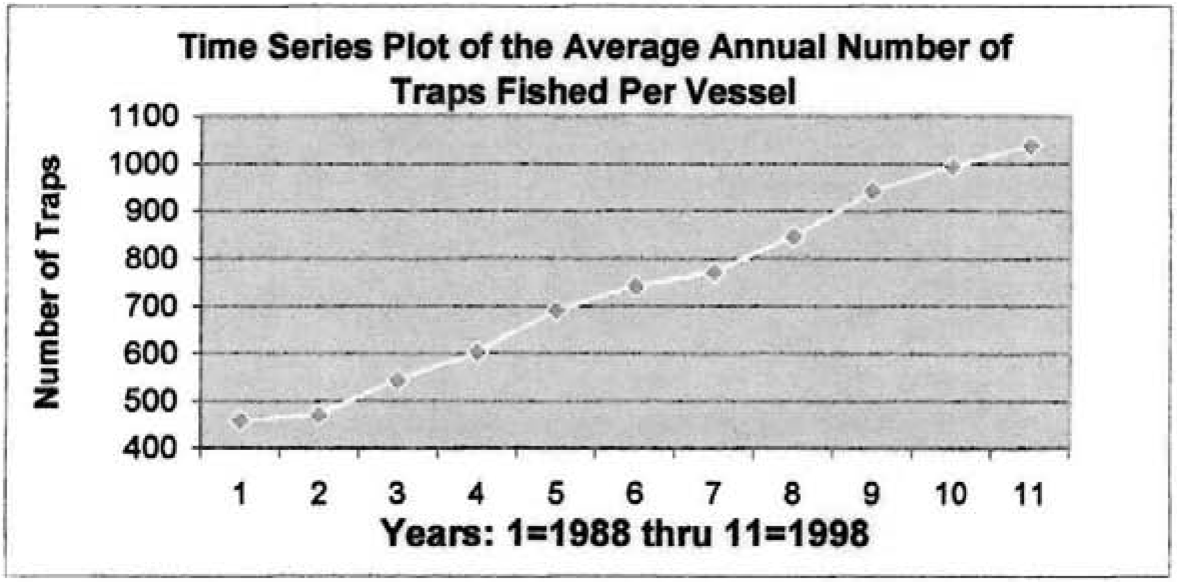


Data gathered from the Vessel Permit Data Base, National Marine Fisheries Service, Northeast Regional Office

Independent Data - Annual Average Number of Traps Fished per Vessel In the State of RI from 1988 to 1998

Years	Traps Fished
1988	458
1989	473
1990	544
1991	602
1992	692
1993	742
1994	771
1995	846
1996	942
1997	994
1998	1038

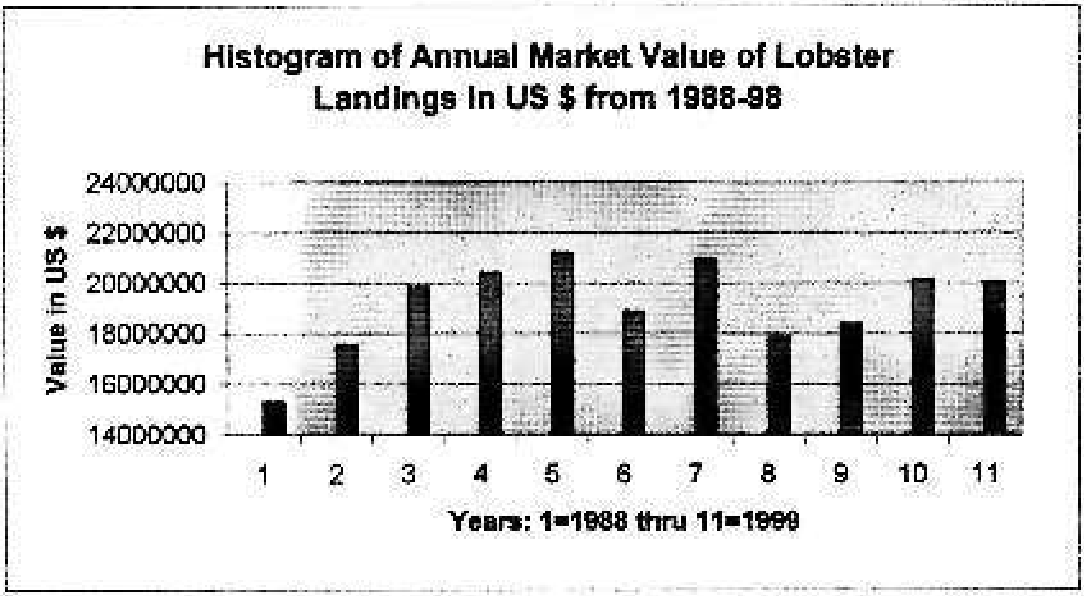


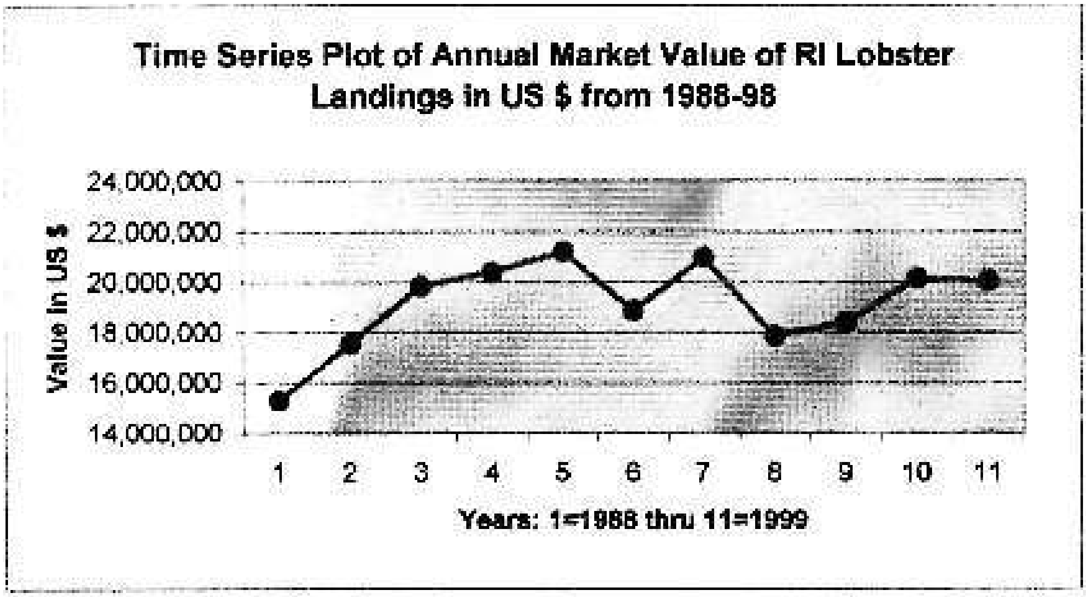


Data gathered from a confidential survey of Lobster Fishing Boat owner operators whose derived 50% or more of their annual income from fishing.

Independent Data - Market Value of RI Lobster Landings in US $ from 1988 - 1998

Year	Value $ Millions
1988	15,268,937
1989	17,530,523
1990	19,824,539
1991	20,392,490
1992	21,198,027
1993	18,843,769
1994	20,953,220
1995	17,842,002
1996	18,358,391
1997	20,125,993
1998	20,013,415

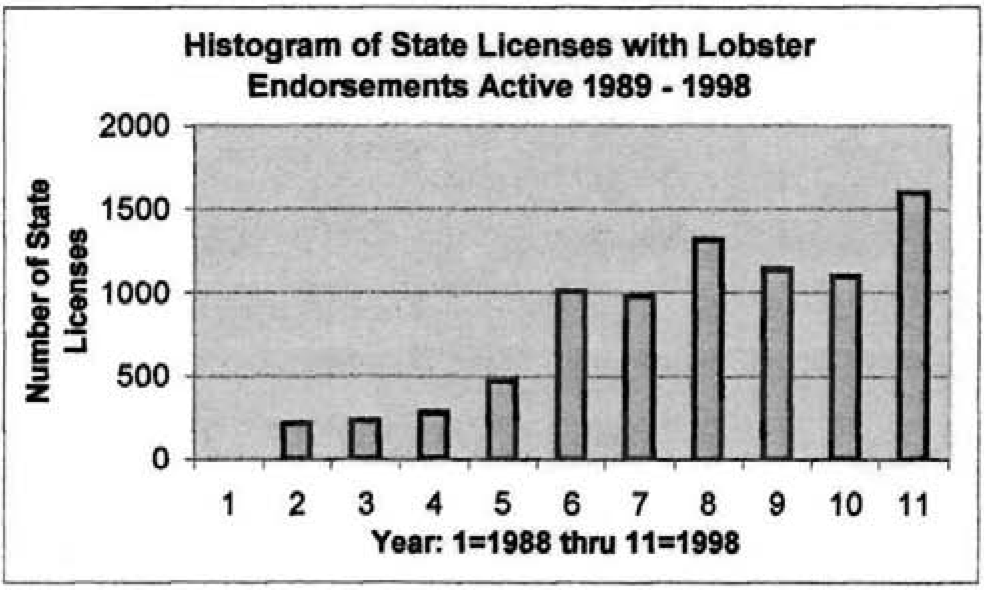


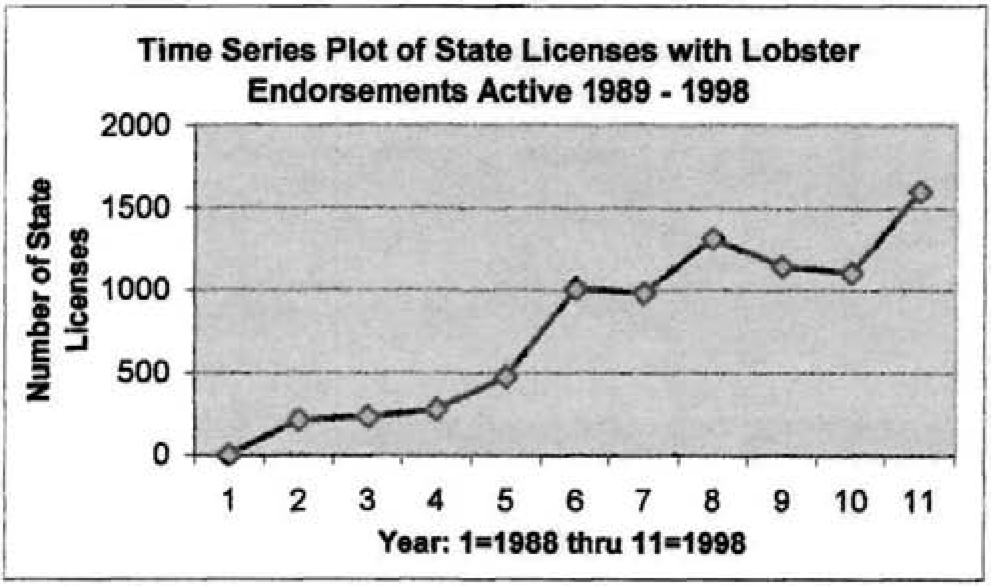


Data gathered from the National Marine Fisheries website:
WWW:st.nmfs.gov/webplcomm/plsql/webst.1MF_LANDINGS_ANNUAL. RESULTS

Independent Data - State Commercial Fishing Licenses with Lobster Endorsements from 1988 to 1998

Years	Total # State Licenses	
1988	*0*	*No Record Available*
1989	214	
1990	230	
1991	275	
1992	472	
1993	1006	
1994	980	
1995	1317	
1996	1143	
1997	1102	
1998	1597	

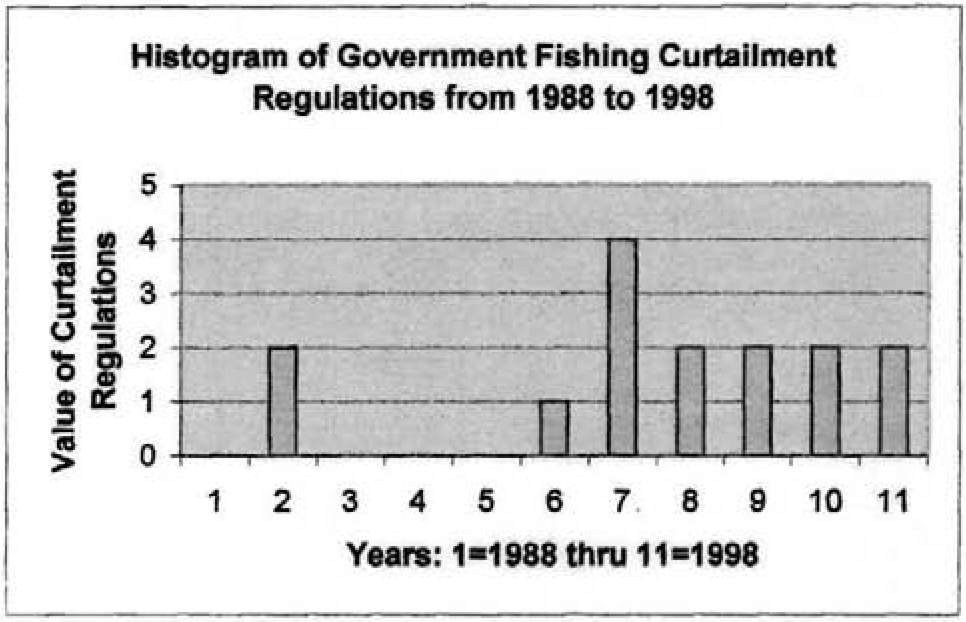


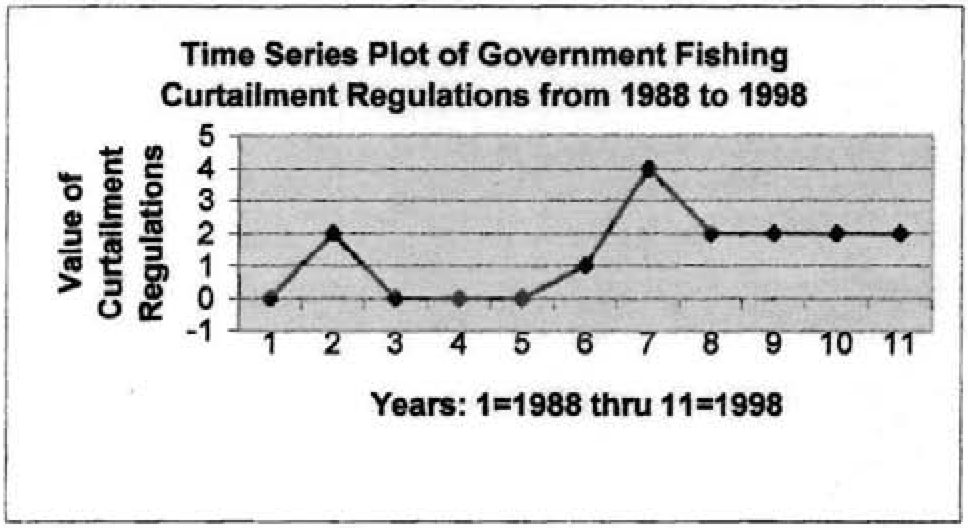


Information gathered from the RI Department of Environmental Management, Office of Registration and Licensing, Margaret McGrath, Administrative Officer

Independent Data -Government Regulations on the Lobster Industry From 1988 to 19989

Year	Value
1988	0
1989	2
1990	0
1991	0
1992	0
1993	1
1994	4
1995	2
1996	2
1997	2
1998	2





Information gathered from the NMFS web site www.mnfs.gov and the RI DEM Regulations from 1988 through 1998. Values have been calculated for each event. *See "Government Regulation Calculation" page

LL vs RF			LL vs AT		
YR	LL	RF	YR	LL	AT
1988	2,159	38.37	1988	2,159	64.40
1989	2,597	56.06	1989	2,597	65.30
1990	3,292	44.78	1990	3,292	65.42
1991	3,377	45.69	1991	3,377	66.70
1992	3,067	47.48	1992	3,067	63.50
1993	2,825	42.16	1993	2,825	66.00
1994	2,936	44.69	1994	2,936	64.87
1995	3,433	38.24	1995	3,433	65.78
1996	3,402	38.06	1996	3,402	62.54
1997	3,631	37.97	1997	3,631	63.93
1998	4,548	52.70	1998	4,548	64.20

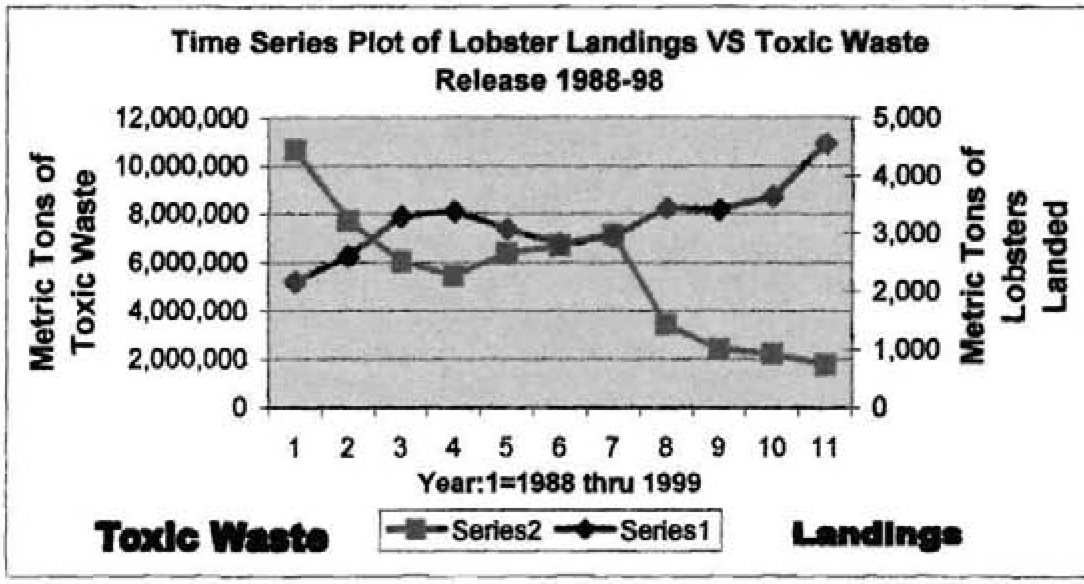
LL vs MV			LL vs FP		
YR	LL	MV	YR	LL	FP
1988	2,159	15,268,937	1988	2,159	34
1989	2,597	17,530,523	1989	2,597	31
1990	3,292	19,824,539	1990	3,292	285
1991	3,377	20,392,490	1991	3,377	324
1992	3,067	21,198,027	1992	3,067	368
1993	2,825	18,843,769	1993	2,825	346
1994	2,936	20,953,220	1994	2,936	289
1995	3,433	17,842,002	1995	3,433	185
1996	3,402	18,358,391	1996	3,402	221
1997	3,631	20,125,993	1997	3,631	236
1998	4,548	20,013,415	1998	4,548	239

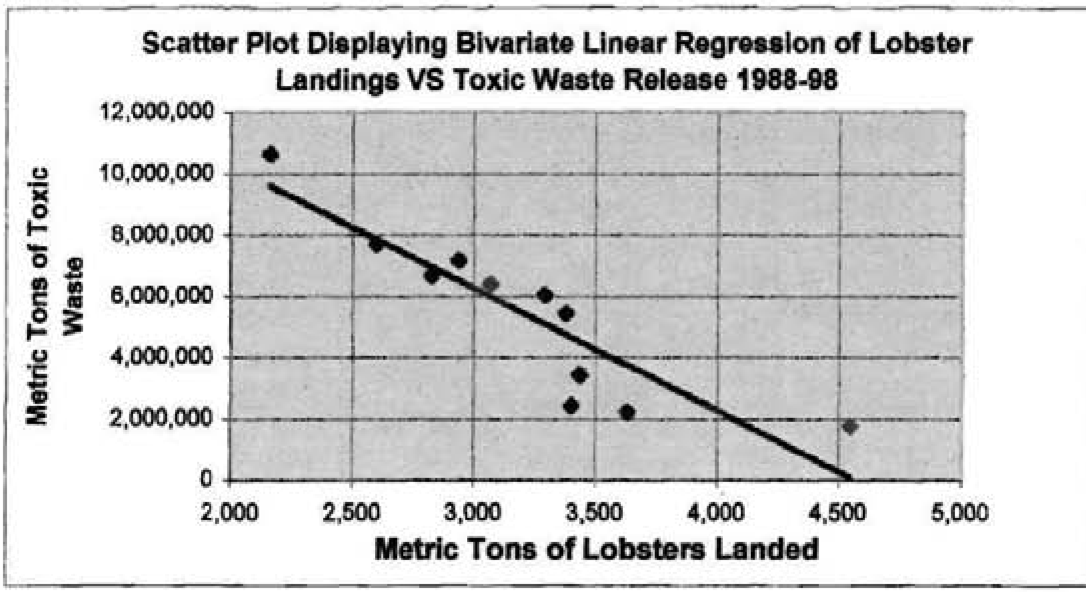
LL vs TW			LL vs TF		
YR	LL	TW	YR	LL	TF
1988	2,159	10,646,338	1988	2,159	458
1989	2,597	7,706,507	1989	2,597	473
1990	3,292	6,031,507	1990	3,292	544
1991	3,377	5,438,400	1991	3,377	602
1992	3,067	6,383,857	1992	3,067	692
1993	2,825	6,673,430	1993	2,825	742
1994	2,936	7,152,425	1994	2,936	771
1995	3,433	3,409,326	1995	3,433	846
1996	3,402	2,402,424	1996	3,402	942
1997	3,631	2,207,449	1997	3,631	994
1998	4,548	1,751,380	1998	4,548	1038

LL vs GR			LL vs SL		
YR	LL	GR	YR	LL	SL
1988	2,159	0	1988	2,159	0
1989	2,597	2	1989	2,597	230
1990	3,292	0	1990	3,292	230
1991	3,377	0	1991	3,377	275
1992	3,067	0	1992	3,067	472
1993	2,825	1	1993	2,825	1006
1994	2,936	4	1994	2,936	980
1995	3,433	2	1995	3,433	1317
1996	3,402	2	1996	3,402	1143
1997	3,631	2	1997	3,631	1102
1998	4,548	2	1998	4,548	1597

The above data was gathered from various sources cited on the separate Data Set Graphic Pages and on the last page.

Graphic Display of Comparative Analysis for Lobster Landings VS Toxic Waste Release





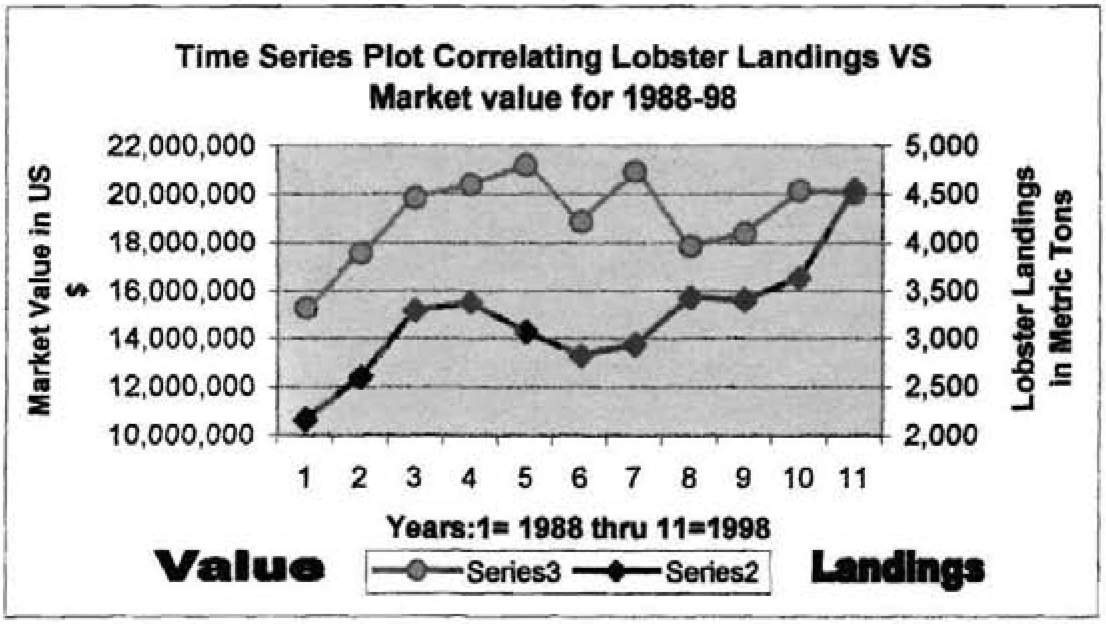
Number of cases used: 11 (1988 to 1998)
Pearson's r (Correlations Coefficient) = -0.8997 R-Square = 0.8095
Test of hypothesis to determine significance of relationship:
H(null): Slope = 0 or H(null): r = 0
(Pearson's) t = -6.183272 with 9 d.f. p < 0.001
(A low p-value implies that the slope does not = 0.)

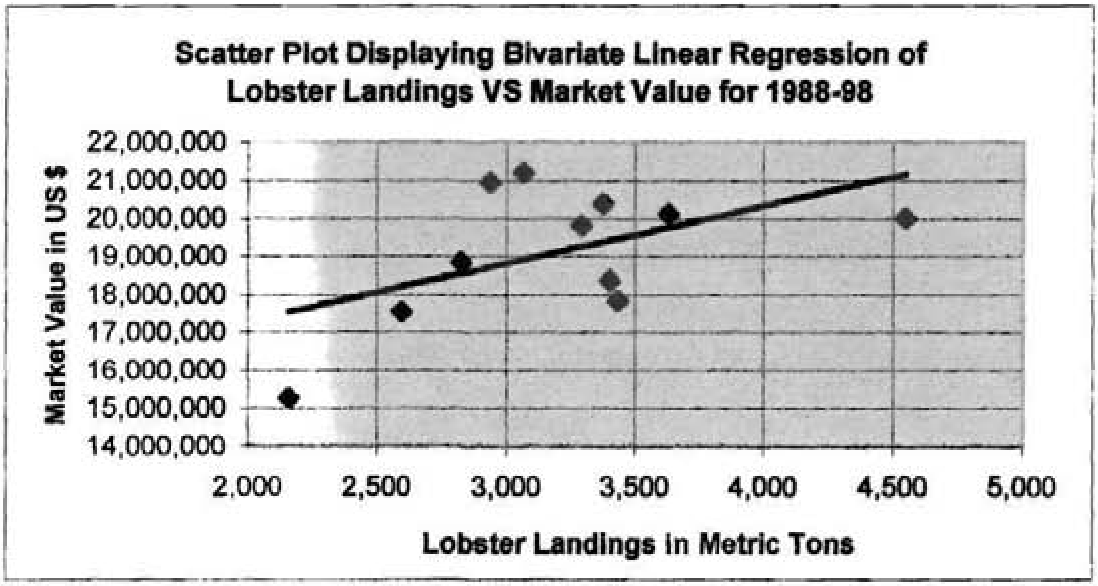
FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
Lobsters Landed	11	3.2100	.6090	.1836	2.150	4.540	35.310
Toxic Waste	11	5436.73	2744.89	827.62	1751.38	10646.33	59803.99

It can be inferred from these charts and data that there is a positive affect (increase) in Lobster Landings (LL) when compared to the reduction (decrease) of Toxic Waste (TW) released into the water. Whether it can be said that there is a direct causal relationship can only be determined when tests on the effects of the TW on lobster are conducted. **See attached list of TW.*

A significant relationship between the effects of Toxic Waste (TW) released into the water and the Lobster Landings (LL) for RI. This can be inferred from a nearly normal distribution.

Graphic Display of Comparative Analysis for Lobster Landings VS Market Value





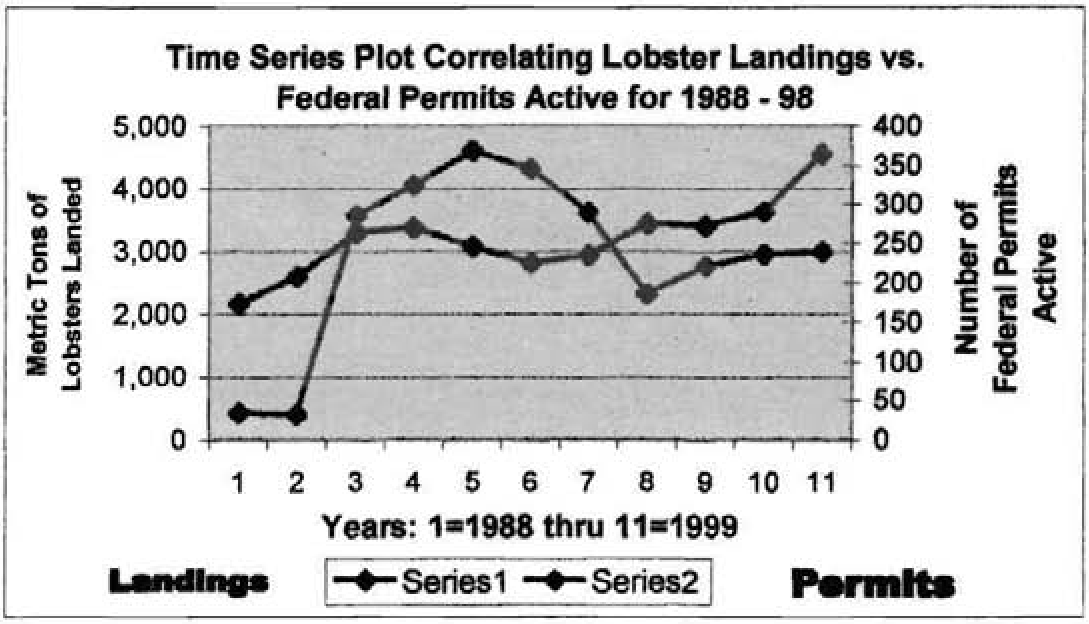
Number of cases used: 11 (1988 to 1998)
Pearson's r (Correlations Coefficient) = 0.5310 R-Square = 0.2819
Test of hypothesis to determine significance of relationship:
H(null): Slope = 0 or H(null): r = 0
(Pearson's) t = 1.679782 with 9 d.f. p = 0.093

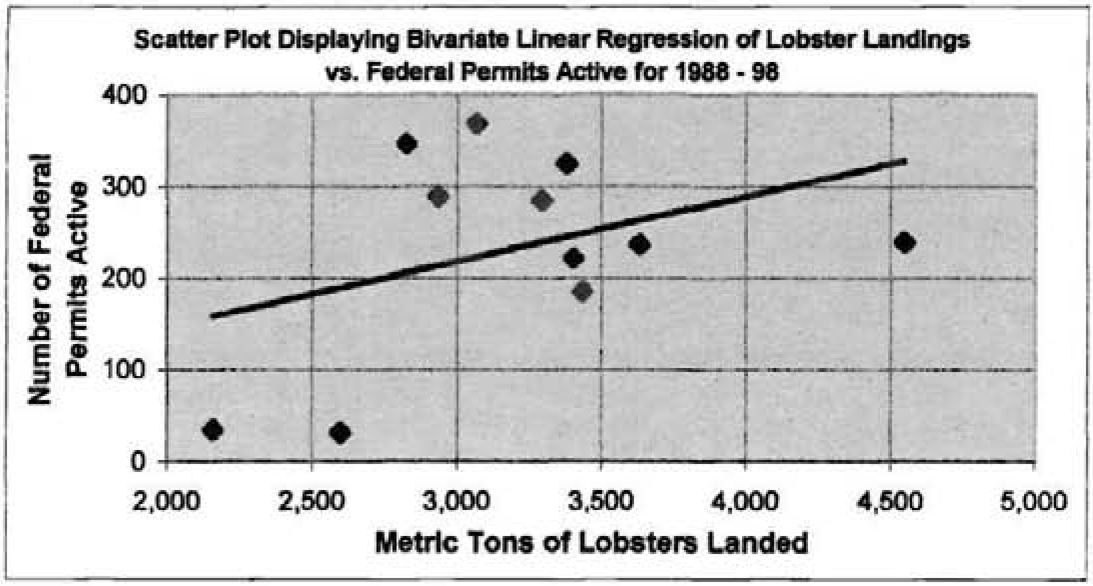
FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
Lobster Landed	11	3206.09	617.47	186.17	2159.00	4548.00	35267.00
Market Value	11	19125.30	1766.66	532.67	15268.93	21198.02	210378.26

It can be inferred from these charts and data that there is a parallel affect until 1995 in Lobster Landings (LL) when compared to the Market Value (MV). From this point on there is a inverse relationship between LL and MV probably due to supply vs demand basic economic variables of increased production and decreased demand equals the MV

No significant relationship between variables can be inferred when comparing the effects of Market Value (MV) and the Lobster Landings (LL). This can be inferred from this less than normal distribution.

Graphic Display of Comparative Analysis for Lobster Landings VS Federal Permits





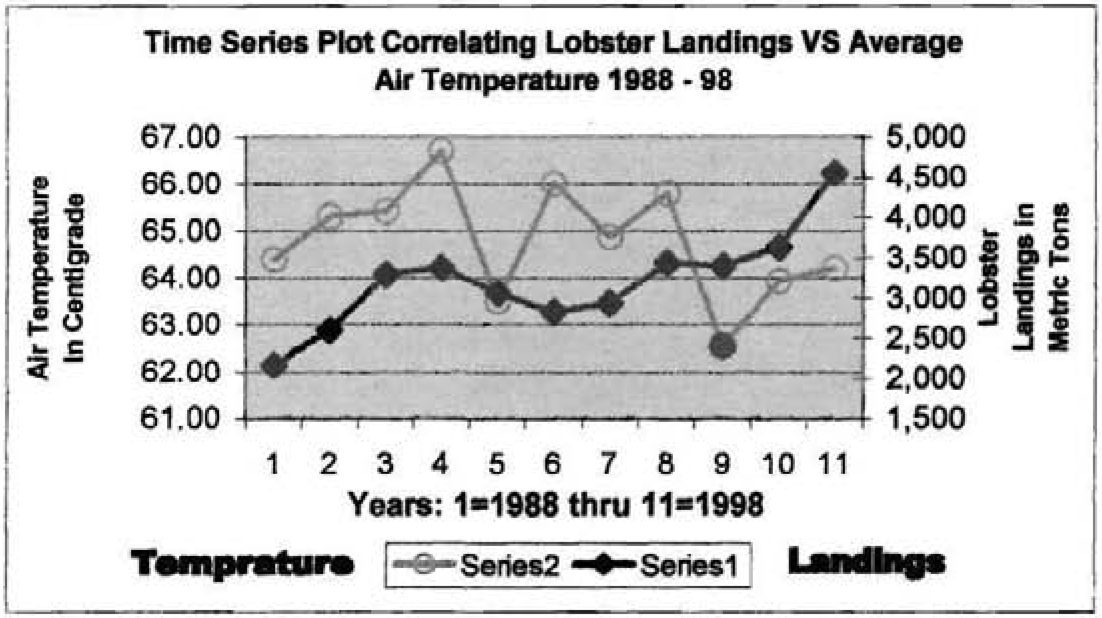
Number of cases used: 11
Pearson's r (Correlations Coefficient) = 0.3873 R-Square = 0.1500
Test of hypothesis to determine significance of relationship:
H(null): Slope = 0 or H(null): r = 0
(Pearson's) t = 1.26011 with 9 d.f. p = 0.239

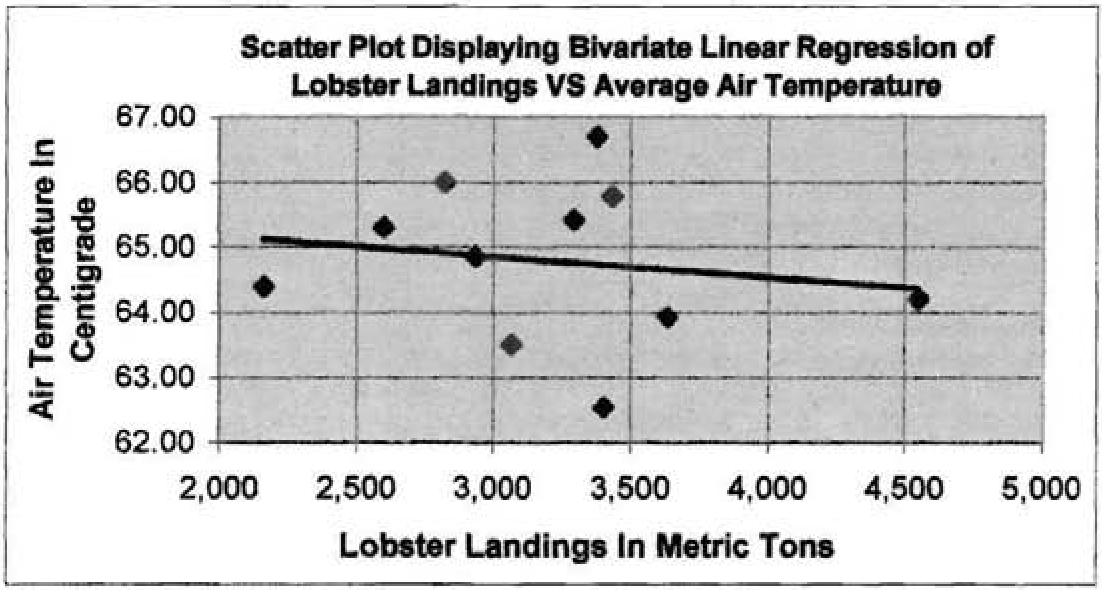
FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	11	3206.09	617.47	186.17	2159	4548	35267
FP	11	232.545	113.142	34.114	31	368	2558

It cannot be inferred from this data or charts that there is correlating affect between Lobsters Landed (LL) when compared to the Number of Federal Permits Active (FP). While in the year 1990 there was a factor of 9.1 increase in the number of FP there was only a factor of 1.26 increase in LL. The distribution is not normal so no correlation can be exists in this relationship.

No significant relationship exists between the effects of the number of Federal Permits (FP) Active and the numbers of Lobsters Landed (LL). This can be inferred from the far less than normal distribution.

Graphic Display of Comparative Analysis for Lobster Landings VS Average Annual Temperatures





Number of cases used: 11

Pearson's r (Correlations Coefficient) = -0.1599 R-Square = 0.0256

Test of hypothesis to determine significance of relationship:

H(null): Slope = 0 or H(null): r = 0

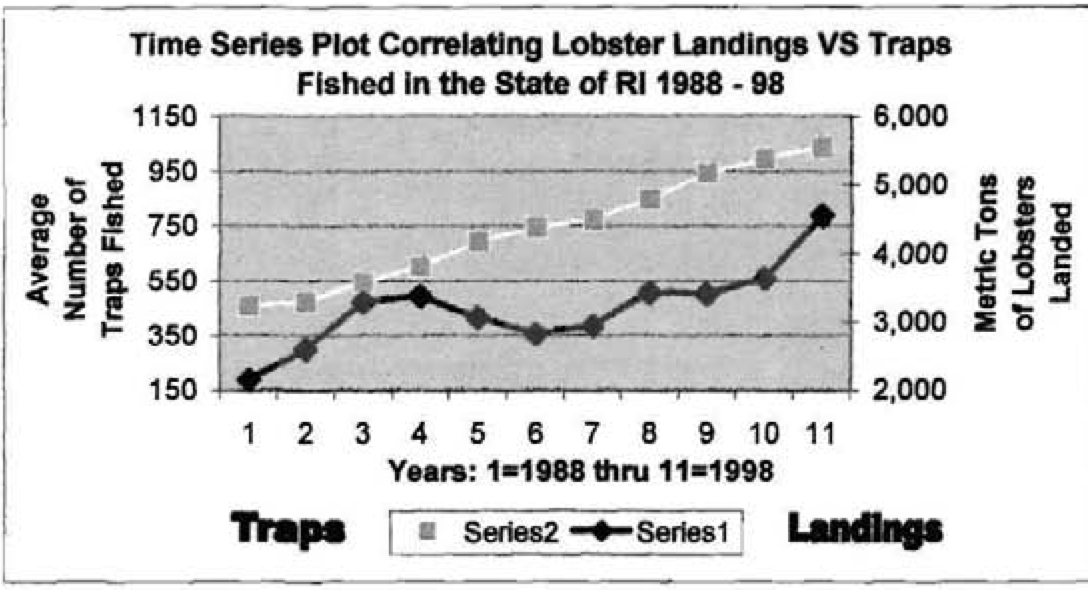
(Pearson's) t = -.4860998 with 9 d.f. p = 0.639

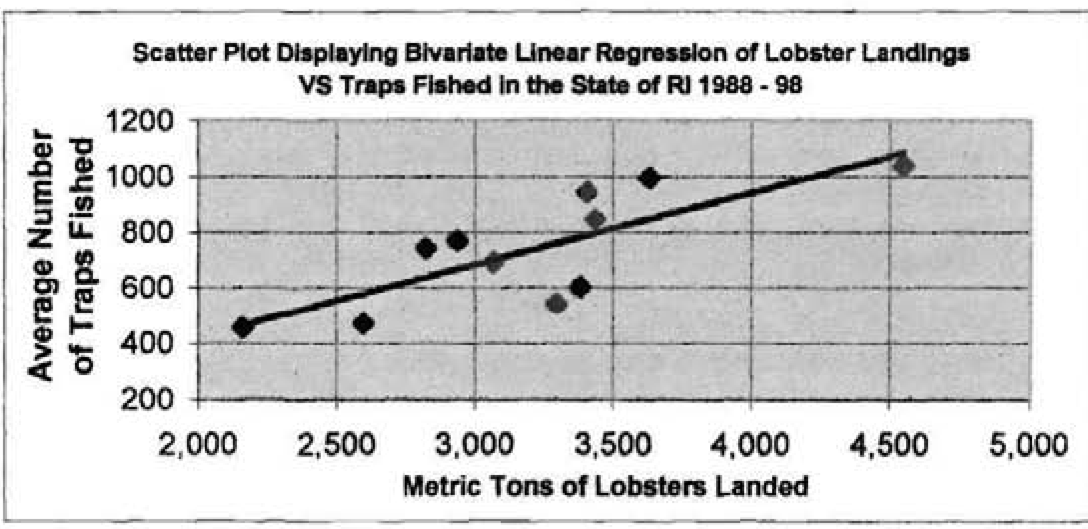
FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	11	3206.09	617.47	186.17	2159	4548	35267
AT	11	64.785	1.213	.366	62.540	66.700	712.640

It cannot be inferred from these charts and data that there is any correlation between Lobster Landings (LL) when compared to the Average Annual Temperatures (AT) during the fishing season. It can be inferred that there is no affect on LL by AT. Water temperature may have an affect but data on mean ocean temperatures was unavailable to me at the time of this project.

No significant relationship exists between the effects of Fishing Season Average Annual Temperatures (AT) and Lobster Landings (LL) for RI. This distribution is not normal.

Grapthic Display of Comparative Analysis for Lobster Landings VS Traps Fished per Vessel





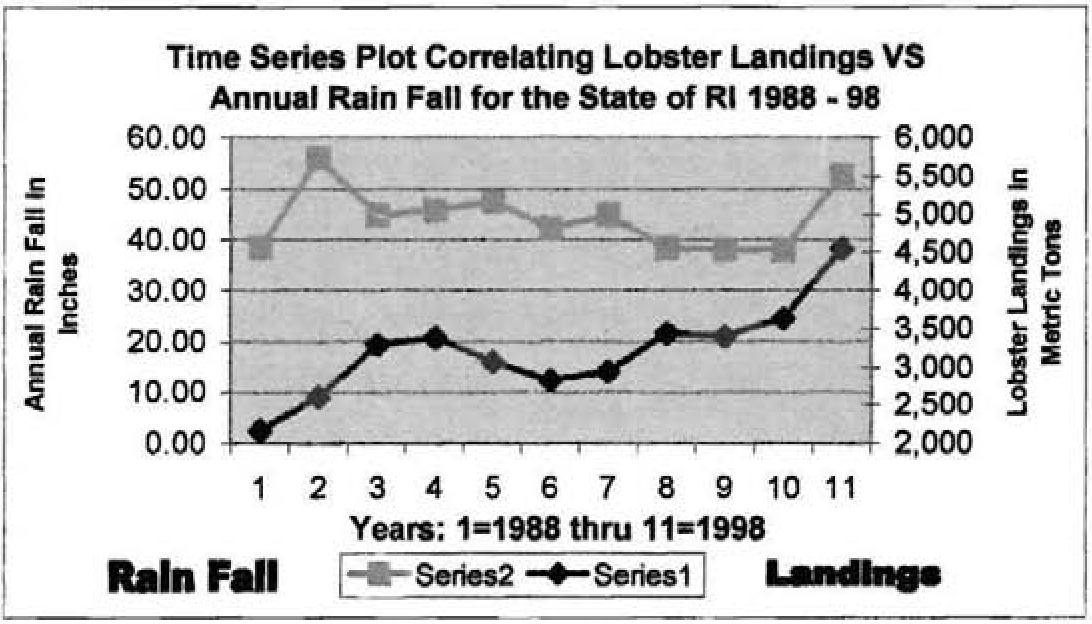
Number of cases used: 11
Pearson's r (Correlations Coefficient) = 0.7826 R-Square = 0.6124
Test of hypothesis to determine significance of relationship:
H(null): Slope = 0 or H(null): r = 0
(Pearson's) t = 3.770985 with 9 d.f. p = 0.004
(A low p-value implies that the slope does not = 0.)

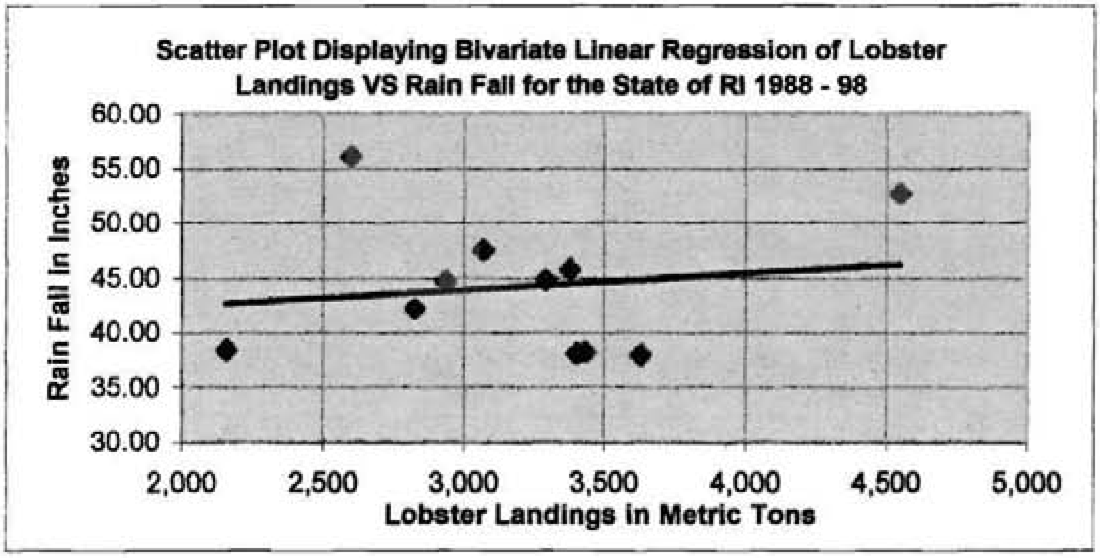
FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	11	3206.09	617.47	186.17	2159	4548	35267
TF	11	736.545	204.150	61.553	458	1038	8102

It cannot be inferred from these charts and data that there is any correlation between Lobster Landings (LL) when compared to the Number of Traps Fished per Vessel. While there is a general trend in the increase of LL, it does not correlate with a specific upward trend in TF. In Years 92,93, 94 there was a marked decrease in LL with a steady increase in TF. Years 90,91, 95,96 were level while there was still a steady upward trend in TF. This would infer that LL has no affect on LL.

No significant relationship exists between the effects of the Number of Traps Fished per Vessel (TF) and Lobster Landings (LL) for RI. This distribution is not normal.

Grapthic Display of Comparative Analysis for Lobster Landings VS Average Annual Rain Fall





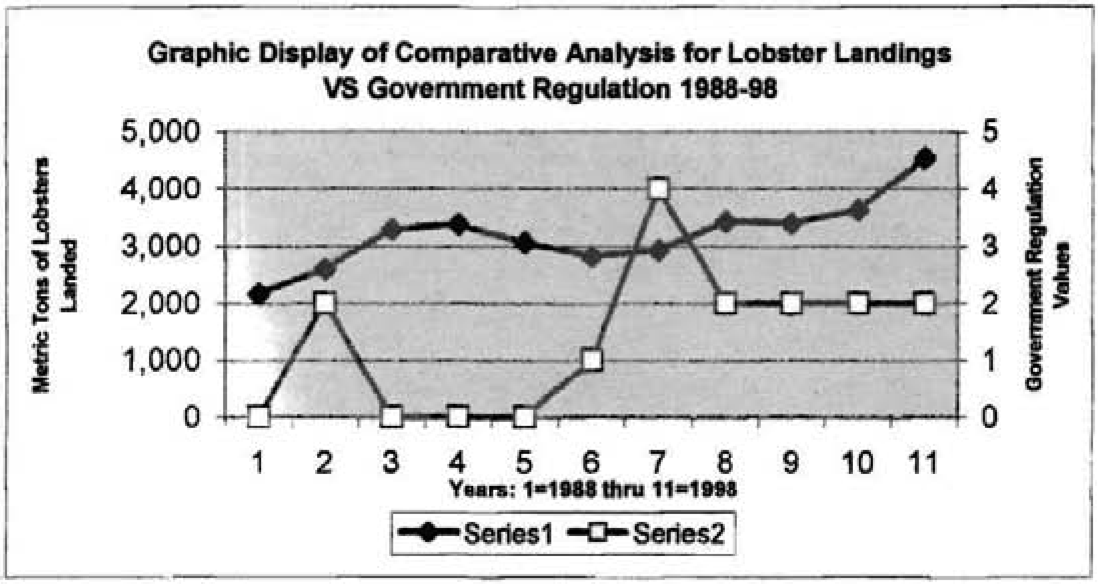
Number of cases used: 11
Pearson's r (Correlations Coefficient) = 0.1472 R-Square = 0.0217
Test of hypothesis to determine significance of relationship:
H(null): Slope = 0 or H(null): r = 0
(Pearson's) t = .4464397 with 9 d.f. p = 0.666

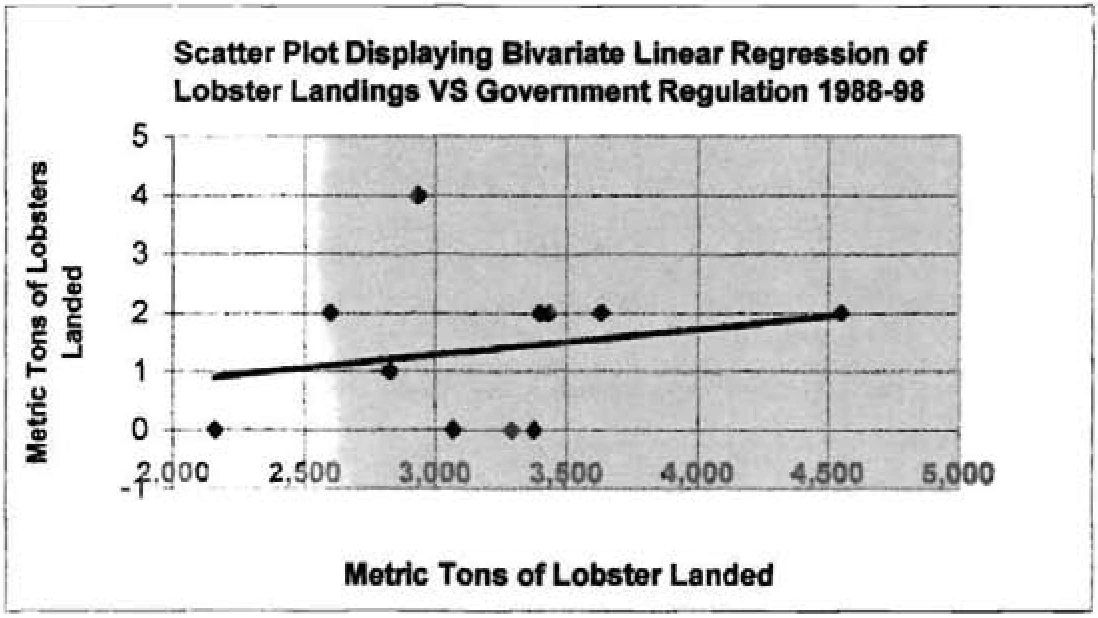
FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	11	3206.09	617.47	186.17	2159	4548	35267
RF	11	44.200	6.137	1.850	37.970	56.060	486.200

It can be inferred from these charts and data that there is a parallel affect in Lobster Landings (LL) when compared to the Average Annual Rain Fall (RF). The relationship displays an increase in LL when there is an increase in the RF and a decrease in LL when there is a decrease in RF.
This maybe due to the rise or fall in water salinity produced by the influx of fresh water into the bay and sound. Lobsters require a salinity of ______ to_____ in order to inhabit an area.

A significant relationship exists between the effects of Rain Fall (RF) and the Lobster Landings (LL). This can be demonstrated from the nearly normal distribution.

Graphic Display of Comparative Analysis for Lobster Landings VS Government Regulations





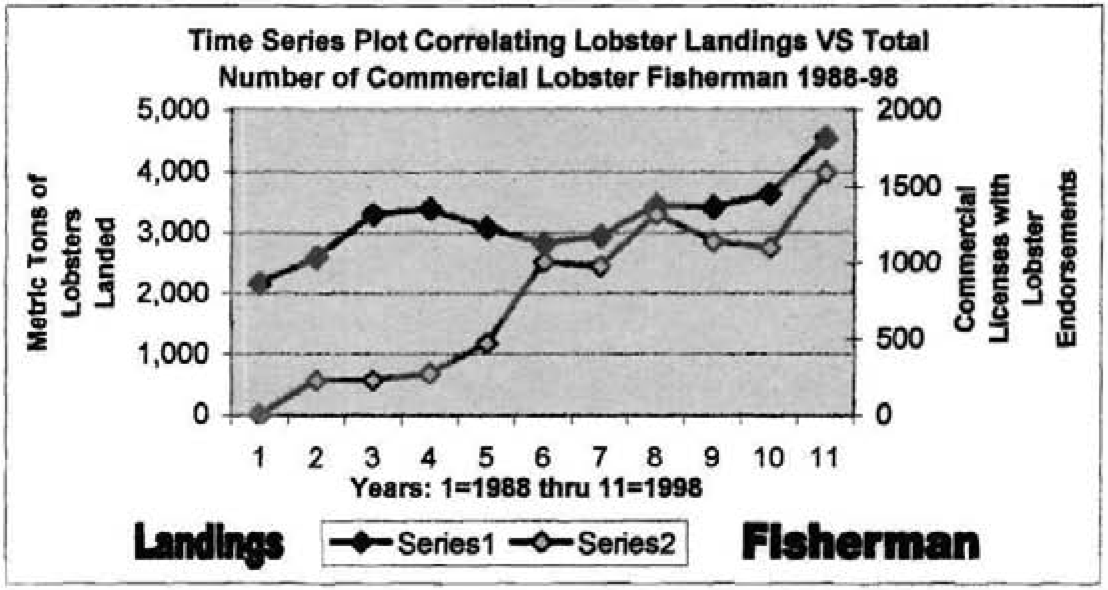
Number of cases used: 11
Pearson's r (Correlations Coefficient) = 0.2140 R-Square = 0.0458
Test of hypothesis to determine significance of relationship:
H(null): Slope = 0 or H(null): r = 0
(Pearson's) t = .6572094 with 9 d.f. p = 0.527

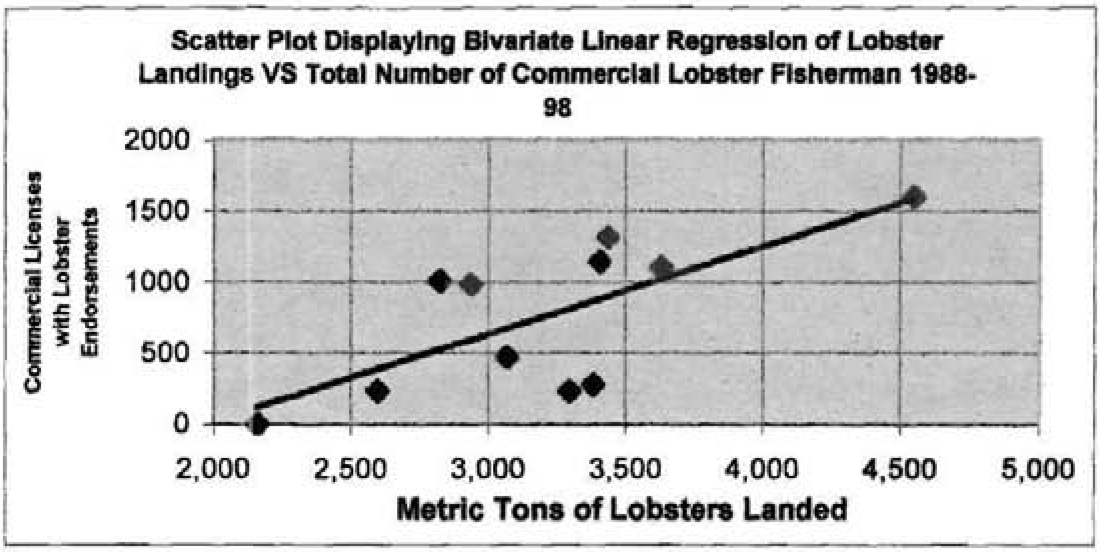
FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	11	3206.09	617.47	186.17	2159	4548	35267
GR	11	1.3636	1.2863	.3878	0	4	15

It cannot be inferred from these charts and data that there is any correlation between Lobster Landings (LL) when compared to the effective value of Government Regulation on fishing effort The shows that while there may be a dramatic increase in fishing curtailment regulations there has no correlating decrease in the amount of lobsters landed that corresponds to these measures.

No significant relationship between the effects of Government Regulations (GR) on Fishing and Lobster Landings (LL) exists. This can be inferred from the erratic patterns of GR and the steady upward trend of LL.18

Graphic Display of Comparative Analysis for Lobster landings VS State Licenses





Number of cases used: 11
Pearson's r (Correlations Coefficient) = 0.7131 R-Square = 0.5086
Test of hypothesis to determine significance of relationship:
H(null): Slope = 0 or H(null): r = 0
(Pearson's) t = 3.051747 with 9 d.f. p = 0.014
(A low p-value implies that the slope does not = 0.)

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	11	3206.09	617.47	186.17	2159	4548	35267
SL	11	759.273	533.006	160.707	0	1597	8352

It can be inferred from this data that there is a parallel correlation in Lobster Landings (LL) when compared to the Total Number of State Licenses Issued [w/lobster endorsements] (SL) for six years from 1993 (6) to 1998 (11) when there is an increase in the SL and a increase in LL. While for fours years from 1989 (2) to 1992 (5) there is a inverse correlation between LL and SL. No data was available for 1988. Federal permits require state licenses but not the reverse.

A significant relationship exists variables from 1993 forward. After the dramatic increase in State Licenses and in 1993 Lobsters Landed have a parallel correlation. This is a nearly normal distribution of variables after this point

Multivariate Data Sets Used for Multiple Regression and Correlation Matrix

Case I Fishing Effort

	Dependent Data	*Independent Data*		
Years	**Metric Tons of Lobsters**	**Federal Permits**	**Traps Fished**	**Value $ Millions**
1988	2,159	34	458	15,268,937
1989	2,597	31	473	17,530,523
1990	3,292	285	544	19,824,539
1991	3,377	324	602	20,392,490
1992	3,067	368	692	21,198,027
1993	2,825	346	742	18,843,769
1994	2,936	289	771	20,953,220
1995	3,433	185	846	17,842,002
1996	3,402	221	942	18,358,391
1997	3,631	236	994	20,125,993
1998	4,548	239	1038	20,013,415

Case II Fishing Effort Regulations

	Dependent Data	*Independent Data*		
Years	**Metric Tons of Lobsters**	**Traps Fished**	**State Licenses**	**Government Reg's**
1988	2,159	458	0	0
1989	2,597	473	214	2
1990	3,292	544	230	0
1991	3,377	602	275	0
1992	3,067	692	472	0
1993	2,825	742	1006	1
1994	2,936	771	980	4
1995	3,433	846	1317	2
1996	3,402	942	1143	2
1997	3,631	994	1102	2
1998	4,548	1038	1597	2

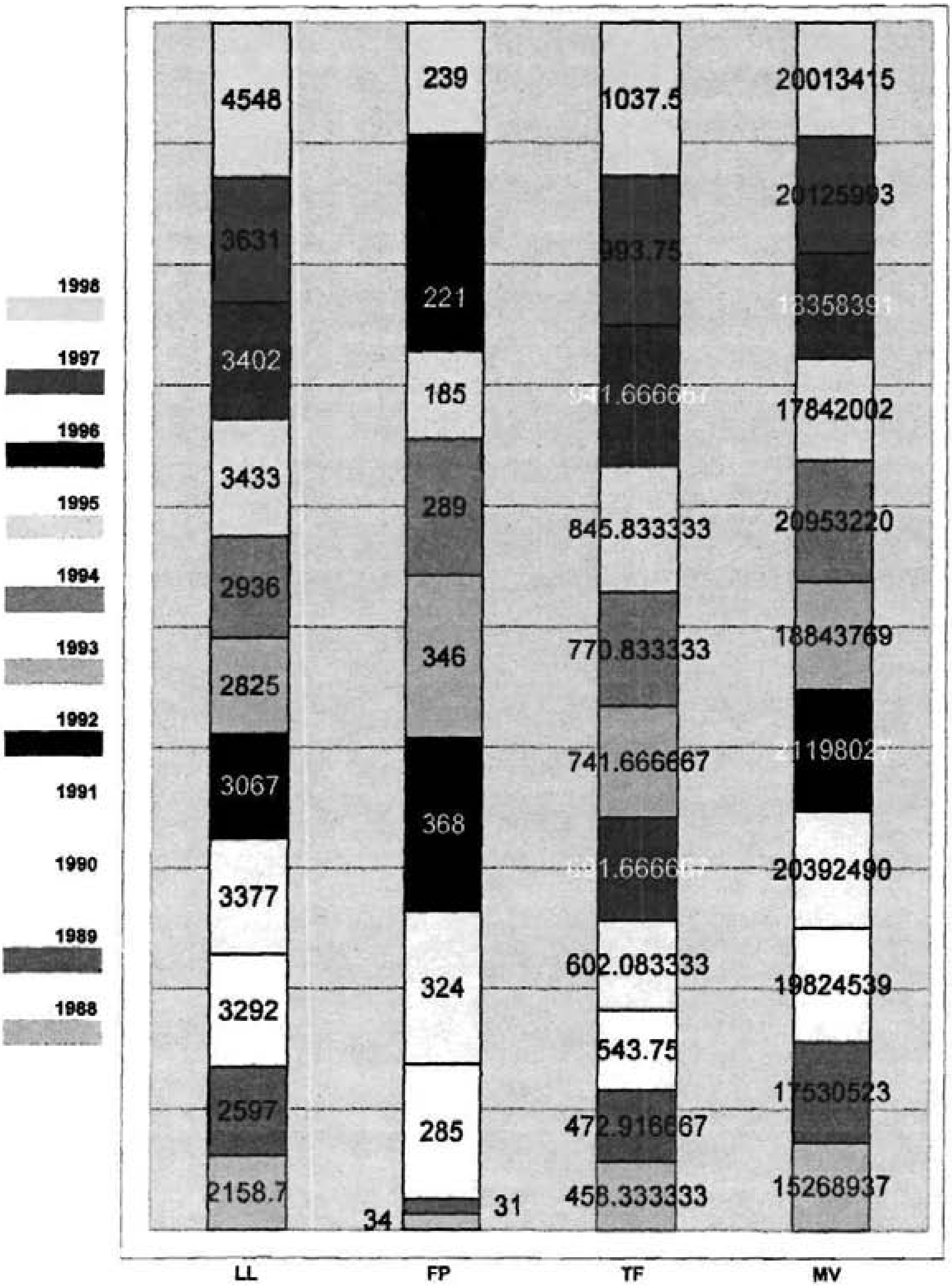
Case III Outside Influences

	Dependent Data	*Independent Data*		
Years	**Metric Tons of Lobsters**	**Toxic Waste**	**Rain Fall**	**Air Temperature**
1988	2,159	10,646,338	38.37	64.40
1989	2,597	7,706,507	56.06	65.30
1990	3,292	6,031,507	44.78	65.42
1991	3,377	5,438,400	45.69	66.70
1992	3,067	6,383,857	47.48	63.50
1993	2,825	6,673,430	42.16	66.00
1994	2,936	7,152,425	44.69	64.87
1995	3,433	3,409,326	38.24	65.78
1996	3,402	2,402,424	38.06	62.54
1997	3,631	2,207,449	37.97	63.93
1998	4,548	1,751,380	52.70	64.20

Case IV Comparison of Factors for Cases I, II, III

Dependent Data	*Independent Data*		
Median LL	**Fishing Effort**	**Government Reg's**	**Outside Influences**
3,206	1+ Factor 2-Factors	.5+ Factors 2.5-Factors	2+ Factor 1- Factors
	1	0.5	2
	-2	-2.5	-1

Case I



1998
1997
1996
1995
1994
1993
1992
1991
1990
1989
1988
4548
3631
3402
3433
2936
2825
3067
3377
3292
2597
2158.7
239
221
185
289
346
368
324
285
34
31
1037.5
993.75
845.833333
770.833333
741.666667
602.083333
543.75
472.916667
458.333333
20013415
20125993
17842002
20953220
18843769
20392490
19824539
17530523
15268937
LL
FP
TF
MV

Fig. 1 A

Case I

WINKS 4.62 November 5,2000

Linear Regression and Correlation C:\WINKS\LOB1.DBF

Dependent variable is LL. 3 independent variables, 11 cases.

Variable	Coefficient	St. Error	t-value	p(2 tail)
Intercept	-1053.919	2174.8727	-.4845887	0.643
FP	-1.202006	2.0936736	-.5741135	0.584
TF	2.0666758	.6908945	2.9913045	0.020
MV	.0001578	.0001366	1.154747	0.286

R-Square = 0.6889 Adjusted R-Square = 0.5556

Analysis of Variance to Test Regression Relation

Source	Sum of Sqs	df	Mean Sq	F	p-value
Regression	2626588.17124	3	875529.39	5.1673043	0.034
Error	1186054.7	7	169436.39		
Total	3812642.90909	10			

A low p-value suggests that the dependent variable LL
may be linearly related to independent variable(s).

Fig. 1 B

Case I

WINKS 4.62 November 5,2000

Matrix of Correlation Coefficients C:\WINKS\LOB1.DBF

	LL	FP	TF	MV
LL		.387 (.239) [11]	.783 (.004) [11]	.53 (.093) [11]
FP			.337 (.311) [11]	.835 (.001) [11]
TF				.384 (.244) [11]
MV				

Key: Correlation
(p-value)
[count]

Fig 1 C

Case I

WINKS 4.62 November 5.2000

Descriptive Statistics, Summary C:\WINKS\LOB1.DBF

Statistics from database C:\WINKS\LOB1.DBF Number of records= 11

------ YEARS = 1988.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2159.00	.00	.00	2159	2159	2159
FP	1	34.000	.000	.000	34	34	34
TF	1	458.000	.000	.000	458	458	458
MV	1	15268937.00	.00	.00	15268937	15268937	15268937

------ YEARS = 1989.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2597.00	.00	.00	2597	2597	2597
FP	1	31.000	.000	.000	31	31	31
TF	1	473.000	.000	.000	473	473	473
MV	1	17530523.00	.00	.00	17530523	17530523	17530523

------ YEARS = 1990.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3292.00	.00	.00	3292	3292	3292
FP	1	285.000	.000	.000	285	285	285
TF	1	544.000	.000	.000	544	544	544
MV	1	19824539.00	.00	.00	19824539	19824539	19824539

------ YEARS = 1991.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3377.00	.00	.00	3377	3377	3377
FP	1	324.000	.000	.000	324	324	324
TF	1	602.000	.000	.000	602	602	602
MV	1	20392490.00	.00	.00	20392490	20392490	20392490

------ YEARS = 1992.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3067.00	.00	.00	3067	3067	3067
FP	1	368.000	.000	.000	368	368	368
TF	1	692.000	.000	.000	692	692	692
MV	1	21198027.00	.00	.00	21198027	21198027	21198027

------ YEARS = 1993.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2825.00	.00	.00	2825	2825	2825
FP	1	346.000	.000	.000	346	346	346
TF	1	742.000	.000	.000	742	742	742
MV	1	18843769.00	.00	.00	18843769	18843769	18843769

------ YEARS = 1994.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2936.00	.00	.00	2936	2936	2936

Fig. 1 D 1

FP	1	289.000	.000	.000	289	289	289
TF	1	771.000	.000	.000	771	771	771
MV	1	20953220.00	.00	.00	20953220	20953220	20953220

------ YEARS = 1995.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3433.00	.00	.00	3433	3433	3433
FP	1	185.000	.000	.000	185	185	185
TF	1	846.000	.000	.000	846	846	846
MV	1	17842002.00	.00	.00	17842002	17842002	17842002

------ YEARS = 1996.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3402.00	.00	.00	3402	3402	3402
FP	1	221.000	.000	.000	221	221	221
TF	1	942.000	.000	.000	942	942	942
MV	1	18358391.00	.00	.00	18358391	18358391	18358391

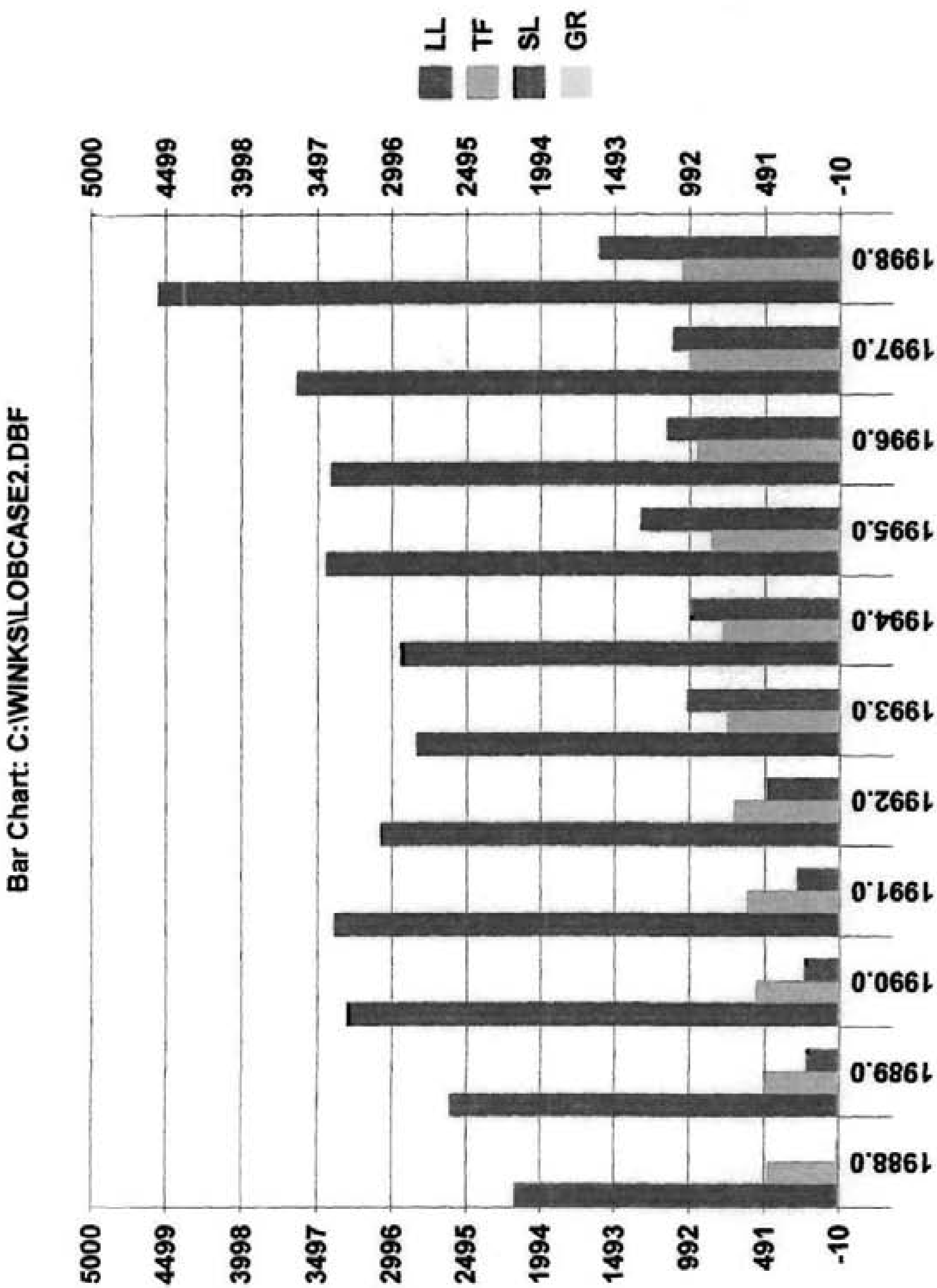
------ YEARS = 1997.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3631.00	.00	.00	3631	3631	3631
FP	1	236 000	.000	.000	236	236	236
TF	1	994 000	.000	.000	994	994	994
MV	1	20125993.00	.00	.00	20125993	20125993	20125993

------ YEARS = 1998.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	4548.00	.00	.00	4548	4548	4548
FP	1	239.000	.000	.000	239	239	239
TF	1	1038.00	.00	.00	1038	1038	1038
MV	1	20013415.00	.00	.00	20013415	20013415	20013415

Fig. 1 D 2



Bar Chart: C:\WINKS\LOBCASE2.DBF
LL
TF
SL
GR
5000
4499
3998
3497
2996
2495
1994
1493
992
491
-10
1988.0
1989.0
1990.0
1991.0
1992.0
1993.0
1994.0
1995.0
1996.0
1997.0
1998.0

Fig. 2 A

Case II

Linear Regression and Correlation C:\WINKS\LOBCASE2.DBF

Dependent variable is LL, 3 independent variables, 11 cases.

Variable	Coefficient	St. Error	t-value	p(2 tail)
Intercept	1520.8734	959.03929	1.5858301	0.157
TF	2.3488605	1.9846485	1.1835146	0.275
SL	.1962944	.8304833	.2363617	0.820
GR	-141.959	139.08438	-1.020668	0.341

R-Square = 0.6658 Adjusted R-Square = 0.5226

Analysis of Variance to Test Regression Relation

Source	Sum of Sqs	df	Mean Sq	F	p-value
Regression	2538407.94059	3	846135.98	4.6482415	0.043
Error	1274235.	7	182033.57		
Total	3812642.90909	10			

A low p-value suggests that the dependent variable LL may be linearly related to independent variable(s).

Fig. 2 B

Case III

WINKS 4.62 November 5, 2000

Linear Regression and Correlation C:\WINKS\LOB3.DBF

Dependent variable is LL, 3 independent variables, 11 cases.

Variable	Coefficient	St. Error	t-value	p(2 tail)
Intercept	897.77585	4631.4208	.1938446	0.852
TW	-.0002125	.000032	-6.646754	<.001
RF	23.560853	13.895186	1.6956126	0.134
AT	37.384008	73.046843	.5117813	0.625

R-Square = 0.8711 Adjusted R-Square = 0.8158

Analysis of Variance to Test Regression Relation

Source	Sum of Sqs	df	Mean Sq	F	p-value
Regression	3321070.83822	3	1107023.61274	15.764047	0.002
Error	491572.07	7	70224.582		
Total	3812642.90909	10			

A low p-value suggests that the dependent variable LL may be linearly related to independent variable(s).

Fig. 3 C

Case III

WINKS 4.62 November 5,2000

Matrix of Correlation Coefficients C:\WINKS\LOB3.DBF

	LL	TW	RF	AT
LL		-.898 (0.0) [11]	.147 (.666) [11]	-.16 (.639) [11]
TW			.106 (.757) [11]	.291 (.386) [11]
RF				.176 (.604) [11]
AT				

Key: Correlation
(p-value)
[count]

Fig. 3 D

Case III

WINKS 4.62 November 5,2000

Descriptive Statistics, Summary C:\WINKS\LOB3.DBF

Statistics from database C:\WINKS\LOB3.DBF Number of records= 11

------ YEAR = 1988.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2159.00	.00	.00	2159	2159	2159
TW	1	10646338.00	.00	.00	10646338	10646338	10646338
RF	1	38.370	.000	.000	38.370	38.370	38.370
AT	1	64.400	.000	.000	64.400	64.400	64.400

------ YEAR = 1989.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2597.00	.00	.00	2597	2597	2597
TW	1	7706507.00	.00	.00	7706507	7706507	7706507
RF	1	56 060	.000	.000	56.060	56.060	56.060
AT	1	65 300	.000	.000	65.300	65.300	65.300

------ YEAR = 1990.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3292.00	.00	.00	3292	3292	3292
TW	1	6031507.00	.00	.00	6031507	6031507	6031507
RF	1	44.780	.000	.000	44.780	44.780	44.780
AT	1	65.420	.000	.000	65.420	65.420	65.420

------ YEAR = 1991.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3377.00	.00	.00	3377	3377	3377
TW	1	5438400.00	.00	.00	5438400	5438400	5438400
RF	1	45.690	.000	.000	45.690	45.690	45.690
AT	1	66.700	.000	.000	66.700	66.700	66.700

------ YEAR = 1992.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3067.00	.00	.00	3067	3067	3067
TW	1	6383857.00	.00	.00	6383857	6383857	6383857
RF	1	47.480	.000	.000	47.480	47.480	47.480
AT	1	63.500	.000	.000	63 500	63.500	63.500

------ YEAR = 1993.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2825.00	.00	.00	2825	2825	2825
TW	1	6673430.00	.00	.00	6673430	6673430	6673430
RF	1	42.160	.000	.000	42.160	42.160	42.160
AT	1	66.000	.000	.000	66	66	66

------ YEAR = 1994.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	2936.00	.00	.00	2936	2936	2936

Fig. 3 E 1

TW	1	7152425.00	.00	.00	7152425	7152425	7152425
RF	1	44.690	.000	.000	44.690	44.690	44.690
AT	1	64.870	.000	.000	64.870	64.870	64.870

------ YEAR = 1995.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3433.00	.00	.00	3433	3433	3433
TW	1	3409326.00	.00	.00	3409326	3409326	3409326
RF	1	38.240	.000	.000	38.240	38.240	38.240
AT	1	65.780	.000	.000	65.780	65.780	65.780

------ YEAR = 1996.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3402.00	.00	.00	3402	3402	3402
TW	1	2402424.00	.00	.00	2402424	2402424	2402424
RF	1	38.060	.000	.000	38.060	38.060	38.060
AT	1	62.540	.000	.000	62.540	62.540	62.540

------ YEAR = 1997.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	3631.00	.00	.00	3631	3631	3631
TW	1	2207449.00	.00	.00	2207449	2207449	2207449
RF	1	37.970	.000	.000	37.970	37.970	37.970
AT	1	63.930	.000	.000	63.930	63.930	63.930

------ YEAR = 1998.0

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
LL	1	4548.00	.00	.00	4548	4548	4548
TW	1	1751380.00	.00	.00	1751380	1751380	1751380
RF	1	52.700	.000	.000	52.700	52.700	52.700
AT	1	64.200	.000	.000	64.200	64.200	64.200

Fig. 3 E 2

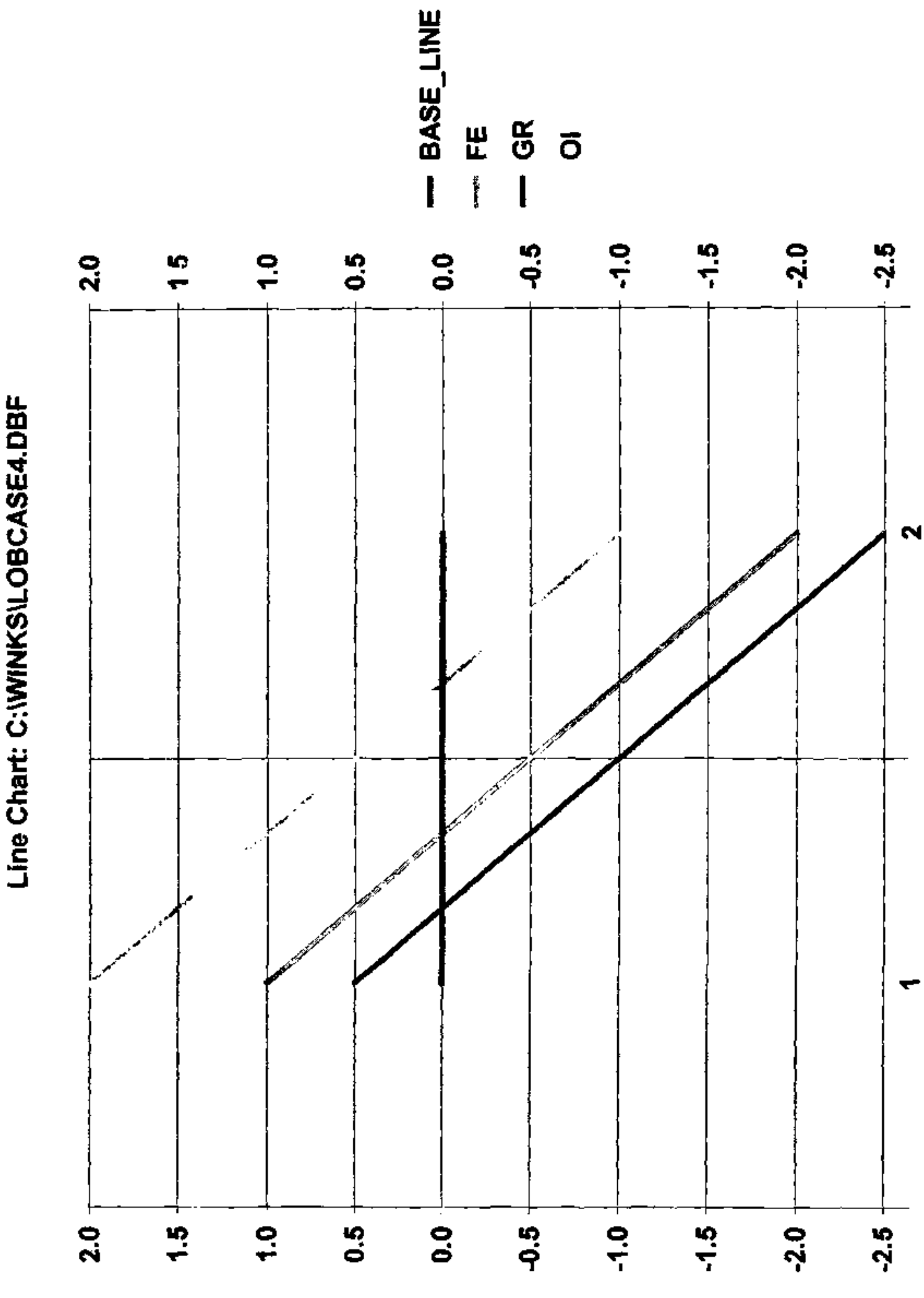
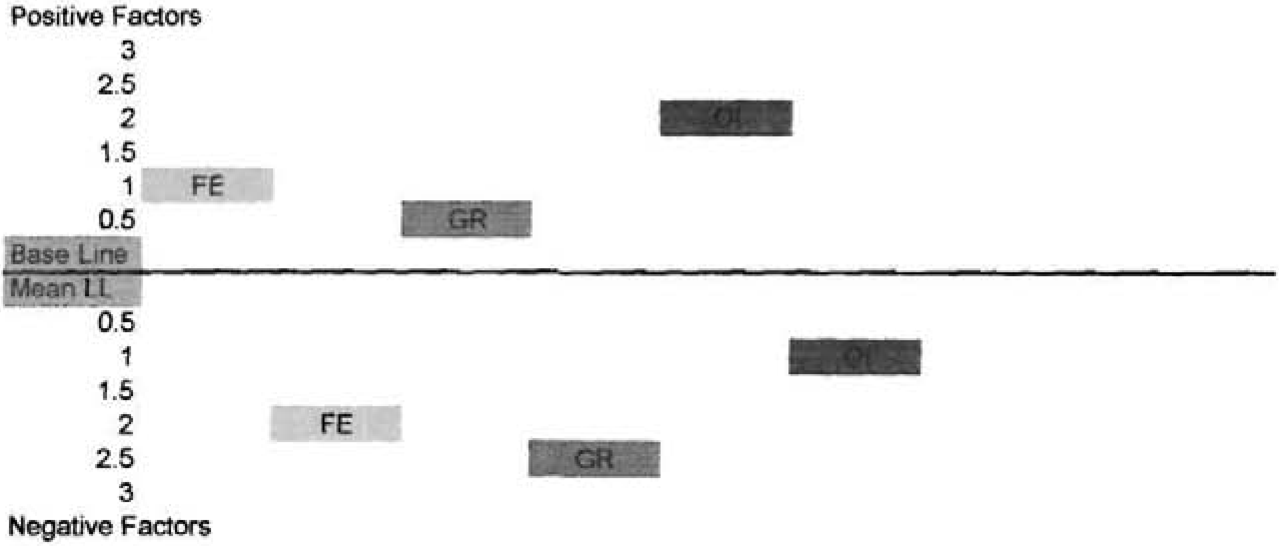

Line Chart: C:\WINKS\LOBCASE4.DBF
BASE_LINE
FE
GR
OI
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
1
2

Fig. 4 A

Case IV



For each bivariate relationship within each case that has a SIGNIFICANT effect a Positive Factor of 1 is assigned.
For each bivariate relationship within each case that has a NO SIGNIFICANT effect a Negative Factor of 1 is assigned.

This chart reveals the effect each case has on the base line of Lobsters Landed (LL).

It can be infered from this chart and the data that was used to construct it that government regulations to have the least effect on the amount of Lobsters Landed (LL) and that Outside Influences (OI) has the greatest effect on Lobsters Landed (LL).

Fig. 4 B

Case IV

WINKS 4.62 November 5,2000

Descriptive Statistics, Summary C:\WINKS\LOBCASE4.DBF

Statistics from database C:\WINKS\LOBCASE4.DBF Number of records= 2

FIELD	N	MEAN	STD	SEM	MIN	MAX	SUM
BASE_LINE	2	.0000	.0000	.0000	0	0	0
FE	2	-.5000	2.1213	1.5000	-2	1	-1
GR	2	-1.0000	2.1213	1.5000	-2.500	.500	-2
OI	2	.5000	2.1213	1.5000	-1	2	1

Fig. 4 C

Temprature and Rainfall Data Comparisons and Calculations for 1988 - 1998

NWS Averages

	MAY		JUNE		JULY
58.00	Average Temprature	67.00	Average Temprature	73.00	Average Temprature
3.60	Total Rainfall	2.90	Total Rainfall	3.10	Total Rainfall
	AUG.		**SEP.**		**OCT.**
71.00	Average Temprature	63.00	Average Temprature	53.00	Average Temprature
3.90	Total Rainfall	3.50	Total Rainfall	3.60	Total Rainfall

1988 - 1998 Data ***1 missing field for Temprature, 2 missing fields for Rainfall***

	MAY		JUNE		JULY
58.41	Average Temprature	68.32	Average Temprature	72.95	Average Temprature
3.14	Total Rainfall	2.18	Total Rainfall	3.07	Total Rainfall
	AUG.		**SEP.**		**OCT.**
72.09	Average Temprature	63.85	Average Temprature	53.40	Average Temprature
3.92	Total Rainfall	3.71	Total Rainfall	3.76	Total Rainfall

Average Temprature Data from the National Weather Almanac - 9th Edition

	May	June	July	August	September	October	Annual Average
1988	58.00	66.90	74.30	75.30	63.00	48.90	64.40
1989	59.30	68.70	72.30	72.10	65.30	54.10	65.30
1990	56.00	67.70	73.00	73.50	63.70	58.60	65.42
1991	63.90	69.30	74.20	73.60	63.10	56.10	66.70
1992	57.60	67.30	70.30	70.10	64.00	51.70	63.50
1993	61.80	69.30	74.50	73.80	65.10	51.50	66.00
1994	56.50	69.40	76.20	69.90	63.00	54.20	64.87
1995	57.30	68.30	75.80	73.50	62.80	57.00	65.78
1996	57.40	68.10	*N/R*	71.00	64.10	52.10	***62.54***
1997	55.40	68.10	73.70	70.60	64.00	51.80	63.93
1998	59.30	68.40	72.20	69.60	64.30	51.40	64.20
Monthly Averages	58.41	63.32	***72.95***	72.09	63.85	53.40	64.79

Total Rain Fall Data from the National Weather Almanac - 9th Edition

	May	June	July	August	September	October	Annual Average
1988	2.83	C.91	5.73	0.95	2.38	1.77	2.43
1989	6.07	5.84	5.59	6.14	4.75	8.37	6.13
1990	5.70	1.13	3.52	3.74	2.28	4.96	3.56
1991	3.30	0.93	2.76	5.98	5.09	2.65	3.45
1992	1.42	4.61	3.59	6.06	5.09	1.53	3.72
1993	1.12	1.40	2.18	1.23	4.08	3.55	2.26
1994	2.98	2.70	1.34	6.34	4.12	0.40	2.98
1995	2.83	2.89	1.17	1.80	4.06	6.37	3.19
1996	2.44	2.17	5.57	2.19	5.72	6.20	4.05
1997	2.68	2.23	0.96	6.32	0.99	1.80	2.50
1998	***N/R***	***N/R***	1.37	2.39	2.30	3.78	2.46
Monthly Averages	3.14	2.48	3.07	3.92	3.71	3.76	3.34

All Data was gathered from the "Weather Alamanac - 9th Edition", the "Climatolicical National Annual Survey" and the National Weather Service Website "www.nws.gov/annual/averages" for the city of Providence.

Trap Survey Data for Fishing Season 1988 thru 1998

Pt Judith/Snug Harbor

Year/Boat	1	2	3	4	5	6	7	8	Average
1988	450	400	600	500	400	400	500	600	481.25
1989	450	400	600	500	400	400	600	600	493.75
1990	450	600	600	625	400	500	700	600	559.38
1991	550	600	600	625	800	500	800	600	634.38
1992	650	800	800	750	800	500	900	800	750.00
1993	750	800	800	750	800	600	1000	800	787.50
1994	750	800	800	875	800	600	1100	800	815.63
1995	850	1000	800	875	1200	600	1200	800	915.63
1996	950	1000	1000	1000	1200	800	1300	1000	1031.25
1997	1050	1200	1000	1000	1200	800	1400	1000	1081.25
1998	1200	1200	1000	1125	1200	800	1500	1000	1128.13

Newport/Jamestown/Tiverton

Year/Boat	1	2	3	4	5	6	7	8	Average
1988	600	400	400	400	500	450	400	500	456.25
1989	600	400	400	400	600	450	400	500	468.75
1990	600	400	600	500	700	450	500	625	546.88
1991	600	800	600	500	800	550	500	625	621.88
1992	800	800	800	500	900	650	500	750	712.50
1993	800	800	800	600	1000	750	600	750	762.50
1994	800	800	800	600	1100	750	600	875	790.63
1995	800	1200	1000	600	1200	850	600	875	890.63
1996	1000	1200	1000	800	1300	950	700	1000	993.75
1997	1000	1200	1200	800	1400	1050	800	1000	1056.25
1998	1000	1200	1200	800	1500	1200	900	1125	1115.63

Warwick/East Greenwich/Wickford

Year/Boat	1	2	3	4	5	6	7	8	Average
1988	500	400	450	400	500	450	400	400	437.50
1989	500	400	450	400	500	600	400	400	456.25
1990	625	500	450	500	625	600	500	400	525.00
1991	625	500	550	500	625	600	500	500	550.00
1992	750	500	650	500	750	750	500	500	612.50
1993	750	600	750	600	750	750	600	600	675.00
1994	875	600	750	600	875	750	600	600	706.25
1995	875	600	850	600	875	750	600	700	731.25
1996	875	600	950	800	875	900	700	700	800.00
1997	1000	700	950	800	1000	900	700	700	843.75
1998	1000	700	1050	800	1000	900	700	800	868.75

Average Number of Traps Fished Each Year

1988	1989	1990	1991	1992	1993
458.33	472.92	543.75	602.08	691.67	741.67

1994	1995	1996	1997	1998
770.83	845.83	941.67	993.75	1037.50

Data was gathered from survey conducted of 24 lobster fishing boat owners operators who derived at least 50% of their annual income from fishing.

Value Calculations for Government Regulation Implementation

Min Lobster Size Increase Iniatitive

Incremental Increase / Values

Year	Size	Value
1988		0
1989		1
1990		0
1991		0
1992		0
1993		0
1994		1
1995		0
1996		0
1997		0
1998		0
Total		2

Value=1per lobster size increase

Min Escape Vent Size Increase

Incremental Increases / Values

Year	Size	Value
1988		0
1989		1
1990		0
1991		0
1992		0
1993		0
1994		1
1995		0
1996		0
1997		0
1998		0
Total		2

Value=1per escape vent size increase

Trap Reduction Iniatitive

Traps per vessel allowed / Values

Year	Number	Value
1988	1200+	0
1989	1200+	0
1990	1200+	0
1991	1200+	0
1992	1200+	0
1993	1200+	0
1994	1200+	0
1995	1200+	0
1996	1200+	0
1997	1200+	0
1998	1200+	0
Total	1200	0

Value = 1 per 100 traps reduced

Permit Moratorium Chronology

Per Year / Values

Year		Value
1988		0
1989		0
1990		0
1991		0
1992		0
1993		0
1994		1
1995		1
1996		1
1997		1
1998		1
Total	0	5

Value = 1 per year of moratorium

License Moratorium Chronology

Per Year / Values

Year	Number	Value
1988		0
1989		0
1990		0
1991		0
1992		0
1993		1
1994		1
1995		1
1996		1
1997		1
1998		1
Total		6

Value = 1 per year of moratorium

Values per Year Summations

Per Year / Values

Year	Number	Value
1988		0
1989		2
1990		0
1991		0
1992		0
1993		1
1994		4
1995		2
1996		2
1997		2
1998		2
Total		15

Value = Annual totals per category

Summary:

The data collected was categorized into three studies, univariate over time, bivariate over time, and multivariate over time. Comparisons of this data were made using various accepted statistical analysis techniques. In most cases data was entered in a chronological manner because the hypothesis is based on a trend over time. In the final case data was entered using forced entry using my background in the industry to make judgments on what order to be used. Measures are made quantitatively using standard unit of measures or assigned values after calculation when standard measures weren't appropriate. When ever possible, alternate explanations for plausible causal relationships have been rendered using known and established information. When no alternate explanation is apparent in depth scientific studies are called for.

<u>Documentation:</u>

All sources have been referenced in the last page of this study using the APA format. Data used was gathered from sources three major areas are generally accepted as reliable.

1) 50% of the data gathered was either used by and/or provided by several governing agencies and the scientific community in the form of printed or electronic media available to the general public.
2) 25% of the data gathered was from "Official Requests for Information" to appropriate agencies under the Freedom of Information Act.
3) 25% of the data was gathered through the use of face-to-face or telephonic interviews and surveys taken by the author.

<u>Comparisons:</u>

Univariate - Data points for an eleven-year period starting in 1988 and ending in 1998 were organized and graphically displayed using histograms and time series plots. Each data point was compared to the next chronologically using one calendar year summations. This was done in order to determine any significant trends from one year to the next.

Bivariate - Various independent data sets were compared to the dependent data set (lobster landings in metric tons). The data was graphically displayed using time series plots and scatter plots. Each data set was compared to the next chronologically using the eleven-year time line. Linear regression, Pearson's correlation, comparison of the basic descriptive statistical data, and any observed correlations in the graphs were used to determine if any significant correlation could be inferred from these data sets.

<u>Multivariate Analysis:</u>

Taking the results from the Univariate comparisons three cases were formed. They were fishing effort (FE), government regulations (GR), outside influences (OI). Each one of these cases compare three independent variables related to the particular case with dependent variable of lobsters landed (LL). A forth case was created comparing the three studies between themselves as independent variables versus the dependent variable median lobster landings. Values were calculated and assigned to each bivariate comparison. The data was then graphically displayed so as to compare all the variables over time. This was done using various graphing techniques such as base line charts, time series plots, line charts and bar charts. Statistical summaries by chronological group, correlation matrixes, and multivariate were used as the descriptive statistical data.

Quantification:

Significant Relationship Inferences - Significance was inferred by the observation of data points over time having or not having a parallel or inverse relationship. That is to say was there a proportionate increase or decrease of the independent data point as compared to the dependent data at the same point in time.

Significant Relationship Quantification - So as to be able to quantify resulting observation a three level scale was used. If three or less continuous independent data points did not correlate than it was inferred that **no** significant relationship existed. If 4 to 7 independent data points correlated then it was inferred that a **moderate** significance existed. If 8 or more existed then it was inferred that a **strong** relationship existed.

Assigning Value - For Case IV if a moderate significance was inferred a **+.5** value was given. If a strong relationship is inferred it was given a value of **+1**. If no significant relationship was inferred it was given a value of **-1**. These values were used to display the existing relationships between cases I, II, and III, as compared to a baseline of 0 on a baseline chart.

Cause and Effect:

Due to the factors of time (11 weeks) and resources (no funding) not all possible studies on every possible scenario were conducted. While **no absolute** causal relationship can be established (this would require a in depth scientific study) there are significant relationships, which can be inferred with a high degree of certainty. The results are so obvious as to bring in to question the validity of positions held by the scientific and government community. The three cases presented where there is enough of a significant relationship to infer that it is highly likely to be a causal relationship are Toxic Waste Releases (TW), Rain Fall (FR) and Traps Fished (TF).

Alternate Theories:
Scientific studies utilizing experiments that would determine to what extent the effects of TW taking each component listed could be conducted. Combinations of elements and amounts of each one could be established by use of computer simulations then actual experiments could be conducted by introducing these elements at various rates into the observed, closed test environments to determine the effect on the test animals. A similar study could be done with salinity/sediment levels in a water table although basic data currently exists concerning these effects thereby addressing the RF correlation.

In regards to traps fished, the position that fishing effort is a root cause to an eventual stock decline and possible collapse (as taken by the government and scientific community) is an assumption that could be quantified and verified (or dismissed) through studies on the following possible scenarios.

1) That all marine life is cyclical in nature because of there required coexistence in the ecosystem. The decline in predators fish due to ground fish over fishing, decrease in toxic waste released into the water due to the "Clean Water Act" and the change in salinity/water temperature due to the "Green House Effect" has actually increased the lobster stocks over time.
2) That by decreasing the number of traps fished the results will only increase the number of lobsters caught per trap. Their by increasing the return on effort (ROE) from the current average of 1 pound per pot per haul seasonally.
3) That there are so many fisherman, fishing so many traps, the amount of bait in the water (in fact an artificial condition) has created an environment where lobsters have a man made habitat where juveniles under legal harvest size have additional advantages towards survival. Food and shelter that would otherwise not be present in the ecosystem is placed by the fisherman, there by assisting sub legal size lobsters to live and breed safely until reaching harvestable size.

These are the most popular contentions held by the fishing community. Scientific studies could be easily conducted and statistical models constructed to quantify or dismiss these contentions. They are directly related to the TF case.

There are currently studies in existence, underway or recently funded that may address these possibilities. Two of which are:
Study to Predict Lobster Catch Funded - The Maine/New Hampshire Sea Grant Program was recently awarded funding from National Sea Grant for a three-year project called "Developing Indices Necessary for Predicting Commercial Catches of the American Lobster". The three year project, researchers will develop and test techniques to predict lobster landings at study sites in coastal waters of Long Island Sound, Rhode Island, New Hampshire, and Maine.

"The Fate of Bait" - Dr. Robert Steneck of the University of Maine conducted an experiment with graduate students where lobsters were observed crawling into and out of the forward chambers of lobster traps to feed on redfish, herring, and other bait fish or

stealing pieces of bait through the slats of the traps. They were even observed crawling into empty traps. Dr. Robert Steneck concluded that, "Baited lobster traps may actually be the largest aquaculture effort in the world."[3] Shortly after all the traps were removed from the fishing grounds, the lobsters left the area, too.

Information gathered from the "The Fate of Bait" study and from the University of Maine's Lobster Institute shows there are various scientific explanations. One of which is that contention #3 may be a large factor. "Research has found that lobsters have definite opinions as to the type of ocean bottom they prefer. Given the option of settling down on mud, sand, gravel, or cobble (small stones), they all gravitated to the cobble bottom where they could hide from predators in the spaces between the rocks and still catch falling food. "Adolescent" lobsters (a few years old to market size) prefer areas with larger boulders. Adult lobsters don't seem to care--they'll go anywhere and sometimes migrate long distances. They also have fewer predators today."[4]

Dr. Steneck also did an observed study where he created what he defined as a "lobster condo" by taking sections of PVC pipe, attaching them together and placing the "condo" on the sea bottom in areas historically inhabited by lobsters. His observations show that it was, "quickly inhabited by sub legal juvenile lobsters".[5]

It would seem that the scientific community has enough evidence in the form of studies conducted by long time reputable members of there community to warrant a full study into these three possible explanations provided by the opposing fishing industry. This would in turn lay to rest logical opposition as it can currently be assessed or give credence and confirmation to questions raised by the fishing community.

[3] Quoted from the "Fate of Bait" study conducted by Dr. Robert Steneck of the University of Maine

[4] Quoted from "A lobsters life cycle" University Maine Lobster Institute, web address http://octopus.gma.org/lobsters/society.html

[5] Quoted from the "Fate of Bait" study conducted by Dr. Robert Steneck of the University of Maine and "A lobsters life cycle" University Maine Lobster Institute, web address http://octopus.gma.org/lobsters/society.html

References:

National Marine Fisheries Service. Annual Landings Results North Atlantic Lobster 1988 through 1998. Retrieved 10 October 2000, from the World Wide Web: http://www.st.nmfs.gov/webplcomm/plsql/webstl.MF_ANNULA_LANDINGS.RESULTS.html

Environmental Protection Agency. New England Region Toxic Waste Release Inventory 1988 through 1998. Retrieved 11 October 2000, from the World Wide Web: http://www.epa.gov/region01/steward/emerplan/toxic.html

National Weather Service. (1999). Weather Almanac (9th ed.) Washington, DC: United States Printing Office

National Climate Data Center. (2000). Climatilogical National Annual Survey –1999 Washington, DC: United States Printing Office

Official request for information under the "Freedom of Information Act" Received 16 October 200 from John Nagel, Supervisory Policy Analyst, Operations Group, Sustainable Fisheries Division, Northeast Regional Office, National Marine Fisheries Service

Official request for information under the "Freedom of Information Act" Received 23 October 2000 from Margaret McGrath, Administrative Officer, Rhode Island Department of Environmental Management Office of Licenses and Registration.

Rhode Island Fisheries Regulations published and implemented from 1988 through 1998

Federal Fisheries Regulations published and implemented from 1988 through 1998

THE BASICS

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INFORMATION

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FILES TO DOWNLOAD

- Lobster Business Models
- Fish Mgt. Slide Show

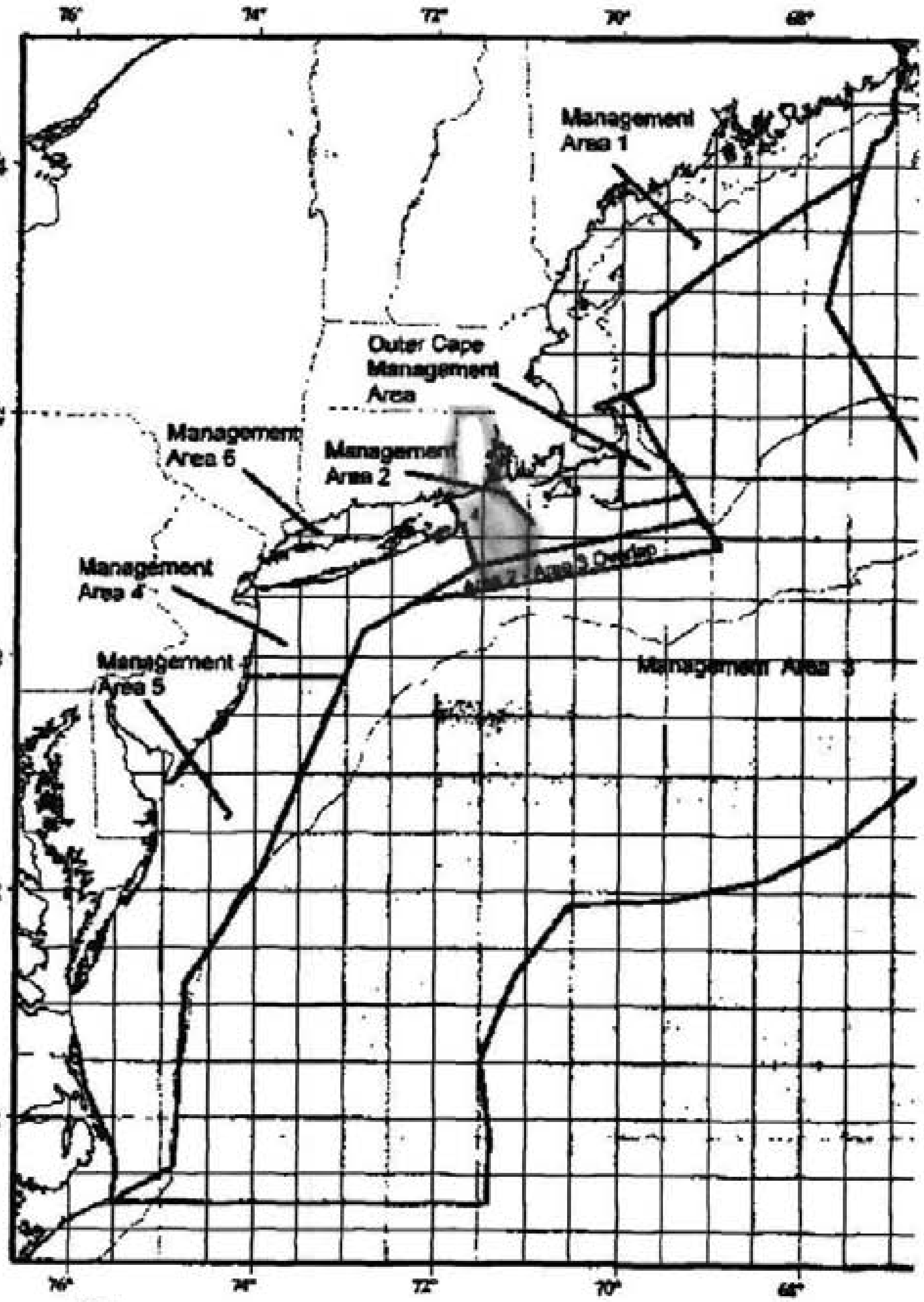
KEY CONCEPTS

- Recruit Overfishing
- Growth Overfishing
- Fishing Mortality
- Conservation Payoff
- Targets vs Thresholds

Sitemap

Owners Suite

American Lobster Management Areas



NOAA Fisheries
Northeast Regional Office
Gloucester, MA

Show All

The "Definition of Overfishing" for the Lobster Resource

"The American lobster resource is overfished when it is harvested at a rate that results in egg production from the resource, on an egg-per-recruit basis, that is less than 10% of the level produced by an unfished population." (Atlantic States Marine Fisheries Commission Amendment #3 to the Interstate Fishery Management Plan for Lobster)

This official definition of overfishing can also be explained as follows: The average female lobster should be allowed to live long enough to produce at least 10% of the eggs that she would produce if she were allowed to live her natural life.

While it may seem impossible to judge the egg production from an unfished population, considering that the lobster population has been heavily fished for over 100 years, it should be considerably easier to calculate the egg production from a female that lived a natural life span. If we know how often a female produces eggs, how many eggs she produces each time, and how many years she is likely to live, we can calculate how many eggs she would produce over her life time.