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X-RADIATION TECHNIQUE FOR WILDLIFE INVESTIGATIONS[1]

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The Tennessee Game and Fish Commission has successfully utilized radiology for the following purposes: (1) determining the effects of hunting season closure on geese (Gore and Barstow 1969), (2) predicting annual productivity of deer (Lewis 1962, Whitehead 1966), and (3) determining lead shot ingestion in doves (Lewis and Legler 1968). Because of this experience, and the results

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of others, we feel that radiology has significant potential for use in wildlife research. This paper briefly presents our use of x-ray equipment and film processing. A detailed paper can be obtained from the senior author.

MATERIALS AND METHODS

The portable x-ray machine used in our investigations was a Meyer Co., Model MO with power ranges to 40 milliamps (MA) and 85 kilovolts (KV). Units of this type should be sufficient for most wildlife uses. This machine was obtained as surplus property at no cost from the State Department of Public Health. Used equipment should be thoroughly inspected and tested by competent authorities prior to usage.

Electrical power can be supplied by regular 110 line voltage or a portable generator capable of generating at least 30 amps. The complete x-ray apparatus (Fig. 1) consists of an adjustable stand, x-ray tube power head, high voltage transformer-electrical control unit, a trigger mechanism, film and several film containers called cassettes. Lead aprons and shields are essential for protection of operators.

Instructions for operating the machine follow:

1. The machine should be set up in a dry, level location making sure it is properly grounded. To obtain a life-size picture, adjust the stand so that the focus mark on the x-ray tube power head is 36 inches above the film cassette. Be sure that the supply of film and personnel are properly protected from radiation before turning the machine on. There are two gauges in the control unit. One gauge registers MA's (milliamps) and the other measures KV's (kilovolts). Notice that the MA meter remains on zero when the machine is turned on, while the KV meter moves forward.

2. The KV meter should be adjusted first. It has two knobs. One knob increases or decreases kilovolts in large steps, five units at a time, while the other knob adjusts in small steps, one unit at a time. Settings of 60 to 75 kilovolts should be used for x-raying wildlife.

3. The MA meter moves only when the trigger is activated. A single knob adjusts milliamps. When the trigger is depressed, the MA meter should read the desired milliamps. Take several 0.5 second test shots to warm the machine up. Then, take additional test shots while adjusting the MA meter rise to the desired milliamps. Our experience indicates that setting of 20-25 milliamps and time exposures of ⅜ to 1.5 seconds should be used for wildlife work.

4. To take a picture, place the loaded cassette beneath the specimen directly below the x-ray tube power head. Set the trigger timer and activate the trigger. Keep an eye on the MA meter to make sure that the meter rises to the desired milliamps. If not, the entire process will have to be repeated.

Several exposure rates or settings were tried on geese. However, the settings of 75 peak kilovolts with 25 peak milliamperes at 0.5 of a second provided the best exposure. For yearling does, Lewis (1962) used settings of 65 peak kilovolts with 25 peak milliamperes at 0.5 second. However, as animal density or width increases or decreases, kilovoltage must be varied.

Safety precautions should be exercised to reduce exposure of x-radiation received by the operator and assistants. We used a 4-foot by 6-foot shield made of lead ⅛-inch thick. The shield was placed 2 to 4 feet from the x-ray head and the operator and his assistant stood behind it when the machine was activated. Both operators also wore lead lined aprons.

Several types, brands and sizes of film are available. The film used in our studies was 14-inch by 17-inch sheets of Dupont Cronex 4. This type of film permits faster drying at the completion of the development process.

Field darkrooms used were a rental van type trailer or a regular four-door sedan. Stray light around doors, windows or cracks was sealed off by using combinations of black, electrician's tape, black plastic sheeting and large, heavy canvas tarpaulins.

The exposed film was removed from the cassette and placed in a Coleman insulated ice chest with a cam type lock-down latch. For further protection against exposure, the cooler was enclosed in a double-thickness, black cloth bag and placed in a cardboard packing box. As each exposed film sheet was taken out of the cassette and placed in the cooler, a sheet of newspaper was placed over the film to prevent sticking. Care was taken to insure that the fresh unexposed film box and Coleman cooler were resealed and tops closed before doors of the darkroom were opened.

Equipment used for film development included a Sunroc Company x-ray film development tank, film hangers, Gra-lab model 300 darkroom timer, a Lenz Hi-speed rotary print washer, a Kodak model A darkroom lamp with 15-watt bulb and oc filter, and a Pako-Dry Cab model 2 forced hot air drying cabinet. This or similar equipment is usually standard for photographic darkrooms. The exception might be the x-ray development tank. This special tank has four separate compartments or containers. The first (left hand) container holds the developer solution, the second compartment holds rinse water, the third has the fixing solution, and the fourth compartment contains rinse water. Minimum equipment for film development would be containers for holding developer, fixer and rinse water, film hangers and a timer.

Two special developing solutions were used: (1) Kodak x-ray developer and (2) Kodak x-ray fixer. Mixing directions for these solutions come with the chemicals. Film and development chemicals can readily be obtained from x-ray supply houses. Material cost per picture was approximately $0.90.

Because specific instruction for film development is lacking in the literature, step by step directions are listed below:

1. Gather all developing equipment, solutions, and exposed film and arrange conveniently in darkroom.
2. Mix developing and fixer solutions and place in respective subcontainers in the x-ray film development tank. Rinse water and chemicals should be approximately 70° F. Instructions accompanying the Kodak x-ray developing solutions will give time (minutes) of film emersion in developing and fixing fluids for different solution temperatures.
3. In the dark, (the special filtered darkroom lamp is permitted) open the cooler and remove a sheet of film. Place the film on a hanger. Prepare as many hangers as the developer solution container will hold.
4. Close and cover cooler.
5. Set time clock for the amount of time the film should be in the developer solution.
6. Place hangers with film in the developer and start timer.
7. When time is up, remove film and rinse once or twice in water. Set timer for amount of time required for fixing.
8. Place film in fixer and start timer.
9. When time is up, remove film.
10. Rinse film for approximately 30 minutes. If available, use a rotary print washer with water at 70° F.
11. Hang up to dry. If available, a forced hot air drying cabinet at 150° F will dry the film in about 30 minutes.
12. Repeat above steps for other exposed film.

The development operation will become familiar as one gains experience. The senior author was able to develop 70 films in a normal eight-hour office day.

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A COMPARISON OF NESTING IN CANADA GEESE USED FOR ESTABLISHING HOME-GROWN FLOCKS

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A plan was initiated in 1960 for establishing a local nesting colony of Canada geese (*Branta canadensis*) on Rockefeller Wildlife Refuge in Louisiana; however, little information was available on Canada goose nesting along the gulf coast. Previous reports on establishing local nesting populations dealt mostly with attempts in north central and northeastern states (U.S. Department of the Interior, 1958; Clark and Nightingale, 1960). Therefore, much of the earlier work on this project was experimental in nature. The purpose of this study was to compare the breeding behavior of Canada geese of different source and age groups and to evaluate the value of each group toward the establishment of a home-grown flock.

The comparison of Canada geese from different sources was made by determining the percentage of adult birds in each group which nested. The groups compared were: hand-reared giant Canada geese (*B. c. maxima*), wild-trapped Canada geese (*B. c. interior*), and locally-hatched geese, which were mostly *B. c. interior*.

Two age groups were compared among the wild-trapped birds. One group consisting of 500 young, was brought to the refuge in 1968 when only two weeks old. The young were transported to Rockefeller Refuge soon after hatching and reared on the area. The geese were banded and permitted to fly to determine if they would remain in the area.

The other age group of wild-trapped Canada geese were captured as adults and taken with cannon net on Swan Lake National Wildlife Refuge in Missouri. This group consisted of 1,500 geese and were trucked to Rockefeller Refuge in November 1963, wing-clipped to prevent flight, banded, and released in a 200-acre enclosure. The adults were held on the refuge for 2 years by subsequent wing-clippings during the summers of 1964 and 1965. They were not wing-clipped during 1966 and were permitted to fly to determine if they would remain on the area after being held there for 2 years.