

# TECHNICAL GAME SESSION WETLANDS SESSION

## THE EVERGLADES BULLFROG LIFE HISTORY AND MANAGEMENT

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### INTRODUCTION

One of the most important but least understood economic natural resources in the Florida Everglades is its bullfrog, *Rana grylio*. Even though more than half a century has passed since the species was first recorded in literature by Stejneger (in 1901) and hundreds of thousands of individuals have been harvested for market by commercial froggers in the glades, information on many aspects of its life history and its role in the ecology of fish, birds, alligators and other reptiles and small mammals is very meager. This frog is of tremendous economic importance to commercial froggers and as a source of recreation for the sportsman. Many people of south Florida supplement their livelihood with revenue obtained from the sale of frog legs to wholesalers, hotels and restaurants. Not only does this frog supply the market with a highly prized delicacy but it ranks highly as a game animal to many airboat enthusiasts. In the total ecology of the animals in the glades, this species probably is an important link in many food chains

Florida, the state with the greatest natural frog producing potential in the world, has no laws to protect this very important resource against overharvesting in certain areas nor is there a law to require commercial interests to submit records to the Game and Fresh Water Fish Commission by which an economic evaluation of the industry could be made for Florida.

In the Everglades, commercial froggers and sportsmen hunt the bullfrog relentlessly throughout the entire year if water conditions are suitable for airboat travel. Some froggers will hunt regardless of the prevailing market price or size of the frogs available for harvest. The smaller sizes and dwindling supply of frogs harvested by froggers coupled with the dearth of facts available on the ecology and life history of the species indicated the need for a study so that the resource could be managed wisely by sound practices in the future.

Subsequently in 1954 a frog study phase was included in Pittman-Robertson federal aid project W-39-R. This comprehensive federal aid project was concerned with determination of the effects of a vast flood control program on the wildlife resources in the Everglades. As part of that plan more than three quarter million acres of the Everglades were to be surrounded with levees and used for water storage (fig. 1). The frog study was performed in these "conservation areas".

This species of frog is distributed throughout the coastal plain area of southeastern United States. The range extends from southern South Carolina to Florida (except the Keys) and to extreme southeastern Texas. In this report "Everglades bullfrog" (rather than "pig frog" or "southern bullfrog") is used to designate *Rana grylio* since this species is so abundant and is the only large frog occurring in the area. It is rather certain that any large frog seen in the sloughs and open water areas of the Everglades, away from canals or levees, is the Everglades bullfrog. The bullfrog *Rana catesbeiana* is unknown south of central Florida. The leopard frog, *Rana pipiens*, lives in the Everglades but is not as abundant or large as *R. grylio* in this habitat. Large leopard frogs seem to be confined to canals, wet pastures or flooded fields. Leopard frogs can be considered land frogs so the sloughs and open water areas of the Everglades are not their optimum habitat. Large leopard frogs were not observed in the interior of the Everglades during the study.

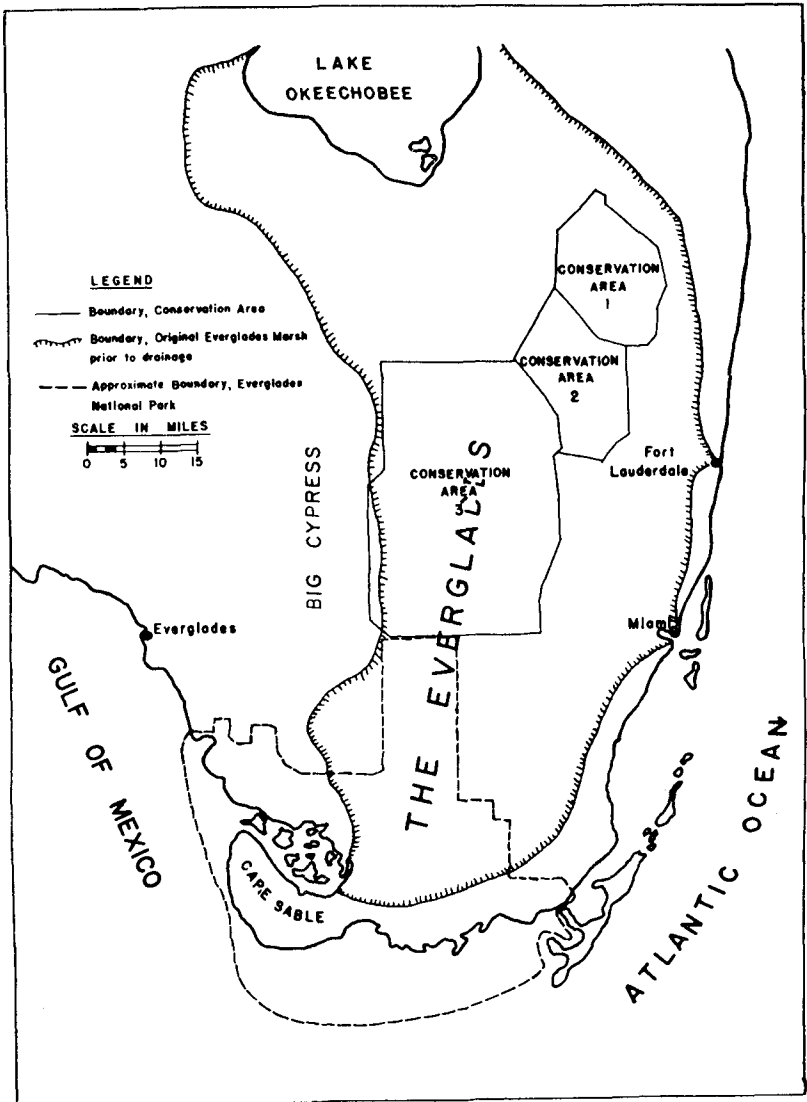


Figure 1. Map of lower Florida showing boundaries of Conservation Areas and Everglades National Park, and extent of original Everglades marsh.

#### PROCEDURES

Frog samples were collected at night since the bullfrog is seldom seen during daylight hours. An airboat equipped with a stovepipe frog chute with burlap bag attached to hold the frogs, and a headlight, mounted on a miner's cap, were used to spot the frog's eyes which reflect the light beam. The airboat battery supplied power to the headlight. Some specimens were giggered, a few dip-netted when they were sluggish in cold weather, but the majority were picked up by hand and placed in the wet burlap bag. Hand picking of

frogs was necessary when collections were being made in tagged frog release areas to prevent killing the marked individuals. Each frog was examined for tags or marks immediately after it was caught so that mobility data could be recorded. All sizes of frogs were taken to obtain data on transformation sizes, weights, measurements and year-round stomach samples for food-habits studies. The wet bag containing the frog sample was placed in a refrigerator until it could be examined the following day.

Each frog was given a number to identify it and the resulting data. The sluggishness of the live cold frogs removed from the refrigerator permitted them to be weighed and measured with ease. Snout-vent length (tip of snout to center of vent) was taken by holding the frog flat against the measuring board and extracting the S-V length with dividers. The dividers were placed on the millimeter rule to obtain the actual reading in millimeters. Extent measurement, i. e., tip of snout to tip of toes on extended hind feet, was made directly on the measuring board. A gram scale balance was used to obtain total and saddle weights but earlier in the study a spring scale graduated in tenths of a pound was used. Total weight denoted the weight of the whole frog while saddle weight was that of a pair of dressed legs with the back attached, hence the name "saddle." Large scissors were used to cut off the fore part just posterior to the front legs. This is the standard procedure used by commercial froggers to dress their catch.

Stomachs were removed and preserved in 10 percent formalin till analyzed. Food habits data were obtained from field observations and the analysis of food items found in all stomachs collected. Percentages of foods consumed by the bullfrogs were expressed by volume and occurrence for each month of the year and as part of the total sample. Volume of each food item was obtained by the water displacement method.

Ovaries were removed and examined for development of eggs from which maturity, breeding readiness and peaks of ovulation were determined. A binocular dissecting scope and a plastic rule graduated in quarter millimeters were used to measure egg sizes. Female frogs were inducted to shed their eggs by injecting them with a 10 percent ethyl alcohol frog anterior pituitary suspension. Eggs were fertilized in the laboratory to obtain data on egg hatching time and to obtain tadpoles for growth and transformation studies. Eggs were fertilized with a few millimeters of freshly prepared suspension of testes in Holtfreter's Solution.

Four methods of marking frogs for growth and mobility studies were used. The first three methods, jaw tags, toe clipping and tattoo marking with India ink, were not satisfactory. Jaw tags interfered with feeding and caused jaw infections; toe-clipping was not detrimental to the health of the frogs but errors in identification of individuals was possible; tattooing was not permanent. The fourth method, perfected during the study, employs small, colored, numbered plastic fish tags inserted under the belly skin. To read the tag number on recaptured frogs the tag must be removed again by making a small slit near the tag. After data are recorded the tag is inserted into the removal hole and the frog released. The 1/4 x 5/8 and .002 inch thick tags used are too large to be used on recently transformed frogs; the tag must be cut down or a smaller size used.

## LIFE HISTORY

A review of literature indicated that little information was available on the life history of this species. Data were obtained on emergence, breeding behavior and cycle, minimum breeding sizes, growth and mobility, embryology and tadpole development and food habits.

Field observations showed that bullfrogs remained active throughout the year if sufficient water was present but fewer were observed during cold periods in winter.

Male bullfrogs in breeding condition tend to congregate in loose chorus groups. In sawgrass, maidencane and willow communities, singing males float on the surface of the water in the densest vegetation available while in sloughs and whitegrass flats areas they are found at night perched on water-lily pads out in the open. Male frogs on breeding territory tend to stick to one spot. Female frogs not in the proper egg development stage for amplexus uttered calls similar to grunts of a male. Both the warning grunt

and small girth size appear to be methods by which males recognize non-breeding readiness of females.

No concerted breeding choruses were recorded for November and December although some breeding takes place in each month of the year. Breeding activity decreased rapidly as air and water temperatures dropped below 70°F. and practically all calling ceased when water temperature dropped below 60°F. Large breeding choruses or "roaring" frogs did not materialize until air and water temperatures remained above 70°F. Little or no breeding takes place during drought or low water periods. There may be a minimum water depth below which frogs will not breed. Partial flooding of the Everglades after drought or dry periods tends to stagger the release of frogs imprisoned in the soil throughout the period of rising water. This occurrence determines the time of year when that segment of the frog population will breed.

Breeding time and peak in the Everglades was determined by analysis of female gonads for breeding readiness. In south Florida this species breeds throughout the year but the major part of breeding takes place from March through September with the peak occurring in June.

Minimum breeding size for female frogs was found to be 94 to 96 mm. S-V length; however, most of the females exceeded 100 mm. S-V length at maturity. Only females with spent ovaries were classed as adults. Growth studies of marked frogs and egg and tadpole development time indicates that females may attain minimum breeding size in 1.5 years after fertilization of the egg. Minimum breeding size for males was found to be between 70 and 75 mm. S-V length. Males were classed as adults if they possessed large to medium sized tympana and large orange-yellow testes. Males attain minimum breeding size in 1 to 1.5 years after fertilization of the egg.

A small female frog shed approximately 6,000 eggs while one of the largest females collected contained approximately 34,000 ripe eggs in the ovary ready to be shed.

Minimum weights recorded for recently transformed frogs was 3.7 grams each or 122 individuals per pound. Female frogs are larger in weight and S-V length than males. This holds true only for females above minimum breeding size.

A small tagged frog grew 4.2 mm. S-V length and 5.2 grams per month over a six months period (Dec. to June). Mature frogs (above 110 mm. S-V length) grew only 1 to 2 mm. S-V length per month or remained the same size.

The heaviest specimen of Everglades bullfrog collected was a female weighing 431 grams. The largest sized female measured 157 mm. S-V length or 170 mm. body length. The heaviest male weighed 228 grams and measured 131 mm. S-V length or 141 mm. body length.

Frogs remained in the same vicinity where they were marked and released. One frog moved 1,350 feet in 52 days. The greatest time lapse between tagging and recovery was 342 days.

Bullfrog eggs hatched in 72 hours at 75 to 85°F. temperatures. First tadpole feeding actions were observed at 6.5 days after hatching. Small tadpoles fed on green unicellular algae (*Scenedesmus* sp.). Prominent transverse gold stripes appeared at 9.5 days on the dorsal surface. One stripe was located just anterior to the eyes, one posterior to the eyes and a small spot at the base of the tail. Tadpoles obtained from the same batch of eggs did not transform at the same time. Some tadpoles transformed in three months' time while others took five months. The observed tadpole transformation period in the Everglades extended from 30 April to 2 October. Maximum and minimum S-V lengths of bullfrogs at time of transformation were recorded to be 30 to 42 mm.

Stomachs of 1,049 frogs of all ages and from all types of habitat in the study area were analyzed to obtain food habits data. Samples were collected for all months of the year during the period May 1956 to May 1959. No attempt was made to identify each food item as to species. Crayfish (*Procambarus alleni*) composed 74.76 percent and insects 15.76 percent of the total volume of food analyzed.

## HARVEST

It is practically impossible to compile an accurate account of frog harvest data for Florida under the present "no license required" commercial frogging and marketing conditions. Other research workers estimated that the frogging industry was worth \$100,000 a year in 1943 and \$1,125,000 a year in 1954.

High water stages in the conservation areas in 1957-58-59 were considered excellent for frog production. Froggers' nightly catches increased from 25 to 30 pounds of frog legs a night in 1956 to 45-50 pounds in 1958 and 75 to 100 pounds in 1959.

Frog leg prices varied from a low of \$.25 per pound in 1943 to a high of \$2.00 in 1956-57, with the average being around \$.80.

The total number of froggers in Florida was estimated as 400 in 1953 and 200 in 1954. The number of commercial froggers in the Everglades decreased after the drought of 1955-56 but the number of sport froggers increased. The number of airboats used in the Everglades increased from 484 in 1954 to 872 in 1960.

The decrease in number of commercial froggers in south Florida was attributed to the reduced frog population following the 1955-56 drought, froggers turning to industry for employment and reduction of frog producing areas by drainage for agricultural purposes.

## MANAGEMENT

Proper water level regulation is the key to frog management in the Everglades. Water depths should be not less than 1.5 feet in November and one foot in May.

Controlled burning during favorable water and weather conditions is beneficial by opening up areas to frogging that are too dense to penetrate with an airboat.

An increase in the alligator population would benefit frogs and other fauna by creating numerous deep water holes which serve as reservoirs for tadpoles and other organisms in dry periods. For this reason continued and increased protection is desirable.

Experimental introduction work on the bullfrog *Rana catesbeiana* should be carried out on a limited scale. It may be possible to introduce this species into the numerous canals and borrow pits of south Florida.

Little is known about the life history of the crayfish in the Everglades. This species is one of the most important food items of frogs. A knowledge of its habitat requirements in the conservation areas would be a justified project.

At present, Florida has no laws which require wholesalers or commercial froggers to report their annual transactions in frog legs. Also, no license fees are required to hunt, sell or buy frog legs. It is recommended that wholesalers and commercial froggers should be required to purchase a license so that frog harvest figures and number of individuals working in the frogging industry can be ascertained. It is recommended that:

1. A regular state or county license be required to hunt or take frogs in all counties of the state. No hunting license should be required for frogging by those individuals in possession of a commercial frogger's license.
2. A wholesale-retail dealer's license be enacted. A report of business transactions in frog legs (native and from foreign countries) should be required periodically.
3. A commercial frogging license be required of all individuals who hunt and sell frog legs. A report of business transactions in frog legs should be required periodically.
4. Frogs (*Bullfrog, Rana catesbeiana*; *River Frog, R. heckscheri*; *Everglades Bullfrog, R. gryllis*; and *Leopard Frog, R. pipiens*) be included as game species on the hunting license.
5. A closed season on frogs, limited to the main breeding months, be placed on the Everglades Management Area. The closed season should extend from April 1 through August 31.
6. No closed season be placed on frogs in the state other than the Everglades Wildlife Management Area until more data are obtained.
7. No size or bag limits on frogs be imposed at the present time.

## ACKNOWLEDGMENTS

The author expresses his appreciation to those individuals who contributed information, assisted with laboratory and field work and the task of preparing the manuscript. Special thanks are expressed to H. E. Wallace, W-39-R Project Leader, who suggested the problem and for his patience, guidance and review of the manuscript; E. B. Chamberlain, Jr., Chief, Game Management Division, for cooperation and review of the manuscript; Dr. C. W. Watson, Regional Federal Aid Supervisor of the Fish and Wildlife Service, for review of the manuscript; J. O. Brown, Area Supervisor of Law Enforcement and Wildlife Officers James Jordan and Thomas Shirley for observations on frogger activity; Commission pilot, Louis Conrad, for assistance with aerial surveys and photography of various habitats; C. M. Loveless, William Ware and Wayne Cone of the Game Management Division for assistance with field and laboratory work and to Mrs. Anne Baldwin Stinson for typing of the manuscript.

The author also wishes to express his gratitude to Dr. B. B. Leavitt, University of Florida, for insect and snail identifications; Dr. Keith Hansen, Stetson University, for assistance with laboratory techniques on induced frog ovulation experiments; Jacob Valentine, South Florida Refuges, for helpful suggestions and frog tagging and Mr. Johnny Lamb, Loxahatchee Refuge Manager, for information on early frogging history and for assistance given during collecting trips.

## WEIGHTS OF MALLARDS IN ARKANSAS

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The weights of 3,425 mallards were recorded in Arkansas during the 1957-58 and 1958-59 hunting seasons. An analysis was made of the food eaten by 583 of these birds. The purpose of this study was to determine: (1) seasonal weight changes, (2) the kinds of food most eaten, and (3) possible effects of the kind and availability of food on the weights of mallards.

## METHODS

Fresh killed ducks were weighed and the gullets examined for food at duck cleaning establishments in Stuttgart and Little Rock, Arkansas. Most of the ducks killed by sportsmen in this part of the state are cleaned at these commercial places. The ducks examined in 1957 were approximately 95 percent mallards, 3 percent pintails, and 2 percent other ducks. Only mallards killed in the morning are reported in this paper. No allowance in weight was made for "wetness" of the ducks.

## DESCRIPTION OF AREA

The general area of collection is one of the major waterfowl wintering grounds in the United States. The Stuttgart area is on the flat, loessial terrace and bottomland soils of Southeast Arkansas. Ducks that were killed in hunting areas within a 20-mile radius usually were brought to Stuttgart to be dressed. This area is considered to be the center of the rice growing business in Arkansas. Soybeans and cotton are the other important farm crops.

The Little Rock area is located on forested coastal plains, bottomland, and some loessial terrace soils. The Little Rock duck cleaning stations serve a considerably larger territory than do the Stuttgart businesses. Most of the ducks cleaned at Little Rock are killed within a 30-mile radius. Some, however, are killed in the Stuttgart area, approximately 50 miles away. Several large impoundments, Maumelle, Conway, Harris Brake, and Peckerwood Lakes, are hunted by sportsmen from the Little Rock area. Rice, soybeans, and cotton are the main crops grown. However, the rice acreage in the Little Rock area is estimated to be about one-half of that in the Stuttgart area.