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The Effects of Channelization Upon the Fish Populations of Lotic Waters in Eastern North Carolina

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..... Abstract

This paper concerns an evaluation of the effects of habitat alteration associated with stream channelization in eastern North Carolina. The evaluation was based upon a comparison of fish populations found in 23 channeled streams, and 36 proximate natural streams within the Chowan, Neuse, Northeast Cape Fear, Pamlico, Perquimans, and Tar River Watersheds.

These comparisons indicated that reductions in the magnitude of 90 percent occurred both in weight of game fish per acre, and in number of game fish exceeding six inches total length per acre, following channelization.

The data further revealed that no significant return towards the natural stream populations occurred within a 40-year period following channelization.



A typical natural "Largemouth-Pickerel" stream.



A "Largemouth-Pickerel" stream after channelization. This is a photograph of Swift Creek facing upstream where a 300 foot right-of-way has been cleared.



This photograph was taken from the same bridge facing downstream. No channelization has been done here.



A "Redfin-Warmouth" stream immediately following channelization.



A "Redfin-Warmouth" stream after some stabilization of the ditch.

For some time, fishery workers have realized that alteration of habitat caused by a formal program of channelization of natural stream beds to obtain better drainage and to reduce flooding of surrounding croplands was detrimental to indigenous fish populations. Until now, however, the extent of damages to fishery resources have not been fully evaluated, but the increasing number of channelization projects and particularly their encroachment upon larger and better fishing streams demand that a careful estimate of the fishery losses be made and mitigation of demonstrable damages be sought on behalf of the fishermen.

In North Carolina alone, for example, 235 watersheds have been deemed feasible for assistance under Public Law 566. A total of 62 watershed improvement project applications involving some 2,900,000 acres have already been authorized for planning and 400 miles of streams have been altered or are under construction as of this writing. In addition P.L. 566 projects, many miles of streams have been altered by other agencies. Unfortunately, accurate estimates of the total mileage of streams affected in North Carolina are not available.

When these channelization projects are considered individually, the losses to the fishery resources often appear insignificant because they usually affect small streams. This concept is very misleading in light of a recently completed survey and classification of streams in North Carolina which demonstrated that the small, black-water streams of eastern North Carolina produce some of the best game-fish populations to be found in the State. Even if these streams were not so valuable individually, collectively they represent a sizeable portion of the public fishing waters. The detrimental effects of excessive siltation and more rapid water-level fluctuations in the receiving waters downstream also must be considered when channelization of the magnitude described above is encountered.

In view of detrimental aspects of stream channelization, data were compiled from various sources to indicate impact of stream channeling upon resident fish populations and more specifically the effects upon game fishes. Correlation of past effects with project types should yield: some gross means for assessing the probable damages that could be anticipated from future projects; possible means for avoiding losses to sport-fishery resources; and mitigation measures for losses which are absolutely unavoidable.

Data used were principally those contained in Survey and Classification Reports upon the Chowan, Neuse, Northeast Cape Fear, Pamlico, Perquimans, and Tar River Watersheds issued by the North Carolina Wildlife Resources Commission. From these data, plus intensive field observations, a total of 23 channelized streams, and 36 proximate natural counterpart streams, were selected (See Figures 1, 2, and 3).

Comparisons between fish populations found in natural streams and channelized streams definitely revealed that stream channelization has serious detrimental effects upon total carrying capacity, number of game fish exceeding six inches in total length, and weight of game fish per surface acre. There is also a significant reduction in average size of the fishes. No appreciable alteration in the ratio between game and nongame species was found.

The channelized streams used in this study were separated into three distinct ecological classifications according to a slight modification of those proposed by Van Deusen (See Figures 1, 2, and 3).^{1/} Often channelization disrupted physical characteristics and altered fish populations so drastically that it was difficult to determine what the ecological classification of a stream might have been prior to alteration. In such a case, the stream was assigned the same ecological classification as applied to adjacent natural streams of the same approximate size.

^{1/} Van Deusen, R. D., A simplified technique for classifying streams useful in fishery and related resources management. The Progressive Fish-Culturist, Vol. 15, No. 1, pp. 14-19.

With the exception of a greater reduction in the average size of game fishes in the Largemouth-Pickereel streams, there was no appreciable variation in effects of channelization upon fish populations in the three ecological stream types studied (Figure 4). Average reduction per acre for each stream type in the number of game fishes exceeding six inches in total length was generally in the magnitude of 90 percent. Reduction in standing crop approximated 80 percent, and loss in weight of game fishes was approximately 85 percent.

Although percentage loss in the stream types was similar, there was a much greater numerical loss of game fishes exceeding six inches in length, as well as in average weight of game fishes, from the Redfin-Warmouth streams because this stream type invariably contained a much larger standing crop.

When averages from all of the channeled streams used in this report are compared with averages from all of the natural streams, each of the eleven major species of game fishes evidences a significant loss in average number per acre, average weight per acre, and average number exceeding six inches in total length. Alteration of habitat apparently has a more serious adverse effect upon the redfin pickerel, chain pickerel, redbreast sunfish, and largemouth bass; while the bluegill, pumpkinseed, and warmouth appear to be somewhat less seriously affected.

Estimates of the original fish populations found in a stream prior to dredging were predicated upon the assumption that they were equivalent to those currently found in comparable adjacent natural streams. A quantitative estimate of the effects of dredging upon any single species, therefore, is strongly influenced by the number of that species found in the counterpart natural stream. For example, the numerical loss of yellow perch from Largemouth-Pickereel streams is far greater than from Robin-Warmouth streams because the former type of stream naturally contains many more yellow perch in the original standing crop (Figure 4).

Wherever possible, the elapsed time between channelization and population sampling was established. Average weight of game fishes per surface acre, and number of game fishes exceeding six inches in total length per acre, were grouped according to the period of time that had elapsed since construction of channels (Figure 5). From these data, it is apparent that recovery toward a natural game-fish population is very slow, and presumably the population will never recover, if the channels are properly maintained in the interest of flood prevention.

-- Recommendations --

In North Carolina, the Wildlife Resources Commission, U. S. Fish and Wildlife Service, Soil Conservation Service, and the local sponsors of Public Law 566 projects, are cooperatively seeking means for accomplishing a mutually satisfactory program. Progressing toward this end, several proposals for alleviating unavoidable losses have been developed. Although the relative efficacy of individual proposals has not been fully evaluated and may not be applicable in every situation, nevertheless, they are listed below in hope they will be of value to other agencies facing similar problems.

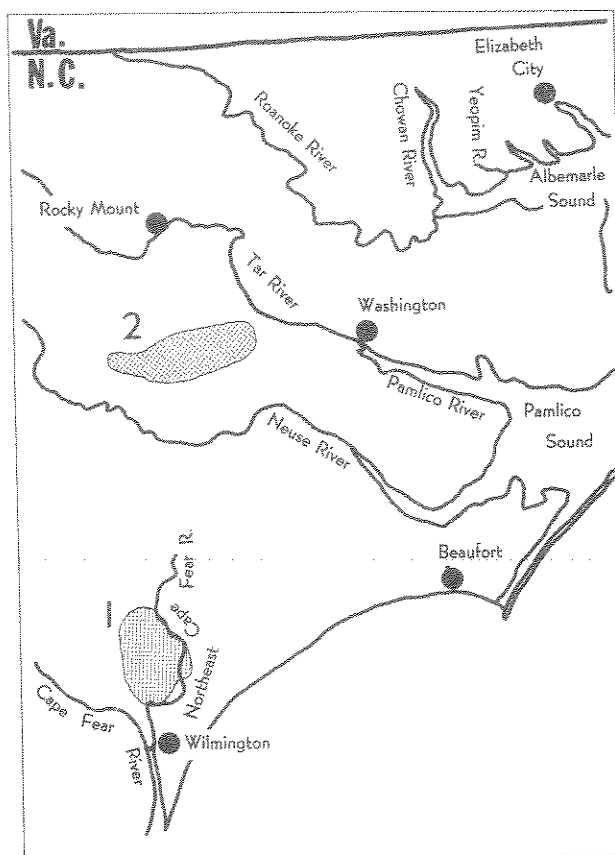
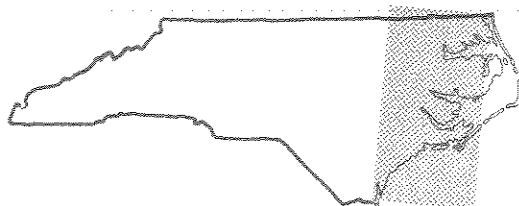
1. Block off oxbows with spoil from stream channels to provide permanent ponds.
2. Replace fish producing waters lost during channelization with impounded water on an acre-for-acre basis.
3. Construct small, deep ponds adjacent to channels to serve as sanctuaries for fishes during periods of low water.
4. Off-set the dredged channel from the natural channel to maintain water in the natural stream bed.
5. When a natural stream parallels the main river for an appreciable distance above the confluence, cut the channel directly into the main river.

6. At every opportunity, use flood-water retarding structures or clearing and snagging instead of channelization.

Class 2 "Robin - Warmouth"

FIGURE 1

**LOCATION OF STUDY AREAS
IN EASTERN NORTH CAROLINA**
Site Locations for Dredged
and Natural Stream Comparisons



"ROBIN-WARMOUTH" - CLASS 2

	WIDTH	DEPTH	FLOW	SUMMER TEMP.	TURB.	BOTTOM	ALK. pH	FAUNA	OTHER
ROBIN WARMOUTH	0-30'	Mod., abundant pools	0-50	Warm	Varies	Sand, muck, silt	Varies	Robin, other Centrarchids, Creek Chubs	Typical medium size Piedmont stream

NAME OF STREAM		AVERAGE GAME FISH PER ACRE 6 INCHES AND GREATER IN TOTAL LENGTH	AVERAGE TOTAL POUNDS PER ACRE	GAME FISH		AVERAGE NUMBER OF NONGAME FISH PER POUND
				AVERAGE WEIGHT (POUNDS) PER ACRE	AVERAGE NUMBER PER POUND	
GROUP 1.						
BURGAW CREEK*		8.0	11.5	5.7	11.2	221.6
Long Creek		520.0	207.8	174.6	4.2	75.0
Rileys Creek		182.3	239.8	145.1	1.9	4.8
GROUP 2.						
MIDDLE SWAMP*		91.8	76.6	35.8	9.8	53.5
SLOUGH CREEK*		24.9	13.8	10.7	9.9	379.0
Aycock Swamp		133.4	65.0	40.0	27.5	59.8
Little Contentnea Creek		40.0	96.6	21.4	4.6	19.3
Nahunta Swamp		94.5	62.3	46.2	6.3	93.5
Sandy Run		470.0	277.0	166.0	9.2	29.6
TOTAL AVERAGE	DREDGED	41.6	34.0	17.4	10.3	218.0
	NATURAL	240.0	158.1	98.9	8.9	47.0

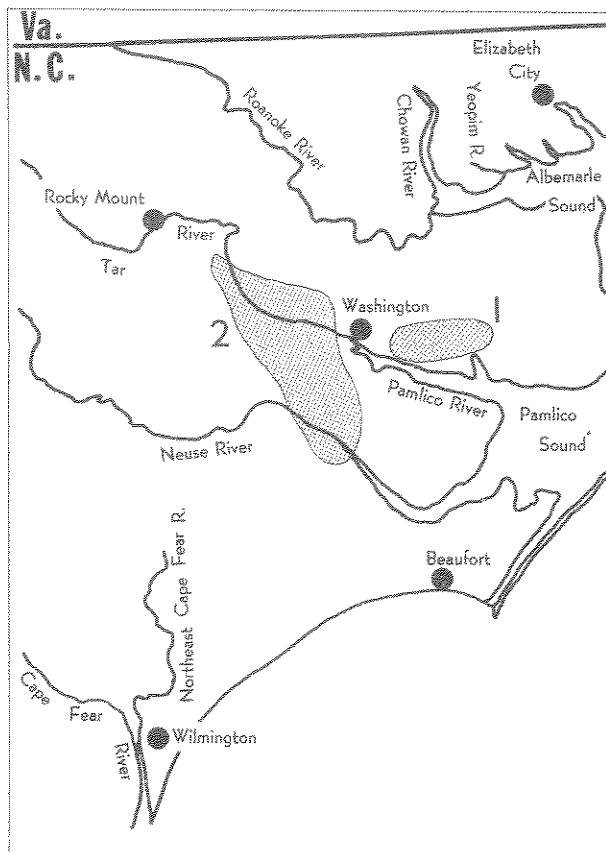
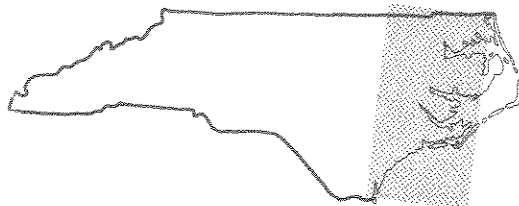
* Dredged Stream

Class 4 "Largemouth - Pickerel"

FIGURE 2

LOCATION OF STUDY AREAS
IN EASTERN NORTH CAROLINA

Site Locations for Dredged
and Natural Stream Comparisons



"LARGEMOUTH-PICKEREL" - CLASS 4

	WIDTH	DEPTH	FLOW	SUMMER TEMP.	TURB.	BOTTOM	ALK. pH	FAUNA	OTHER
LARGEMOUTH PICKEREL	Over 10'	Mod., deep pools	Over 5	Cool	Clear	Predominantly sand	Low	L.M.B., Chain Pickerel, Robin	Blackwater upper Coastal Plain streams. Highly stained

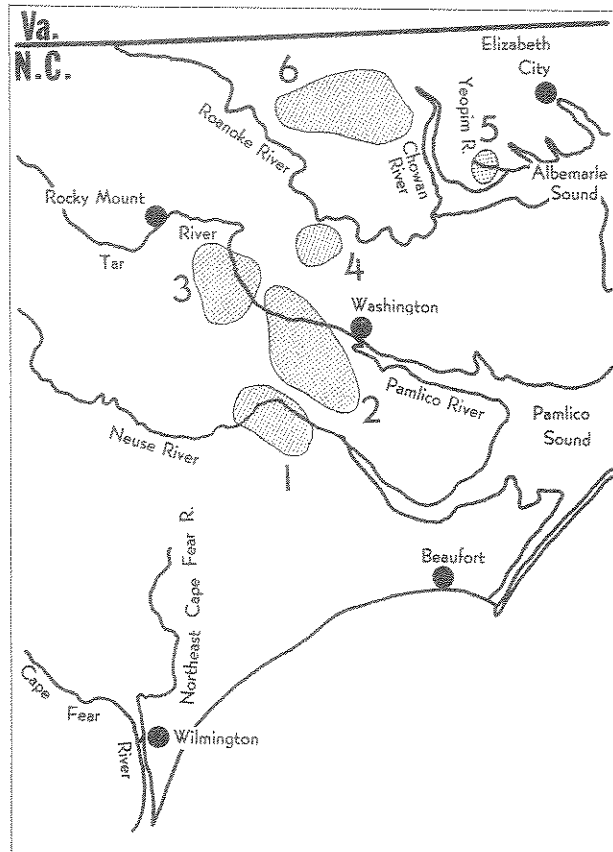
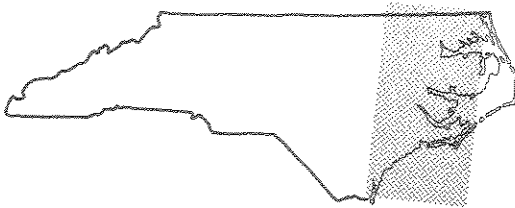
NAME OF STREAM	AVERAGE GAME FISH PER ACRE 6 INCHES AND GREATER IN TOTAL LENGTH	AVERAGE TOTAL POUNDS PER ACRE	GAME FISH		AVERAGE NUMBER OF NONGAME FISH PER POUND
			AVERAGE WEIGHT (POUNDS) PER ACRE	AVERAGE NUMBER PER POUND	
GROUP 1.					
BROAD CREEK*	36.0	30.5	6.1	31.8	52.2
PANTEGO CREEK*	0.0	13.5	1.0	45.0	180.5
Bath Creek	688.6	615.3	251.0	7.7	7.6
Lower Dowry Creek	525.0	197.7	192.0	4.3	253.5
Pungo Creek	100.0	139.2	63.6	5.5	97.5
GROUP 2.					
GRINDLE CREEK*	10.3	25.8	3.2	40.7	345.0
SWIFT CREEK*	4.3	111.9	1.4	37.2	51.5
Batchelders Creek	119.8	87.6	61.2	6.8	50.7
Chicod Creek	85.8	79.8	36.4	14.6	27.4
Town Creek	164.6	597.7	71.2	5.3	2.7
Tranters Creek	255.0	270.3	73.8	16.0	11.1
TOTAL AVERAGE					
DREDGED	12.7	45.4	2.9	38.7	157.3
NATURAL	277.0	283.9	107.0	8.6	65.1

* Dredged Stream

Class II
"Redfin - Warmouth"

FIGURE 3

LOCATION OF STUDY AREAS
IN EASTERN NORTH CAROLINA
Site Locations for Dredged
and Natural Stream Comparisons



"REDFIN-WARMOUTH" - CLASS 11

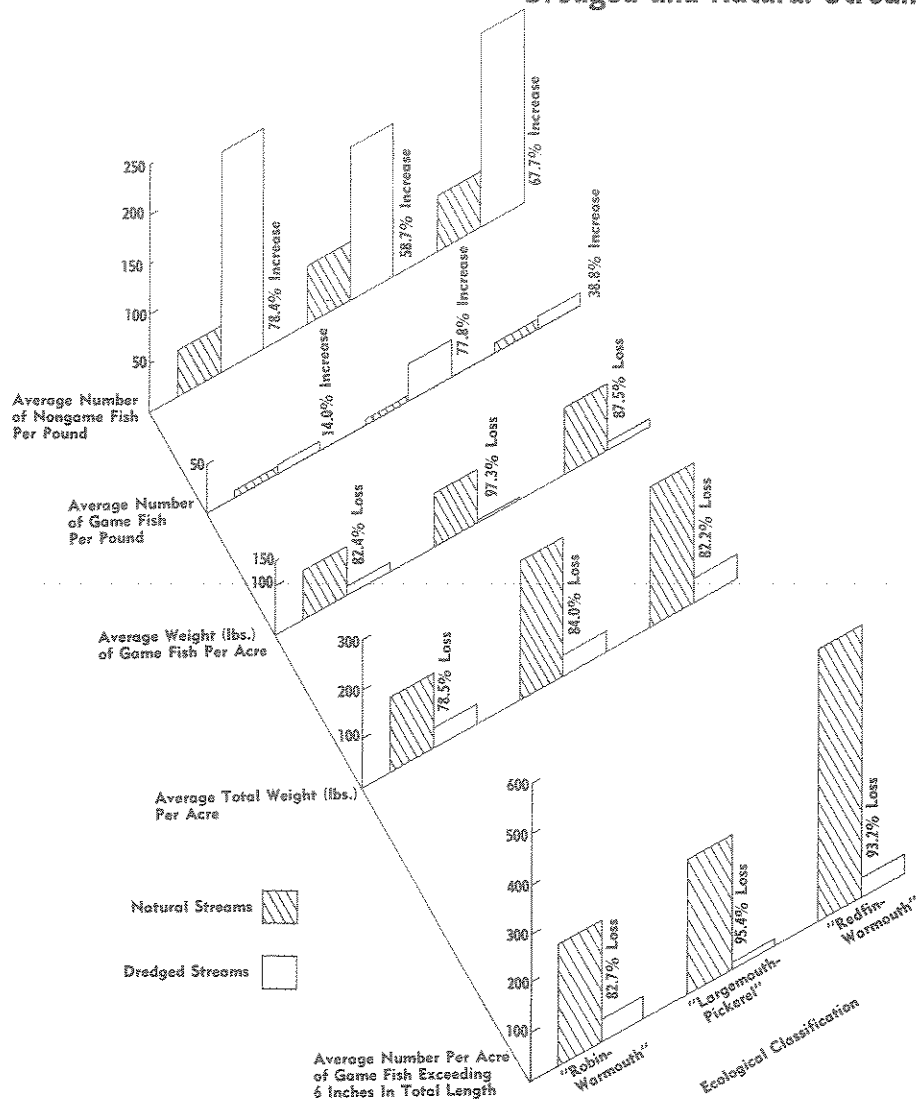
DREDGED AND COMPARATOR STREAMS BY ECOLOGICAL CLASSIFICATION

	WIDTH	DEPTH	FLOW	SUMMER TEMP.	TURB.	BOTTOM	ALK. pH	FAUNA	OTHER
REDFIN WARMOUTH	0-30'	No pool or riffle	0-20 cfs Imp.	Warm	Clear	Sand, muck, detritus	Low	Redfin pickerel, Warmouth, Flier	Swamp drainage stream of Coastal Plains

STREAM NAME	AVERAGE GAME FISH 6" + LENGTH AVERAGE NO. PER ACRE	AVERAGE TOTAL POUNDS PER ACRE	GAME FISH		NONGAME FISH
			AVERAGE NUMBER OF FISH PER POUND	AVERAGE WEIGHT (lbs.) PER ACRE	
GROUP 1.					
EAGLE SWAMP*	11.1	14.2	40.2	10.5	231.0
QUINERLY CREEK*	81.9	45.2	9.6	39.7	240.0
Briery Run	60.0	68.0	17.3	40.0	46.5
Core Creek	374.7	147.9	10.2	70.4	43.3
Moselys Creek	41.2	62.7	7.6	25.5	4.1
GROUP 2.					
CANNON SWAMP*	0.0	7.5	0.0	0.0	463.0
CLAYROOT SWAMP*	60.0	30.1	9.9	14.1	31.2
FORK SWAMP*	117.8	74.1	10.7	39.1	14.8
JOHNSONS MILL RUN*	18.1	4.4	8.3	3.3	321.5
Cow Swamp	650.0	189.3	12.5	131.1	102.6
Creeping Swamp	150.0	39.0	7.9	28.0	37.3
Hardee Creek	100.0	67.7	11.4	31.5	168.5
Juniper Branch	400.0	295.9	11.1	106.4	78.5
Palmetto Swamp	455.2	176.2	9.2	86.2	28.4
GROUP 3.					
BLACK SWAMP*	125.0	132.5	23.9	57.5	44.4
CONETOE CREEK*	6.4	17.9	17.8	2.7	129.6
Bynum Mill Creek	625.0	364.9	11.0	182.4	86.3
Cokey Swamp	203.1	167.7	7.8	73.8	13.6
Kitten Creek	866.6	199.2	11.7	93.8	104.2
Otter Creek	1,550.0	659.1	7.7	343.1	23.5
Tyson Creek	433.3	324.2	19.7	210.7	101.5
GROUP 4.					
BEAR GRASS SWAMP*	25.0	31.6	11.9	16.9	37.4
FLAT SWAMP*	14.3	76.9	26.4	3.2	60.8
TURKEY SWAMP*	40.0	27.2	23.8	10.9	157.0
Briery Swamp	1,266.0	544.0	10.6	209.0	27.1
Collie Swamp	2,666.0	1,264.0	10.5	594.0	10.2
GROUP 5.					
BURNT MILL CREEK*	28.6	41.4	31.9	30.0	386.5
Yeopim River	317.0	210.2	8.9	148.5	158.0
GROUP 6.					
AHOSKIE CREEK*	55.5	16.3	6.4	15.6	301.6
CUTAWHISKIE CREEK*	0.0	239.7	59.7	6.7	31.2
FLAT SWAMP*	0.0	39.9	35.7	5.7	585.0
HORSE SWAMP*	14.3	25.7	38.3	12.7	105.5
Chinkapin Creek	60.0	47.0	13.2	21.5	95.3
Deep Creek	0.0	108.3	37.1	28.3	41.8
Potecasi Creek	100.0	80.1	24.6	43.4	23.6
Stoney Creek	88.3	65.3	9.4	20.0	161.5
Urahaw Swamp	200.0	306.3	35.6	173.0	21.8
Urahaw Swamp	650.0	287.5	18.3	170.0	19.6
Whiteoak Swamp	1,500.0	1,000.0	18.0	250.0	59.5
DREDGED	37.4	51.6	23.6	16.8	196.0
NATURAL	556.0	289.5	14.4	134.0	63.3

* Dredged Stream

Figure 4
Comparison of Fish Populations in
Dredged and Natural Streams



COMPARATIVE PRODUCTION DATA FOR DREDGED AND NATURAL STREAMS

GAME SPECIES	AVERAGES FOR CLASS 2 - "ROBIN-WORMMOUTH" STREAMS						AVERAGES FOR CLASS 4 - "LARGEMOUTH-PICKEREL" STREAMS						AVERAGES FOR CLASS 11 - "REDFIN-WORMMOUTH" STREAMS						AVERAGES FOR ALL ECOLOGICAL CLASSIFICATIONS - 2, 4, AND 11					
	AVERAGE NUMBER PER ACRE		AVERAGE WEIGHT (lbs.) PER ACRE		GAME FISH PER ACRE GREATER THAN 6" TOTAL LENGTH		AVERAGE NUMBER PER ACRE		AVERAGE WEIGHT (lbs.) PER ACRE		GAME FISH PER ACRE GREATER THAN 6" TOTAL LENGTH		AVERAGE NUMBER PER ACRE		AVERAGE WEIGHT (lbs.) PER ACRE		GAME FISH PER ACRE GREATER THAN 6" TOTAL LENGTH		AVERAGE NUMBER PER ACRE		AVERAGE WEIGHT (lbs.) PER ACRE		GAME FISH PER ACRE GREATER THAN 6" TOTAL LENGTH	
	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D
REDFIN PICKEREL	118.4	11.1	11.9	1.3	79.7	5.2	5.6	18.9	0.2	0.4	1.4	3.8	959.0	53.7	72.7	4.7	532.0	19.1	633.0	41.1	48.5	3.9	344.0	14.7
CHAIN PICKEREL	12.4	9.0	20.0	3.4	12.4	6.2	92.1	1.0	24.1	Tr.	63.9	-	83.0	4.3	17.9	1.2	40.7	3.5	74.1	4.3	14.6	1.1	34.2	3.3
MUD SUNFISH	6.9	-	0.9	-	-	-	-	-	-	-	-	-	73.4	9.5	5.4	0.9	2.2	1.1	82.0	6.6	3.6	0.8	3.2	0.8
FLIER	40.1	9.6	4.3	0.4	13.0	-	13.2	1.1	0.7	Tr.	1.0	-	102.8	33.1	6.4	0.5	6.6	-	75.1	24.5	5.0	0.5	7.2	-
WORMMOUTH	59.9	70.6	3.3	4.9	9.0	10.4	114.9	8.3	9.1	0.5	32.4	1.0	141.0	103.3	9.2	3.3	11.5	7.6	122.5	81.9	7.9	3.9	13.7	6.9
BROOKS SUNFISH	200.6	3.4	37.1	0.5	105.9	1.3	46.6	-	7.7	-	19.3	-	108.5	7.6	20.6	0.4	47.5	1.0	115.5	5.8	19.2	0.3	51.8	0.8
PUMPKINSEED	35.9	22.9	1.7	1.7	-	4.1	171.4	48.2	10.6	0.8	21.8	6.0	157.5	59.2	5.5	1.6	-	0.3	140.5	47.2	5.6	1.4	4.2	0.7
BLUEGILL	152.9	34.7	2.9	3.0	7.9	8.3	150.2	20.6	12.3	1.0	28.8	2.0	193.5	142.5	3.5	1.5	3.0	0.9	179.5	114.6	5.4	1.6	8.2	2.1
LARGEMOUTH BASS	19.5	8.6	12.7	1.8	14.6	5.6	46.0	2.4	13.2	Tr.	13.0	-	12.3	2.9	2.1	0.3	3.5	1.0	20.5	3.2	6.1	0.4	8.4	1.3
BLACK CRAPPIE	10.0	3.0	1.6	Tr.	5.5	-	11.8	3.1	2.1	Tr.	6.7	-	5.3	6.3	0.5	0.1	2.0	-	7.4	5.8	1.0	Tr.	3.5	-
YELLOW PERCH	1.9	-	0.6	-	1.0	-	114.1	-	23.3	-	88.2	-	28.0	19.5	1.3	0.8	4.5	2.8	41.3	13.6	4.0	0.6	21.5	1.9
TOTALS	664.7	169.9	97.0	17.0	240.0	41.1	765.9	104.6	103.3	2.7	276.5	12.8	1,856.9	442.4	145.1	15.3	654.5	37.3	1,471.4	348.6	120.8	13.9	498.9	32.7

N - Natural Streams D - Dredged Streams

Figure 5

Recovery of Game Fishes

Subsequent to Stream Alteration

