FISH MANAGEMENT SESSION

A PRELIMINARY REPORT ON THE USE OF HORMONES TO OVULATE STRIPED BASS, Roccus saxatilis (Walbaum)

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ABSTRACT

Of 162 female striped bass treated with hormones during the 1962 spawning season, 44 (27.2%) were induced to ovulate.

Of several preparations used, chorionic gonadotropin proved to be very effective while follicle stimulating hormone was slightly effective.

Of 36 million striped bass eggs put into the hatchery only 7.3 percent hatched. The cause of mortality is largely unknown.

INTRODUCTION

The phenomenal success of striped bass in the Santee-Cooper Reservoir and the concomitant values of this population as both a sport fish and as an effective biological control of gizzard shad (*Dorosoma cepedianum*) resulted in the formation of a management plan by the South Carolina Wildlife Resources Commission to establish striped bass populations in all the other large reservoirs within South Carolina.

Accordingly, these reservoirs were stocked repeatedly between 1955 and 1961 with striped bass from Santee-Cooper ranging in size from fingerlings to adults up to 25 pounds (Stevens, 1957).

To date none of these stockings has resulted in the establishment of a reproducing population of striped bass within these reservoirs. It is assumed that the spawning requirement has been the main factor in limiting successful establishment. This spawning requirement dictates that the freely spawned striped bass eggs must drift in a current until hatching and, therefore, a reservoir must have many uninterrupted miles of stream above it for spawning purposes. Apparently, none of the other reservoirs in South Carolina meet this requirement.

In order to overcome this limiting factor, a striped bass hatchery was constructed in 1961 at Moncks Corner on the bank of the Tailrace Canal below Pinopolis Dam. This hatchery was patterned after the Weldon Hatchery which has been operated successfully for many years by the North Carolina Wildlife Resources Commission.

The Weldon Hatchery depends upon commercial fishermen to bring ripe males and females to the hatchery. The roe is removed surgically from the female and is fertilized by manually stripping sperm from the ripe male. The fertilized eggs are then put into McDonald Hatchery Jars which received a constant supply of fresh water until the eggs hatch 36-72 hours later. The fry swim from the jars into aquaria and are stocked at this stage of development.

While commercial fishing for striped bass is illegal in South Carolina, it was felt that the large number of striped bass in the sanctuary would provide enough ripe female striped bass to substitute for the commercial effort responsible for the successful hatchery operation in North Carolina.

Accordingly, a very intensive effort was conducted in April and May of 1961 in the sanctuaries below both Pinopolis Dam and Wilson Dam. An estimated 900 female striped bass between 8 and 25 pounds were examined without finding one with freely flowing eggs. The progress of the spawning season could be traced by the ratio of spent to unspawned females and all stages of ripeness were encountered except running ripeness. From this experience it was concluded that striped bass release their eggs shortly after they become free within the ovary and that the chance of finding a female ripe, but unspawned is slight. Males, however, remain ripe throughout the spawning season.

Two factors are missing at the Moncks Corner Hatchery which are responsible for the successful operation of the Weldon Hatchery as follows:

1. During peak spawning periods several hundred commercial fishermen are in operation at Weldon.

2. Many of the ripe fish are taken while in the spawning act ("rock fights") in which case a female is bound to be either ripe or spent.

These "rock fights" have not been observed in South Carolina although reports of fishermen this year indicate an area in Cooper River where the spawning act may be concentrated.

Two other striped bass hatcheries have failed for lack of ripe fish as related by Raney (1957:45) as follows: "According to Pearson (1938:829), attempts in the past to artificially propagate striped bass at Havre de Grace, Maryland, failed becouse of the difficulty of getting ripe males and females simultaneously (see Snyder, 1918, 1919). Coleman and Scofield (1910) also ran experiments on the artificial propagation of striped bass in California; Scofield (1910) described attempts to run a striped bass hatchery on the San Joaquin River, a project which was abandoned after three consecutive years of failure to collect ripe spawn."

During the 1961 season, it was decided to try hormones to induce ovulation in order to overcome the difficulty of taking naturally ripe female striped bass. A few females were unsuccessfully treated but the failure was laid to inadequate holding facilities and plans were made to explore this avenue more fully during the 1962 spawning season.

During the winter of 1961, a holding pond 100′ x 12′ x 4′ was constructed and lined temporarily with plastic to make it water tight. A six-inch drain was positioned in the center of the pond and a 15 h.p. pump conveyed water from the Tailrace Canal into the pond through two ¾″ nozzles pointing in opposite directions in order to create a current. The water theoretically changed completely every three hours.

PROCEDURES

Between April 3 and May 19, 1962, 167 female striped bass were captured in the sanctuary below Pinopolis Dam by hook, bow net, gill net and electric seine. These fish ranged in size between 7.6 and 31.0 pounds, averaged 15.9 pounds and 162 of them were injected with hormones as soon as possible after capture. As a result, 44 (27.2%) of the treated fish were brought to a state of ripeness in which the eggs would flow freely from the genital pore with gentle pressure upon the abdomen.

TABLE I

THE OUTCOME OF 167 FEMALE STRIPED BASS USED IN THE HATCHERY OPERATION IN APRIL AND MAY, 1962

	Number	*Percent*
Spawned in Hatchery	24	14.3
Spawned in Pond	15	9.0
Found Dead but Ripe	5	3.0
Negative	62	37.1
Atypical	42	25.1
Treated with Estrogen	14	8.3
Controls	5	3.0
TOTAL	167	100.0

Table I summarizes the result of the 167 female striped bass used in the experiment.

Spawned in Hatchery

Twenty-four fish were taken from the pond in a ripe condition, the eggs fertilized and placed in McDonald Jars as described above. All but one were induced to ovulate with chorionic gonadotropin (CG) at an average dose of 406 International Units (I.U.) per pound (Table II). The one exception was treated with follicle stimulating hormone (FSH).

The 24 fish which spawned in the hatchery averaged 17.6 pounds and were found ripe an average of 42 hours after treatment. Other preparations which were used in combination with CG appear in Table II and will be discussed below.

TABLE II

DATA CONCERNING 24 HATCHERY-SPAWNED STRIPED BASS

Date	No.	Water Temp.	Length	Weight	Class‡	CG/lb. (I. U)		FSH-P	TSH	Thyroid	Decadron	Time Lapse in Hours
4/14	18	61	30.7	16.6	2	620	<——24 hrs.	50 mg.†		2		48
4/16	19	60	27.1	10.5	2	951				1		48
4/16	24	60	29.1	14.5	?	689				2		49
4/16	26	60	31.0	17.0	?	...		75 mg.*		2		61
4/17	27	60	33.4	22.8	1	439			30 units			40
4/20	49	61	32.6	21.0	?	250	<——64 hrs.	25 mg.†				97
4/27	83	64	28.7	12.8	1	390				1	2 mg.	36
4/27	84	64	29.5	14.9	1—	336				2		34
4/27	85	64	35.1	24.5	1—	286					2 mg.	34
4/30	88	66	30.4	14.8	1+	339						39
4/30	89	66	26.2	10.3	1+	324						35
5/ 1	95	66	29.0	15.5	1 or 1—	322					2 mg.	35
5/ 1	96	66	28.8	14.0	1 or 1—	261						34
5/ 4	100	70	34.1	25.1	1 or 1+	598*					2 mg.	41
5/ 4	106	70	35.3	27.6	1++	400						26
5/ 4	107	70	33.5	21.7	1+	384						40
5/ 5	113	68	31.8	19.7	2	255	<——38 hrs.	25 mg.†				57
5/ 7	122	69	30.3	16.3	1	511*						40
5/ 8	124	69	34.2	25.9	1	542*						37
5/ 9	...	70	28.3	12.0	1 or 1+	278						35
5/12	131	72	28.8	13.8	1 or 1+	242						35
5/13	132	70	30.7	17.0	1 or 1+	312						33
5/14	134	70	33.0	23.2	1+	287						33
5/17	...	74	27.0	10.5	1 or 1—	317						34
AVERAGE			30.8	17.6		406						42

* Applied in two treatments—the second treatment occurring around 32 hours after the first treatment.
† Applied as indicated, *i. e.*, FSH initially, followed by CG 24-64 hours later.
‡ Class denotes an attempt to judge the degree of ripeness at time of capture. Class 1 signifies advanced ripeness.

Spawned in Pond

Fifteen fish spawned within the holding pond. This loss of eggs was due to inexperience concerning the time lapse between treatment and ovulation; to the temporary design of the pond which made it difficult to properly observe the fish; and to a reluctance to handle the fish during the terminal hours because of the resultant high mortality.

All the pond-spawners were treated with CG at an average dose of 507 I.U. per pound and spawned at an approximate average of 45 hours after treatment (Table III).

The fish averaged 18.5 pounds before spawning and all were released alive and healthy except one which was sacrificed for study.

Found Dead but Ripe

Five fish were found dead in the pond in a ripe condition. An average of 357 I.U. per pound of CG was used and death occurred approximately 57 hours after treatment (Table IV).

Negatives

Sixty-two fish were classed as negatives after dying without becoming ripe. Fifty-seven were treated with CG at an average dose of 383 I.U. per pound and died an average of 45 hours after treatment. Most of these fish advanced in ripeness and mortality seemed to be the result of an inability to achieve a state of complete ripeness. The five fish not treated with CG were treated with FSH, lutenizing hormone (LH) or testosterone (Table 5).

Atypical

Forty-one fish were classified as atypical to the study by virtue of death due to handling injury, or because they had immature or underdeveloped ovaries and for other miscellaneous reasons. The fish averaged 12.5 pounds and died in an average of only eight hours after treatment.

Treated with Estrogen

At the beginning of the hatchery operation between April 3 to April 16, 14 fish were treated with estrogen in tablet form as well as by injection. The fish were retreated every other day for up to 10 days and, while the cumulative dose was massive, none achieved complete ripeness before death (Table VI). These fish lived in the pond an average of 166 hours and most ripened to some degree before mortality.

Controls

The use of only five controls leaves much to be desired in the design of the study. The objective of the operation, however, was not basic research but rather the production of as many striped bass fry as possible and, in a sense, the fish treated with preparations other than CG served as controls when compared with CG-treated fish.

Controls usually did not survive over three days except for one which was sacrificed after 16 days of residence in the pond.

Chorionic Gonadotropin

The subject of fish endrocrinology is represented in surprising volume in the literature and that part concerning the pituitary and its target organs is reviewed through 1957 in an excellent manner in *The Physiology of the Pituitary Gland of Fishes* by Grace E. Pickford and James W. Atz. Since 1957, the use of human chorionic gonadotropin as a substitute for pituitary material has received significant attention by Sneed and Clemens (1959) and Sneed and Dupree (1961) and others.

The current study employed veterinarian grade chorionic gonadotropin the majority of which was produced by Biolab, Norborne, Missouri and the remainder by Haver-Lockhart, Kansas City, Missouri.

The quantity of CG used to inject the 44 fish which were successfully induced to ovulate ranged from 238 to 951 I.U. per pound and the average dose was 436 I.U. per pound. The threshold dose was not established.

The fifty-seven CG-treated fish which died before ovulation received an average of 383 I.U. per pound and a range in dosage between 64 and 1,000 I.U. per pound.

TABLE III

DATA CONCERNING 15 POND-SPAWNED STRIPED BASS

Date	*No.*	*Water Temp.*	*Length*	*Weight*	*Class*†	*CG/lb. (I. U)*	*FSH-P*	*TSH*	*Thyroid*	*Testosterone*	*Decadron*	*Estimated Time Lapse in Hours*
4/10	12	61	35.6	29.0	1+	655			3			Between 24 and 78
4/11	16	60	35.5	29.0‡	1	345	<————	37 hrs.	————	50 mg.**		Between 37 and 85
4/16	22	60	30.4	16.0‡	?	936*			3			Between 49 and 61
4/16	23	60	29.9	17.0‡	?	936*		30 units	1			Between 37 and 50
4/19	33	60	30.5	17.0‡	2	382						Less than 50
4/19	33½	60	30.5	17.0‡	2	500						Less than 50
4/20	35	61	29.6	15.0‡	?	625						Less than 44
4/20	42	61	33.9	25.0‡	1	870		20 units				Less than 42
4/20	44	61	29.1	15.5‡	?	313	25 mg.					Less than 42
4/29	87	65	24.3	7.6	1	289						Between 35 and 72
5/ 2	101	70	34.5	28.3	1+	353					2.0 mg.	Less than 33
5/ 3	103	70	35.8	26.3	1+	367			1			Less than 31
5/ 3	104	70	30.3	16.0	1+	313					1.6 mg.	Less than 30
5/14	133	70	27.1	10.0‡	2	333						Less than 30
5/19	...	76	25.6	8.5‡	2	392						Less than 31
AVERAGE			30.8	18.5		507						Approximately 45

* Applied in two treatments—the second treatment occurring 38 hours after the initial treatment.
** Applied as indicated, *i. e.*, testosterone initially followed in 37 hours by CG.
† Class denotes an attempt to judge the degree of ripeness at time of capture. Class 1 signifies advanced ripeness.
‡ Approximate weights.

TABLE IV

DATA CONCERNING FIVE STRIPED BASS FOUND DEAD IN A RIPE CONDITION

Date	*No.*	*Water Temp.*	*Length*	*Weight*	*Class*†	*CG/lb. (I. U)*	*FSH-P*	*PLH*	*Thyroid*	*Testos-terone*	*Time Lapse (Hours)*
4/17	28	60	28.2	12.7	2	393	<——57 hrs.——25 mg.*		1		73
4/17	29	60	24.9	8.6	2	465	——————————14 hrs.——1——>50 mg.*				74
5/ 7	113½	69	26.1	9.7	1	344	<——38 hrs.——25 mg.*				56
5/ 8	125	69	29.1	14.0	1+++	238	<——32 hrs.——————25 mg.*				54
5/ 9	126	70	31.8	19.3	1	345					30
AVERAGE			28.0	12.9							57

* Applied in two treatments, the second treatment occurring in the number of hours indicated on the arrow.
† Class denotes an attempt to judge the degree of ripeness at time of capture. Class 1 signifies advanced ripeness.

TABLE V

DATA CONCERNING 62 STRIPED BASS WHICH DIED BEFORE BECOMING RIPE

Date	No.	Water Temp.	Length	Wt.	Class At Capture	Class At Death	CG/lb. (I. U.)		FSH-P	TSH	Thyroid	Testos-terone	Decadron	Time Lapse (Hours)
4/16	21	60	36.5	32.0	?	1+	938				3			60
4/16	25	60	29.3	15.2			658			30 units				62
4/17	30	62	26.6	10.0	1	?	1,000			30 units				48
4/17	31	62	33.2	23.0	1	?	652				3			48
4/20	34	61	28.3	13.0			384							50
4/20	36	61	28.3	14.3			350				1			43
4/20	37	61	29.1	14.4	?	1+	279		25 mg.		1			60
4/20	38	61	28.0	13.0					25 mg.					50
4/20	39	61	30.3	16.0	?	1+	625			20 units				44
4/20	40	61	27.8	13.0			384			10 units				50
4/20	41	61	26.8	10.0								50 mg.		60
4/20	43	61	28.0	14.2	1	?	704							42
4/21	48	62	33.8	21.0		3			75 mg.		2			84
4/21	50	62	32.9	21.3		1	469	<—134 hrs.	25 mg.					157
4/24	53	61	26.9	10.7	1	2	623		25 mg.					37
4/24	54	61	29.0	14.3	1	2	350							37
4/24	55	61	34.0	22.5	2	1	444		25 mg.					41
4/24	56	61	26.1	11.0	2	2	455			10 units				41
4/24	59	61	26.6	10.8	3	3	309				1			41
4/24	60	61	27.6	11.5	3	3	290				2			41
4/24	61	61	31.4	18.9	2	1+	750				2			37
4/24	62	61	26.0	10.5	3	?	190							37
4/24	63	61	30.0	14.5	1	2	445		25 mg.					40
4/24	64	61	26.5	10.5	1	1+	317			10 units				42
4/24	65	61	31.5	17.9	1–	1	279			45 units				36
4/25	66	61	25.7	10.0	1	1	500		25 mg.					37
4/25	67	61	26.5	10.5	1	1+	630				1			37
4/25	68	61	29.9	15.9	1	2	215			32 units				34

TABLE V—*Continued*

DATA CONCERNING 62 STRIPED BASS WHICH DIED BEFORE BECOMING RIPE

Date	*No.*	*Water Temp.*	*Length*	*Wt.*	*Class‡ At Capture*	*Class‡ At Death*	*CG/lb. (I.U.)*	*PLH*	*FSH-P*	*TSH*	*Thyroid*	*Testosterone*	*Depo-Medrol*	*Decadron*	*Time Lapse (Hours)*
4/25	69	61	28.7	13.7	2	2	365					50 mg.			34
4/25	70	61	26.4	10.4	2	1	481					50 mg.			36
4/25	71	61	29.3	14.1	2	1++	142				1				43
4/25	72	61	26.6	10.8	1	1	124					50 mg.			38
4/25	74	61	28.8	15.0	1+	1+	222			30 units					47
4/25	75	61	26.8	10.8	1	1+	617				2				39
4/25	76	61	26.7	11.0	2	2	666								33
4/26	78	64	30.0	15.4	1	1	346								41
4/26	79	64	27.9	12.9	1+	2	310				1				37
4/26	81	64	32.5	20.8	1+	1+	321								46
4/27	82	64	27.4	11.5	1	?	290							2 mg.	35
4/27	86	64	30.3	15.5	1−	1+	623								34
4/30	90	66	25.9	10.2	1+	1+	424*								74
4/30	91	66	27.2	10.4	1−	1−	481*							2 mg.	46
4/30	92	66	29.2	14.8	1−	1−	338						32 mg.		31
5/ 1	93	66	26.6	12.2	1	1	410*								32
5/ 1	94	66	35.0	26.0	1	1+	410*						16 mg.		43
5/ 1	97	66	27.1	13.2	1+	1−	379*						24 mg.	2 mg.	41
5/ 1	98	66	28.5	13.4	1	1−	249				2				41
5/ 2	99	66	26.2	11.3	1	1−	300								33
5/ 2	102	66	29.5	14.5	1	1	345							2 mg.	32
5/ 4	109	70	25.4	9.2	1+	1−		12.5 mg.							59
5/ 4	110	70	26.6	10.9	1+	2	489*	12.5 mg.							84
5/ 4	112	70	30.1	14.5	2	1+			25 mg.						38
5/ 7	114	69	30.1	14.5	2	1+	231	<—35 hrs.—	—25 mg.†						39
5/ 7	115	69	29.8	15.1	2	1+	221	<—41 hrs.—	—25 mg.†						42
5/ 7	116	69	32.0	18.1	1	1+	368								33
5/ 7	117	69	28.4	13.2	1	2	252	25 mg.							46

TABLE V—*Continued*

DATA CONCERNING 62 STRIPED BASS WHICH DIED BEFORE BECOMING RIPE

Date	*No.*	*Water Temp.*	*Length*	*Wt.*	*Class‡ At Capture*	*At Death*	*CG/lb. (I. U.)*	*PLH*	*FSH-P*	*TSH*	*Thyroid*	*Testos-terone*	*Depo-Medrol*	*Deca-dron*	*Time Lapse (Hours)*
5/ 7	119	69	27.5	12.6	1	2	397								32
5/ 7	121	69	28.1	12.7	1	2–	657*								39
5/ 7	123	69	29.1	13.7	1	1+	195								31
5/ 8	127	69	26.7	10.9	1	1+	306	<—32 hrs.——	25 mg.†						35
5/11	130	71	26.3	9.3	2	1++	64	<—26 hrs.——	25 mg.†						38
5/12	133	72	32.2	20.0	1+	1++	500*	<—25 hrs.——	25 mg.†						39
AVERAGES			28.8	13.9			383								45

* Applied in two treatments—the second treatment occurring 5-24 hours before death.
† Applied in two treatments as indicated.
‡ Class denotes an attempt to judge the degree of ripeness at time of capture. Class 1 signifies advanced ripeness.

TABLE VI

DATA CONCERNING 14 ESTROGEN-TREATED STRIPED BASS

Date	No.	Water Temp.	Length	Wt.	Class† At Capture	Class† At Death	Premarin*	Estynil	Cytomel	Enovid	Thyroid	TSH	CG/lb.* (I.U.)	Dienestrol	Hrs. in Pond
4/ 3	1	57	34.2	25.6	1+	1++	100 mg.(5)			1		4 units			240
4/ 3	2	57	29.3	14.1	2	2	90 mg.(5) (2 mg. Progynon)	1		1		8 units			228
4/ 3	3	57	35.2	25.2	1	1++	100 mg.(5)							1.0 mg.	240
4/ 5	4	57	35.1	26.7	1	1+	40 mg.(2)	1		1		8 units		2.0 mg.	212
4/ 5	5	57	29.8	16.6	1	1	50 mg.(3)	2	1			8 units			156
4/ 5	6	57	33.0	23.0	1	1	110 mg.(4)		1		1		434	4.0 mg.	258
4/ 5	7	57	30.2	15.8			100 mg.(3)	1	2	1	1				182
4/ 5	8	57	35.5	28.3			20 mg.(1)		1						24
4/ 6	9	57	32.2	20.0			80 mg.(3)		1		1				96
4/ 6	10	57	35.0	27.6			20 mg.(1)	1	1		1	8 units	724(2)	2.0 mg.	240
4/ 7	11	57	28.3	12.9	1	1+	40 mg.(1)	2	2	1					140
4/10	13	61	32.0	21.6	1	1++	50 mg.(2)				3		912(2)		120
4/10	14	61	24.8	8.7	2	2	60 mg.(2)	1		1	1				48
4/10	15	61	34.6	28.7	1	1++	30 mg.(1)	1		1	1		349	1.7 mg.	144
AVERAGE			32.1	21.1											166

* The number in parentheses denotes the number of treatments employed to establish the total dose.
† Class denotes an attempt to judge the degree of ripeness at time of capture and at time of death. Class 1 signifies advanced ripeness.

Injections were typically made interperitoneally due to the rapidity with which the preparation could be introduced. Intramuscular injections resulted in some loss of the preparation unless it was introduced very slowly.

Retreatment with CG of three hatchery-spawned fish and two pond-spawned fish resulted in ovulation within eight hours after the second treatment.

Retreatment with CG of five negative fish resulted in death within 10 hours after the second treatment in four of the fish and within 48 hours in one of the fish.

CG, as used in this study, invariably resulted in either ovulation or in death within an average of about 45 hours. An examination of the ovaries of striped bass which died before ovulation showed, with but rare exception, a change in color from the normal bright green of controls to a typical brownish green color assumed in nature by striped bass ovaries as a state of ripeness is approached. The ovaries also were more turgid than the ovaries of controls.

On the other hand, the fifteen striped bass which spawned in the pond were all released in good condition and in presumed good health. One was retained for four days after spawning and then released in good health.

On the basis of these observations it would appear that death is a result of an inability to spawn under the influence of CG rather than any toxic quality of the preparation itself. In one period, however, between April 24 and April 26, 30 striped bass were treated without any success. This experience was so atypical to the results both before and after that it was surmised that a toxic batch of CG may have been responsible for the lack of success. It is also possible, however, that these particular fish were far from being ripe and the failure was due to this factor. After this experience, females were selected with greater care as to ripeness and many obviously unripe fish were returned untreated to the Tailrace Canal.

Unfortunately, we were unable to establish any criteria which would enable us to choose ripe fish with accuracy. Extremes of ripeness or unripeness presented no problem but classification as to the stage of ripeness of most females left much to be desired. Undoubtedly individual variation was involved, but any increase in the accuracy of selection would have resulted in greater success in inducing ovulation with hormones.

Follicle Stimulating Hormone-Pituitary

The preparation used in this study was produced by the Veterinary Department of Armour Pharmaceutical Company, Kankakee, Illinois.

One 17.0 pound striped bass was induced to spawn by injecting 25 mg. of FSH-P followed in 38 hours by a 50 mg. dose. The fish was found ripe 23 hours after the second treatment and had received a total of 4.41 mg. per pound of FSH-P.

Six successful spawnings were achieved with FSH-P in conjunction with CG. One of the six received simultaneous injections of FSH-P and CG and spawned in 42 hours (Table III). The remaining five received 1.19 to 3.01 mg. per pound of FSH-P initially and were treated with CG 24-64 hours later. Spawning occurred within 32 hours after the CG injection (Tables II, III, IV).

Three negative results were obtained with FSH-P alone and 11 negative results were obtained with FSH-P in combination with CG (Table V).

FSH-P seemed to produce a slower, more moderate reaction than CG but also a much less effective result.

Thyroid Simulating Hormone (TSH)

Sneed and Dupree (1961) found that the effects of CG and TSH were complimentary when used together to ovulate gravid goldfish (*Carassius auratus*) and gravid green sunfish (*Lepomis cyanellus*).

In the present study, 12 striped bass were treated with simultaneous injections of TSH and CG. Three positive and nine negative results were obtained. Five estrogen-treated fish received small amounts of TSH with negative results.

TSH was used in only two instances in the amount recommended by Sneed and Dupree (1961) and this fact along with the indifferent results obtained with the few fish treated with TSH makes any conclusions uncertain. TSH is almost prohibitively expensive, however, to utilize extensively on fish averaging nearly 16 pounds. At the current price of $360.00 per 1,000 units, it would cost about $15.00 to treat each female striped bass used in the study.

Pituitary Lutenizing Hormone (PLH)

This preparation was also produced by the Armour Pharmaceutical Company. It was received near the end of the spawning season and was used on only four striped bass. On the basis of this small sample it appeared the PLH either had no effect or a retarding effect in inducing ovulation. The striped bass judged most nearly ripe of 167 used during the study was injected with 25 mg. of PLH. In 32 hours no change was noticed and the fish were injected with CG at 238 I.U. per pound. The fish was found dead but ripe about 40 hours later (Table V).

Three negative results were obtained with PLH alone or in combination with CG and in every case the fish showed no advancement toward a state of ripeness.

Thyroid U.S.P. (1 grain)

Thyroid tablets were used as a possible substitute for TSH and also to increase metabolism in general. Twelve of the 44 successful fish and 14 of the 62 negative fish received one or more tablets. Seven estrogen-treated fish also received thyroid tablets, but the effect of thyroid in the study is uncertain.

Cytomel

Another possible substitute for TSH is Cytomel produced by Smith, Kline and French Laboratories, Philadelphia. The manufacturers describe Cytomel as a brand of liothyronine (L-triiodothyronine or LT3) and discusses several advantages of Cytomel over thyroid.

Seven estrogen-treated fish received 5 to 10 mcg. of Cytomel but the results were negative and inconclusive by virtue of the smallness of the sample.

Estrogen

The following estrogen preparations were used during the study:

Name	*Manufacturer*	*Description*	*Method of Treatment*
Premarin	Ayerst	Naturally occurring water soluble conjugated estrogens expressed as sodium estrone sulfate	Oral
Premarin Intravenous	Ayerst	Naturally occurring water soluble conjugated estrogens expressed as sodium estrone sulfate	Intramuscular Interperitoneal
Progynon Benzoate	Schering	A crystalline Estradiol Bensoate U.S.P., as ester of estradiol (dihydroxyestrin) in oil	Intramuscular
Estinyl	Schering	ethinyl estradiol	Oral
Dienestrol Cream	Ortho	A cream containing the synthetic estrogen dienestrol .01%	Introduced into genital pore

As mentioned before, the estrogen-treated fish seemed to advance in ripeness but none spawned. The estrogen-treated fish lived well in the pond in comparison to the other classifications even though they were handled every other day. It should be noted, however, that the water temperature during the use of estrogen ranged only between 57-61° F. This is probably the minimum spawning temperature and the use of estrogen later in the season may have contributed a more positive result.

Perhaps the use of massive doses of estrogen was a mistake in that in mammals high dosage of estrogen may tend to inhibit the function of the anterior pituitary.

Enovid

Enovid is produced by G. D. Searle and Company, Chicago. The manufacturer describes Enovid as being estrogenic and progestestational in its actions

and of having the effect of inhibiting ovulation by inhibiting the elaboration of the gonadotropic hormones by the anterior pituitary gland but with no adverse effect on the ovum-producing capacity of human ovaries.

Enovid was used on seven of the estrogen-treated fish with inconclusive results.

Testosterone

Depo-Testosterone produced by the Upjohn Company, Kalamazoo, Michigan, was injected intramuscularly into six striped bass. Two of the fish spawned but since both also were treated with CG the effects of testosterone, if any, were masked.

Decadron and Depo-Medrol

Decadron is a trademark of Merck and Company, Inc., for dexamethasone which is a synthetic adrenocortical steriod used for anti-inflamatory therapy.

Depo-Medrol is an anti-inflamatory steriod synthesized by the Upjohn Company.

These preparations were used on twelve striped bass in the hope of mitigating the "spawn or die" influence of CG. Six of the treated striped bas spawned successfully and several appeared much more lively than those not receiving the anti-inflamatory preparations.

Sriped Bass Egg Production

Fecundity studies at Weldon and elsewhere indicate than a 15-pound striped bass would produce about 1½ million eggs (Raney 1952). On this basis, we estimate that approximately 66 million eggs were produced at the Moncks Corner Hatchery this year although only 36 million entered the hatchery due to fish spawning within the holding pond or dying just before spawning. This record, compared to the negative results in 1961, certainly attests to the value of hormones as a solution to the problem of finding naturally ripe female striped bass. The experience gained in 1962 with the several preparations listed above leads to the assumption that the same or better egg production could be obtained with the use of CG alone although FSH-P also has value.

Striped Bass Fry Production

While the egg production picture was a bright one, fry production was very disappointing. Of the estimated 36 million eggs which entered the hatchery only approximately 2,640,000 fry were produced for a mortality of about 93 percent. Some of this mortality was the result of inexperience in the operation of the hatchery but the greater part was due to unknown causes.

Several hypotheses as to the cause of mortality have been formulated for additional study as follows:

1. The hormones induced ovulation of immature eggs which were unfertilizable and/or unhatchable.
2. If eggs remain within the ovary after becoming ripe, they suffer from a low oxygen (inter-ovarian-hypoxia) and are rendered unfertilizable and/or unhatchable for this reason.
3. Some unknown fault of the hatchery such as the possible lethal aspect of fluorescent lighting (Eisler, 1957).
4. After the water temperature remained at 70° or above, egg mortality was 100 percent. Future effort will be concentrated at lower water temperature.

The demands upon the limited technical personnel this year in capturing, injecting, checking and handling the ripe fish was such that the eggs and larvae received scant attention. The potentially ripe females were not properly observed in the holding pond for the same reason. It is anticipated that these faults will be remedied in the near future and much more emphasis will be placed upon the dose levels, brands and combinations of hormones employed, in order to produce hatchable eggs. A much closer watch will be kept upon the females in the pond in order to anticipate the earliest possible moment that a female is ripe. An ovary and egg study will be instituted to try to determine the cause of mortality.

Due to the readily available source of large female striped bass in the sanctuaries it should be possible with the use of CG to produce several hundred million striped bass eggs at Moncks Corner annually. If fry production can be made to approximate egg production, then the other reservoirs of South Carolina can be stocked with significant numbers of striped bass fry. The success of

such introductions remains to be seen. Warm water put and take stocking in the past has proven, in most cases, to be futile but neither has it been carried out on the scale anticipated here.

One young-of-the-year striped bass was taken in a population sample in the Wateree Reservoir on June 30, 1962. This fish is either a survivor from 760,000 fry stocked from the hatchery on April 22, 1962 or from the natural reproduction of a previous stocking of adult striped bass.

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