6-1-1997

Evaluation of the Potomac River American Eel (Anguilla rostrata) Pot Fishery based on Commercial Landings

Patrick J. Geer
Virginia Institute of Marine Science

Evaluation of the Potomac River American Eel (*Anguilla rostrata*) Pot Fishery based on Commercial Landings

Prepared by

Patrick J. Geer

for

The Potomac River Fisheries Commission
and the Technical Committee for the
Atlantic States Marine Fisheries Commission

Virginia Marine Resource Report
VMRR 97-06

June, 1997

ACKNOWLEDGEMENTS

Gratitude must be expressed to several staff members at the Virginia Institute of Marine Science who help with collections, including Joy Dameron, Dave Hata, and Bob Wood. A special thanks to Maurice Bosse, owner/operator of Robberecht's Seafood of Montross, Virginia, for allowing us access to his processing center to collect the necessary samples.

INTRODUCTION

The catadromous American eel (*Anguilla rostrata*) supports valuable commercial and limited recreational fisheries throughout most of its range. Adults are prized in the European market while elvers (immature eels less than 60 mm in total length) are shipped live to Japan for pond culture. Commercial catch from Atlantic states reached a peak of 1645 metric tons in 1979, and has shown a steady decline since (571 metric tons in 1995) (USDOC, 1997). Regionally, the Mid-Atlantic states (New York, Delaware, New Jersey, Maryland, and Virginia) have consistently dominated landings, with over 80% of all legal catches historically landed in these five states. The coastal waters of Virginia and Maryland have often provide the bulk of the Mid-Atlantic catches (Figures 1 & 2) with eel pots being the primary harvesting gear.

In response to concerns of the Potomac River Fisheries Commission (PRFC) over declining catches, The Virginia Institute of Marine Science agreed to monitor the commercial harvest during the spring and early summer of 1997. The monitoring entailed visiting eel processing plants and sampling the catch to obtain basic biological information.

METHODS

All sampling was performed at Robberecht's Seafood of Montross, Virginia, located on Nomini Creek, a tributary of the Potomac River. Samples were obtained only on days when processing was being performed. The owner of the plant, Mr. Maurice Bosse, would be contacted and arrangements made so staff members could be present during processing. On each day, samples were obtained after grading (according to size) and lengths and weights taken using the Limnoterra@ electronic measuring boards. Grades were sampled independently and noted in the database as (1) small, (2) medium, (3) large, or (4) jumbo. Grading was performed by the processing plant staff by dumping large quantities of eels into a runway with various size slots emptying into several large containers. Samples were obtained from these containers or from live wells . For each day, the site where the catch was harvested, and the approximate weight of the catch was obtained from Mr. Bosse.

RESULTS

A total of 392 eels were sampled between April 16th and May 28th, 1997. Only three grades were sampled, with the medium grade absent or not available during the three collection days. Lengths ranged from 107 mm to 710 mm with the corresponding weights ranging from 16.1 g to 744.5 g (Table 1). The grading appears to be successful in separating size classes, with an analysis of variance indicating significant differences in both length and weight between grades ($P \leq 0.0001$) with only minor significance ($P \leq 0.05$) between the sampling periods. However, there is still a fair amount of overlap between the ranges of the various size grades. Lengths are dominated by individuals less than 330 mm (Figure 3)

with over 50% of the individuals weighed being less than 80 grams (Figure 4).

The length-weight regressions for the first two sampling days (April 16th and 23rd) appear quite similar with the third day (May 28th) unique because the fact a larger grade was processed which was absent on the first two sampling days. The overall length-weight regressions appear in Figures 5 and 6 are represented by;

$$\text{Weight} = \text{Length} * 1.178 - 314.940 \quad r^2 = 0.8768,\ p \leq 0.0001,\ df=352$$

$$\text{LogWeight} = \text{LogLength} * 3.082 - 5.946 \quad r^2 = 0.9748,\ p \leq 0.0001,\ df=352$$

DISCUSSION

These data represent only the most rudimentary biological information on American eels. The species is long lived (15-25 years) and although many ageing studies have been undertaken, they've all show great variation in length at age, both within and between year classes (Van Den Avyle, 1984). Size for the small graded individuals in this study ranged from 107 to 395 mm (mean = 294.7). Based on an ageing study conducted on the York and James Rivers (Hedgepeth, 1983), these animals can be from two to five years old.

The absence of the medium size grade offers some interesting questions. There is a notable lack of data points between 325 and 400 mm (Figures 3 & 5), suggesting (1) a fishing bias, (2) a grading bias, (3) a sampling bias - three sampling days might not be enough to capture all size grades, or (4) a year class(s) failure.

Data collected over the past 25 years by the VIMS trawl survey suggests a decline in

average length of the population, occurring most dramatically since 1990 (Figure 7). These data, collected from river miles 20 to 40 on each of the James, Rappahannock, and York Rivers, indicate an average size of 270.63 mm (S.E.=3.67) prior to, and 244.30 since 1990 (S.E. = 1.89). The Potomac River was sampled by the VIMS survey only between 1974 and 1985, with somewhat similar results (Figure 8).

CONCLUSION

The recent concerns over the Atlantic states' American eel fishery warrants further investigation. The impact of increased elver export to Japan for pond culture may not be realized for several years. Several fisheries have already shown signs of collapse. The St. Lawrence Seaway has shown a dramatic decrease in juveniles at eel ladders, (Castonguay, et al, 1994a). At the same time the European eel, *Anguilla anguilla*, has had recruitment failure similar in magnitude (Castonguay, et al, 1994b). Since the Sargasso Sea is the site where both species spawn, there may be Atlantic-wide cause for this decline in juveniles. Several hypotheses have been put forth, including chemical contamination, habitat modifications, commercial fishing, and oceanic changes (Castonguay, 1994a). Interannual variability of the Gulf Stream transport system may effect transport and recruitment of glass eels to both the west and east coasts of the Atlantic. Although the Mid-Atlantic (in particular Virginia and Maryland) eel fishery may appear healthy, because of panmixia, the entire species may experience recruitment decline in the future.

REFERENCES

Castonguay, M., P.V. Hodson, and C.M. Couillard. 1994a. Why is recruitment of American eel, *Anguilla rostrata*, declining in the St. Lawrence River and Gulf? Can. J. Fish. Aquat. Sci., 51: 479-488.

Castonguay, M., P.V. Hodson, C. Moriarty, K.F. Drinkwater, and B.M. Jessop. 1994b. Is there a role of ocean environment in the American and European eel decline? Fisheries Oceanography 3(3): 197-203.

Hedgepeth, M.Y. 1983. Age, growth and reproduction of American eels, *Anguilla rostrata*, (Lesueur), from the Chesapeake Bay area. M.S. Thesis. College of William and Mary, Williamsburg, VA. 61pp.

USDOC (United States department of Commerce). April 24,1997. "Annual commercial landings statistics. National Marine Fisheries Service Fisheries Statistics Division Annual Landings Query". <http://remora.ssp.nmfs.gov/MFPUBLIC/owa/mrfss.FT_HELP.SPECIES>.

Van Den Avyle, M.J. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic) - American eel. USFWS FWS/OBS-82/11.24. U.S. Army Corp of Engineers, TR EL-82-4. 20pp.

Table 1A. Length and weight statistics by grade and sampling trip.

Date	Grad	Length (mm)					Weight (g)				
		Mean	SE	Min.	Max	N	Mean	SE	Min	Max	N
4/16	1	280.0	4.17	107	356	71	39.9	2.03	16.1	67.1	45
	3	474.2	8.84	267	680	59	208.7	14.12	33.3	655.1	58
4/23	1	298.6	3.00	242	395	91	48.2	1.63	28.5	105.7	86
	3	483.3	8.31	398	690	58	218.6	14.03	118.7	653.6	57
5/28	1	307.3	4.73	250	395	54	58.6	3.10	24.5	112.7	49
	3	435.3	11.99	310	590	38	178.0	15.51	60.2	493.8	38
	4	631.9	11.31	533	710	21	537.6	26.95	249.0	744.5	21

Table 1B. Length and weight statistics by grade for ALL sampling trips.

Grad	Length (mm)					Weight (g)				
	Mean	SE	Min.	Max	N	Mean	SE	Min	Max	N
1	294.7	2.31	107	395	216	49.0	1.35	16.1	112.7	180
3	468.1	5.62	267	690	155	204.8	8.46	33.3	655.1	153
4	631.9	11.31	533	710	21	537.6	26.95	249.0	744.5	21

American Eel Commercial Landings by State, Region, and Atlantic Coast

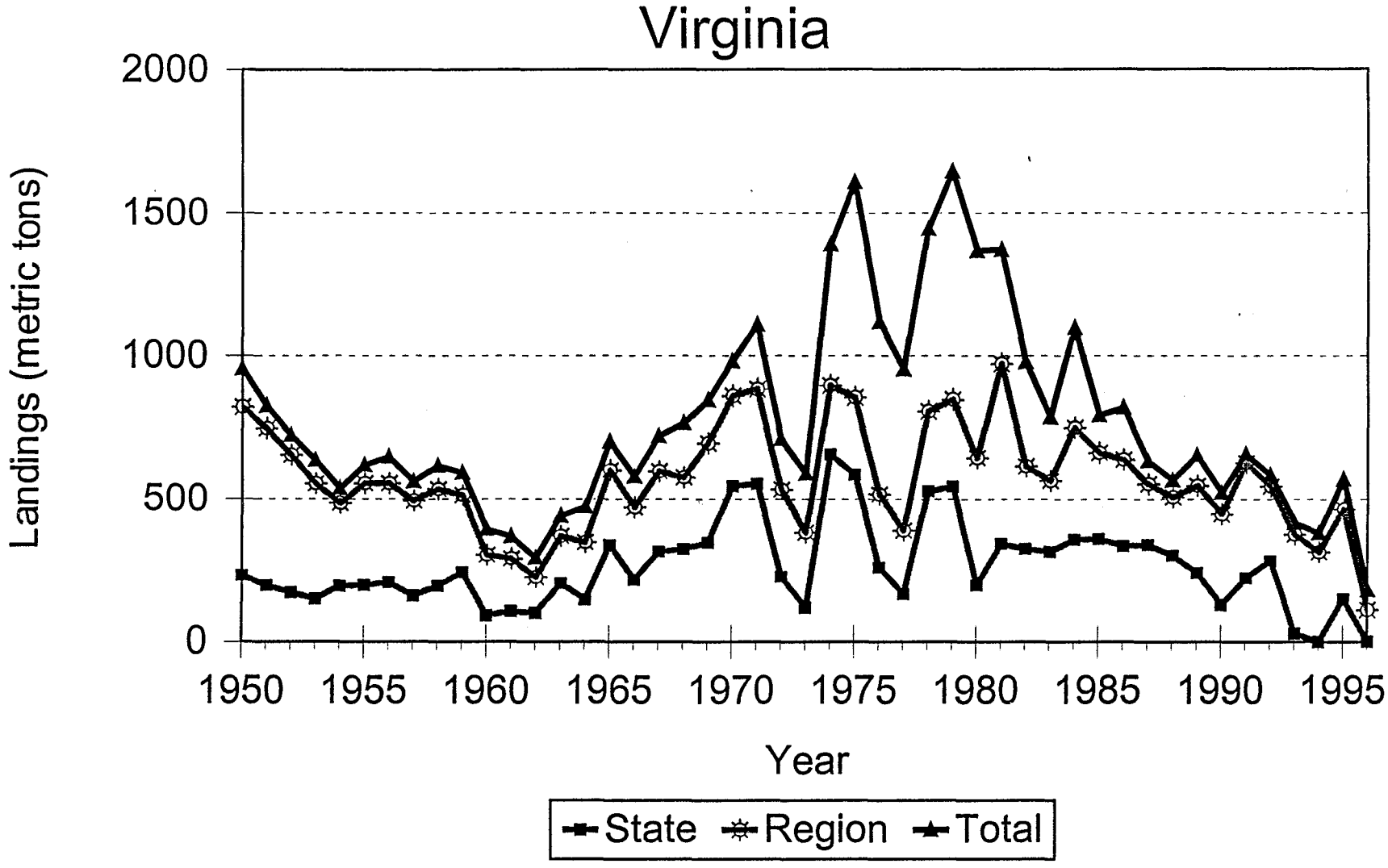


Figure 1: Commercial Landings of American eel by State, Region (Mid-Atlantic), and Atlantic Coast

American Eel Commercial Landings by State, Region and Atlantic Coast

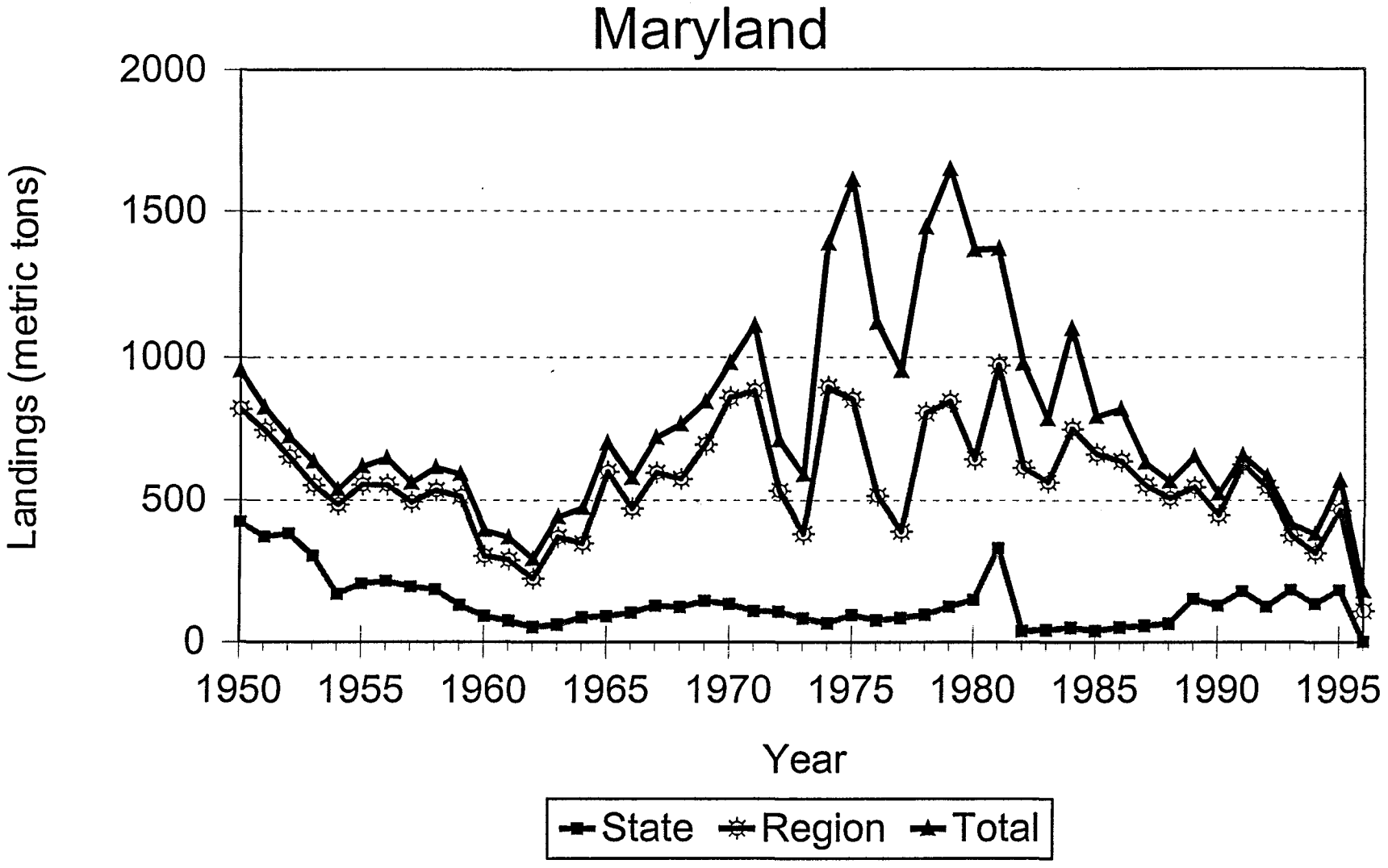


Figure 2: Commercial Landings of American eel by State, Region (Mid-Atlantic), and Atlantic Coast

Potomac River Eel Pot Fishery

1997 Length Frequency

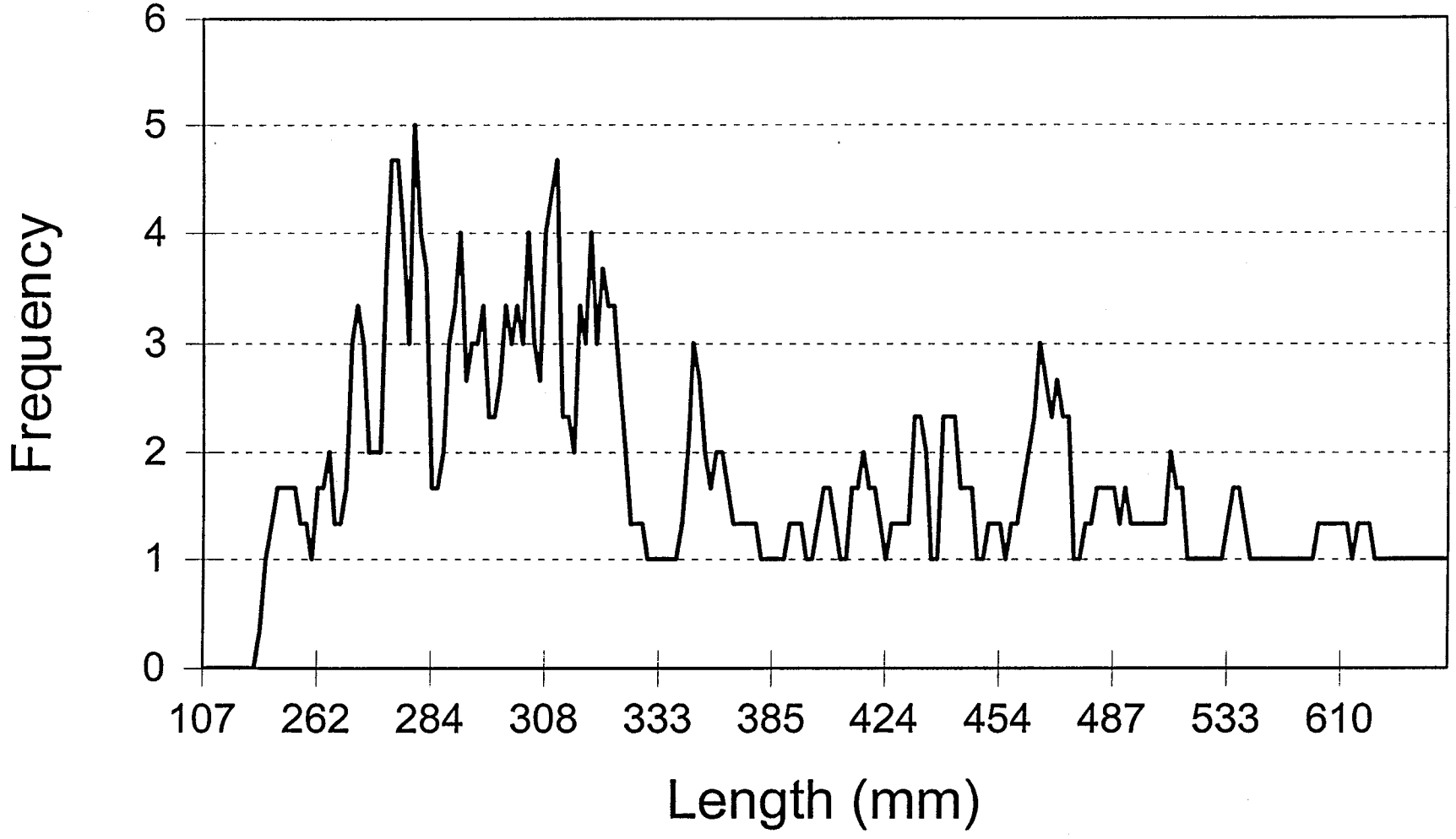


Figure 3. Length frequency of the Potomac River eel pot fishery. N = 392

Potomac River Eel Pot Fishery

1997 Weight Distribution

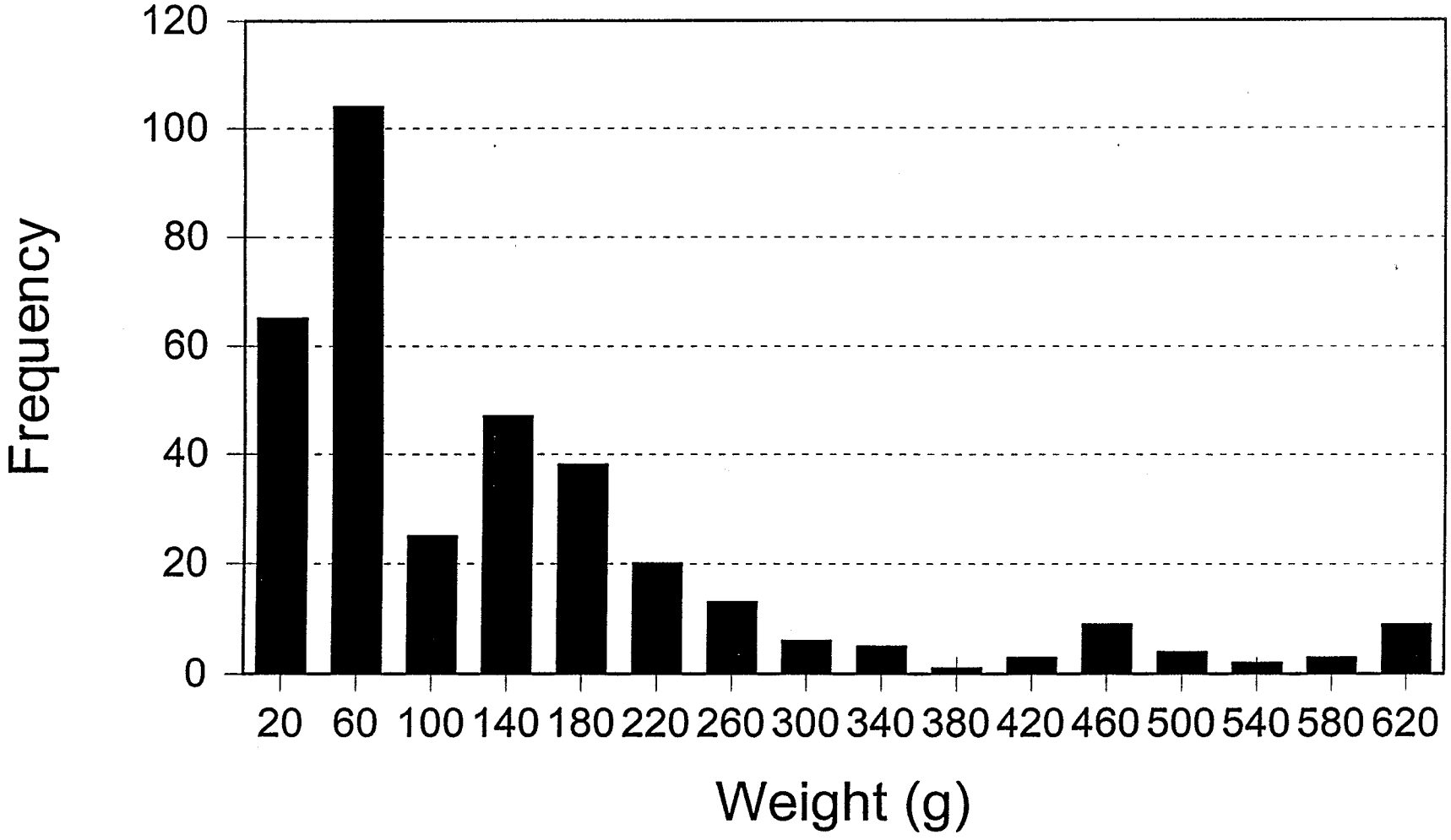


Figure 4. Weight distribution of the Potomac River eel pot fishery. N = 354

Figure 5. Length-Weight regression line and 95% confidence intervals for the 1997 Potomac River eel pot fishery. The regression line is as such;

Weight = Length * 1.178 - 314.940
$r^2 = 0.8768$, $p \leq 0.0001$, $df = 352$

POTOMAC RIVER EEL POT FISHERY – 1997

Length-Weight Regression of Raw Data for Year

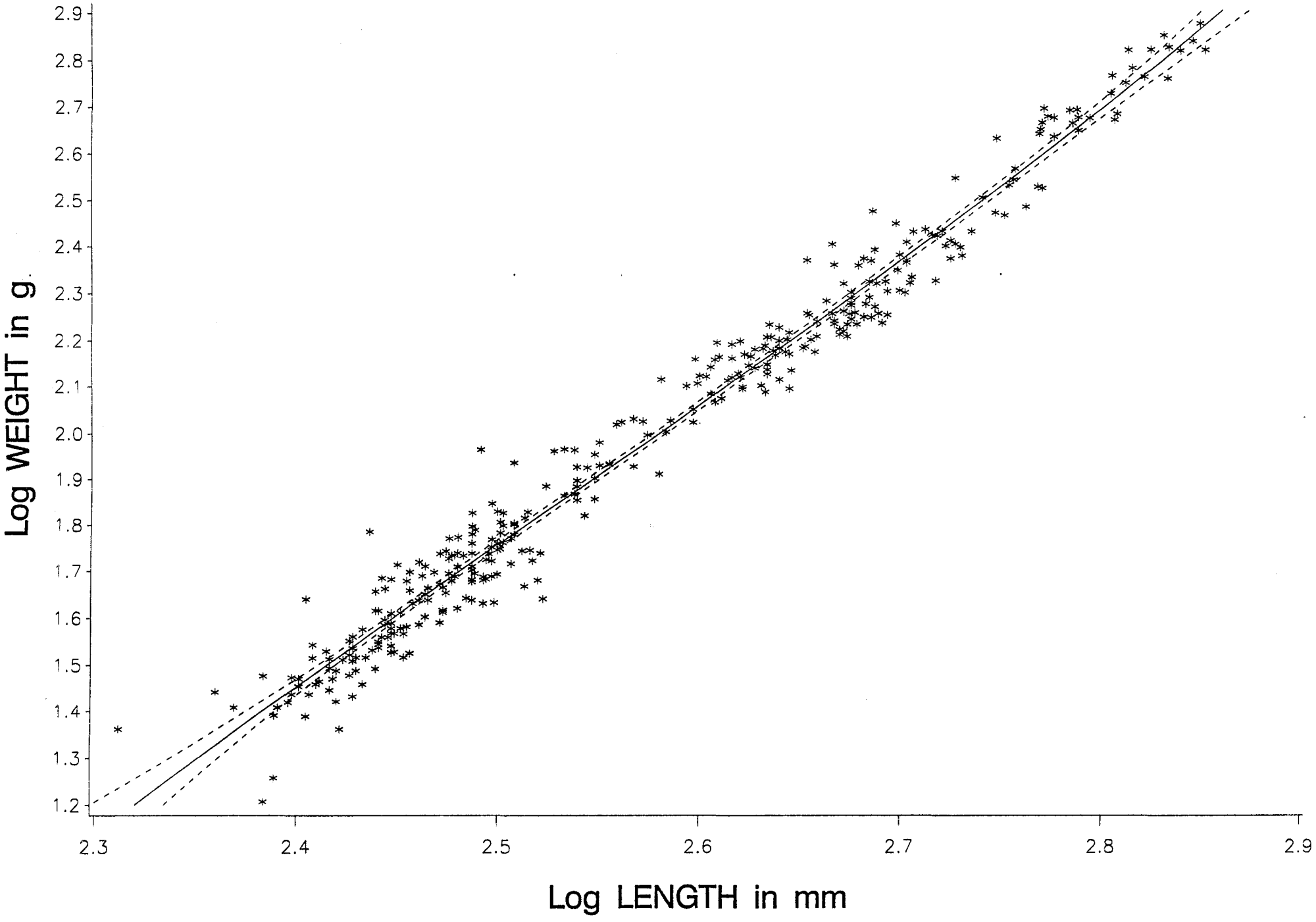


Figure 6. Length-Weight regression line and 95% confidence intervals for the 1997 Potomac River eel pot fishery expressed as a log base 10 function. The regression line is as such;

Log Weight = Log Length * 3.082 - 5.946
$r^2 = 0.9748$, $p \leq 0.0001$, df = 352

POTOMAC RIVER EEL POT FISHERY – 1997

Length-Weight Regression of Raw Data for Year

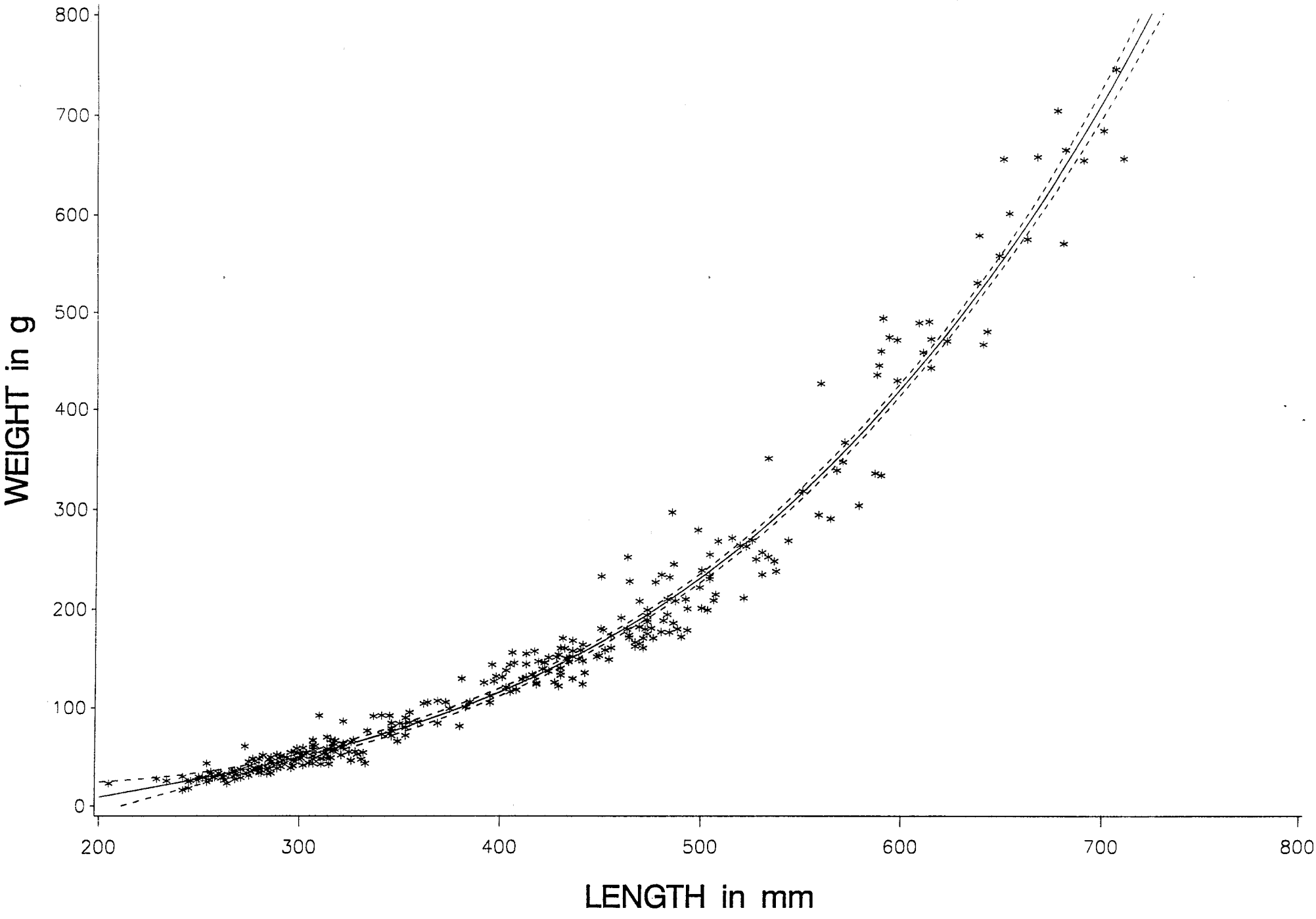
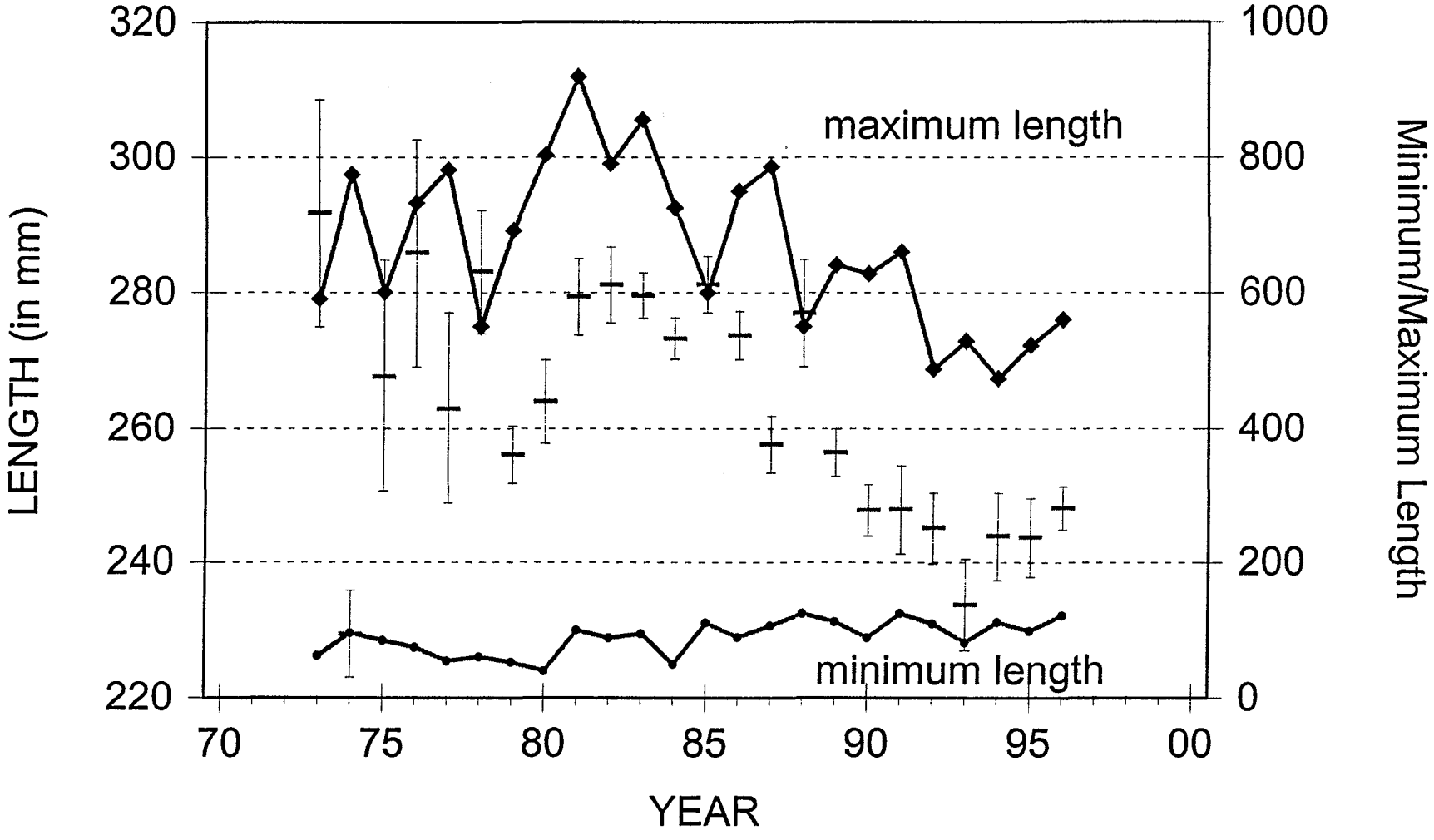


Figure 7. American eel length statistics for selected regions from the VIMS trawl Survey. The upper solid line represents the maximum length recorded for a given year, while the lower solid line indicates the minimum length. The bars indicate the mean and the 95% confidence intervals. The geographic regions represent 10 mile intervals on each tributary as such;

J3 - James River miles 20-30
Y3 - York River miles 20-30
R3 - Rappahannock River miles 20-30
J4 - James River miles 30-40
Y4 - York River miles 30-40
R4 - Rappahannock River miles 30-40

American Eel Length Statistics

VIMS Trawl Survey



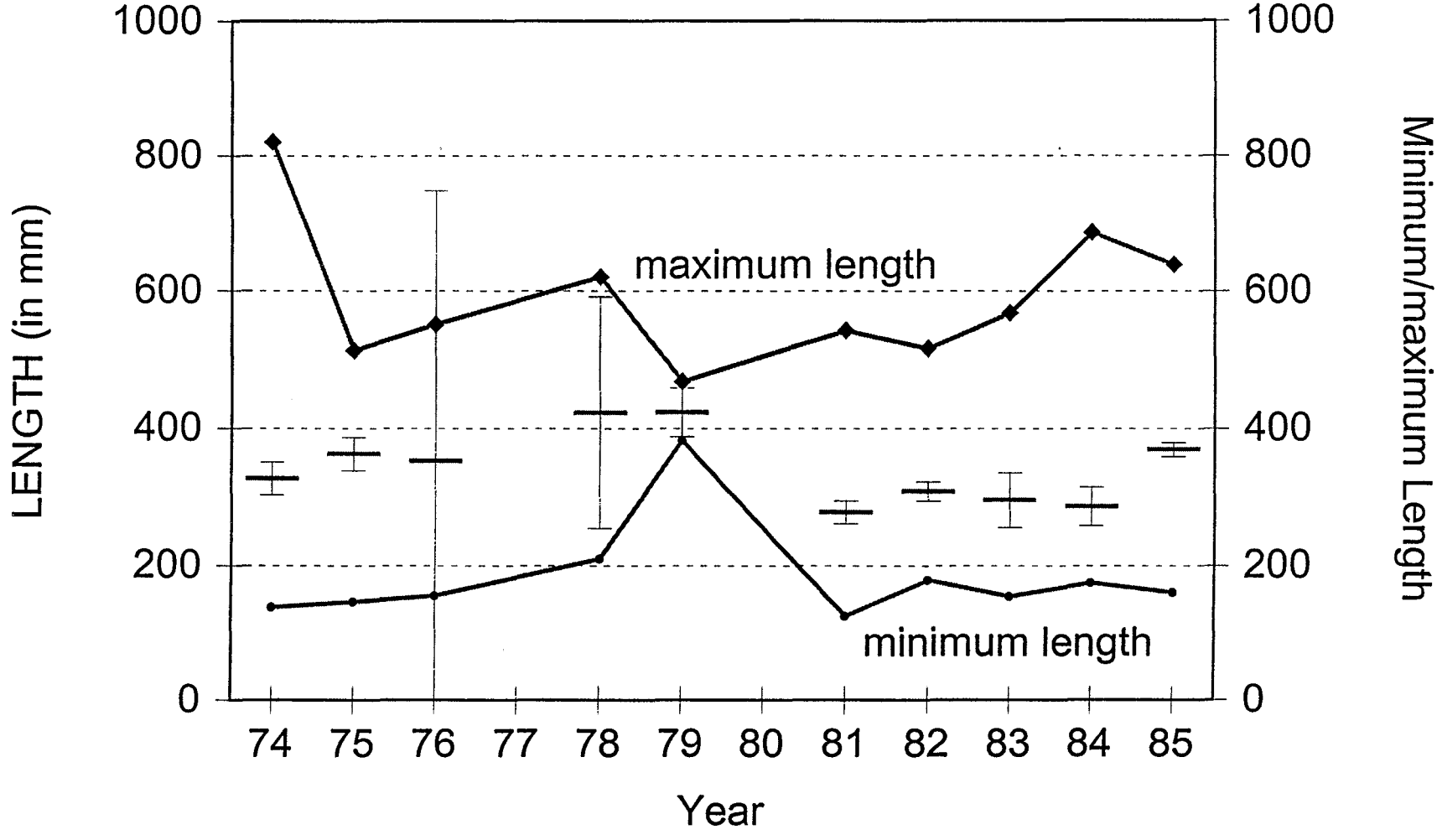
Regions: J3, J4, Y3, Y4, R3, R4 Stats are based on 95% C.I.'s.

Figure 8. American eel length statistics for the Potomac River from the VIMS trawl Survey. The upper solid line represents the maximum length recorded for a given year, while the lower solid line indicates the minimum length. The bars indicate the mean and the 95% confidence intervals. In the case of the Potomac River, the geographic regions represent 20 mile intervals as such;

P01 - Potomac River miles 0-20 P02 - Potomac River above mile 20

American Eel Length Statistics

VIMS Trawl Survey



Regions: Potomac River - PO1, PO2. Stats are based on 95% C.I.'s.