Journal of the Iowa Academy of Science: JIAS

Volume 101 | Number 3-4 Article 6

1994

Evaluation of Implanted Radio Transmitters in Pheasant Chicks

Dean E. Ewing
Iowa State University

William R. Clark
Iowa State Universtiy

Paul A. Vohls
Iowa State University

Jour. Iowa Acad. Sci. 101(3-4):86-90, 1994

Evaluation of Implanted Radio Transmitters in Pheasant Chicks

Dean E. Ewing[1,2], William R. Clark[3], and Paul A. Vohs[1,4]

[1]Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, IA 50011

[2] Present address: Department of Game, Fish and Parks, 4725 Rimrock Highway, Rapid City, SD 57702

[3]Department of Animal Ecology, Iowa State University, Ames, IA 50011

[4]Present address: Office of Information Transfer, National Biological Survey, Fort Collins, CO 80525

We studied game-farm pheasant (*Phasianus colchicus* Linneaus) chicks implanted with miniature transmitters to determine if surgery and implantation affected growth, behavior, or survival. Transmitters (weighing 1.2 g) were implanted subcutaneously in the interscapular region in day-old chicks. In Experiment 1, biological effects on chicks with transmitters implanted were compared with data from a control group. In Experiment 2, the effects of anesthesia only, anesthesia with an implanted transmitter, and implanted transmitter only were compared with a control. We measured responses of weight gain, survival, and pecking behavior in each experiment. In Experiment 1, we found no significant differences in weight between chicks with implanted with transmitters versus the control group during 23 days after implantation (repeated-measures ANOVA, $n = 34$, $P = 0.34$) in Experiment 1. In Experiment 2, we found overall differences in weight of treated chicks and controls (repeated-measures ANOVA, $n = 76$, $P = 0.02$). Chicks in the control group were heavier ($P < 0.05$) at ages 9, 11, 14, and 21 days but there was no significant differences in weight among treatments and control at 28 days ($P = 0.07$). Surgery and the presence of implants had no effect on survival or on pecking rates of chicks among groups in either experiment. We failed to reject the hypothesis that surgery and implantation had no effect on growth, behavior, or survival of pheasant chicks.

INDEX DESCRIPTORS: growth, implantation, Iowa, pheasant, *Phasianus colchicus*, radio telemetry

Radiotelemetry has been widely used to study animal behavior, habitat use, and survival (Kenward 1987, Samuel and Fuller 1994). Most researchers have been concerned that capture and transmitter attachment have some effect on subsequent behavior, growth, and survival, but observations suggest that effects are variable among species, age, and time. On adult birds attachment is usually external by means including adhesive and velcro (Raim 1978, Kálás et al. 1989, Sykes et al. 1990), harness of various designs (Dwyer 1972, Sykes et al. 1990, Samuel and Fuller 1994), and external suturing (Martin and Bider 1978, Mauser and Jarvis 1991, Rotella et al. 1993). Evaluation of transmitter effects has been done primarily on adult mammals or birds >25 g using transmitters weighing >2 g, and in general, birds are more sensitive to transmitter attachment than mammals (Samuel and Fuller 1994). Field and experimental studies have shown that visibility and weight of the transmitter and method of attachment can influence behavior (Greenwood and Sargeant 1973, Perry 1981, Houston and Greenwood 1993, Pietz et al. 1993, Rotella et al. 1993) and survival (Marks and Marks 1987, Marcström et al. 1989) of waterfowl and upland game species.

Implantation offers advantages for types of studies in which externally-attached transmitters have met with variable success (Korschgen et al. 1984). Transmitters have been abdominally implanted in small rodents (Smith 1980, Madison et al. 1985) and birds (Southwick 1973, Korschgen et al. 1984, Olsen et al. 1992, Rotella et al. 1993) with no immediate adverse effects. Subcutaneous implantation is especially appealing for use with chicks of precocial species (Zenitsky 1993).

We wanted to evaluate whether anesthesia, surgery, and implantation of miniature transmitters would adversely affect ecologically important responses of pheasant chicks before using the technique in a field of study of chick survival (Ewing 1992). We experimentally evaluated effects on behavior, growth, and mortality of implanting day-old game-farm pheasant chicks with miniature transmitters. We followed the implantation technique originally developed by C.E. Korschgen and K. Kenow (Patuxent Environmental Science Center, LaCrosse, Wisc.), which was approved by the Committee on Animal Care at Iowa State University and meets recommendations of the American Ornithologists' Union (AOU 1988).

METHODS

Pheasant chicks <24 hours posthatch were obtained from Murray McMurray Hatchery, Webster City, Iowa. Transmitters implanted (18.0 x 9.0 x 5.0 mm) weighed 1.2 g, had a life expectancy of 40 days (Holohil Systems, Ltd., Woodlawn, Ont., Can.), and averaged 7.4% of each bird's body weight at implantation. A 14-cm extruding whip antenna (0.55 mm diameter nylon coated stainless steel stranded wire) was selected instead of an internal coiled antenna because the former provided 400-450 m of additional reception. Both active and dummy transmitters were used for the experiments.

Hereafter, we briefly describe the implantation technique and note slight modifications from that developed by Korshgen and Kenow (pers. commun.) The detailed procedure may be obtained from C.E. Korschgen (Patuxent Environmental Science Center, North Central Research Group, c/o National Fisheries Research Center, LaCrosse, WI 54602-1897). In our case, surgical equipment and transmitters were cold sterilized in aqueous benzalkonium chloride (Zephiran). Chicks were laid on a flat, electric heating pad during surgery to minimize heat loss. Down feathers on the neck were moistened with Zephiran to expose the narrow cervical region (cervical apterium) that extends from head to trunk. The skin was lifted with fine-tip forceps prior to incision to avoid piercing muscles, arteries, and veins. An 8-mm incision using a surgical scalpel was made in the cervical apterium extending ventrally from the leading edge of the dorsal feather tract. A 2 mm diameter, blunt, stainless steel probe was inserted to disjoin the loose subcutaneous connective tissue or superficial facia. A space was created extending from the incision to the mid-back region via the dorsal midline. A hollow stainless steel tube (i.d. = 1.5 mm, o.d. = 2.0 mm) was inserted beneath the skin to facilitate threading the antenna to the rear of the cavity. The distal end of the needle-tipped tube was pushed through the skin near the mid-back point of exit. The antenna was threaded through the tube, and the tube was removed through the antenna exit site. The transmitter was pulled gently into position completely posterior to the incision in the interscapular region of the spinal tract, thus avoiding pressure on the incision. The incision was closed with a mattress stitch using 4-0 polyglycolic acid suture.

We compared the effects of no anesthesia with methoxyflurane on game-farm pheasant chicks; anesthesia techniques not evaluated by Korschgen and Kenow (pers. commun.). Methoxyflurane is considered the safest volatile agent for induction of anesthesia in birds (Green 1979:122, Mandelker 1987:151). Chicks to be anesthetized with methoxyflurane were placed in a litre glass jar containing 0.1 ml of methoxyflurane on a cottonball attached to the side. A glass lid was placed on the jar until the chicks reached the stages of deep narcosis or light anesthesia. In these stages chicks exhibited (1) little to no response to sound; (2) minimal fluttering or occasional shrill cries when provoked by a painful stimuli; (3) rapid, deep, and regular respiration that often became irregular following stimulation; (4) the presence of normal reflexes (palpebral, corneal, cere, pedal) but a lack of voluntary movement; and (5) no response to vibration or postural change (Arnall 1961).

We conducted preliminary trials with methoxyflurane on both domestic chicken (*Gallus gallus*) chicks (n = 5) and game-farm pheasant chicks (n = 5) to estimate an optimal induction time. All chicks were given anesthesia until respiratory arrest.

Some treatment groups in the 2 main experiments received no anesthetic because young birds are relatively insensitive to pain (AOU 1988), particularly subcutaneous incisions (Green 1979). Sex of chicks was ignored because rates of development during the first few weeks are unrelated to sex (Thomas and Bailey 1973).

We followed the diet and floor space recommendations of Thomas and Bailey (1973) and Cain et al. (1984) to assure normal behavior and growth of pheasant chicks. Feather pecking is a normal behavior in pheasant chicks and not entirely related to intraspecific competition (Hoffmeyer 1969). Therefore, feather pecking experiments were conducted to determine if this behavior increased due to transmitter implant and external antennae.

Two experiments were conducted. In Experiment 1, we compared responses of a treatment group implanted with a transmitter without anesthesia (n = 17). In Experiment 2, we compared a control group (n = 20) with 3 treatments: anesthesia and implant (n = 18), implant only (n = 18), and anesthesia only (n = 20). Chicks in Experiment 1 were weighed at days 1, 3, 5, 7, 9, 16, and 23. Chicks in Experiment 2 were weighed at days 1, 3, 5, 7, 9, 11, 14, 21, and 28. The pattern and relative variation in growth between the treatments and control were examined. Pecking behavior was observed during 5-minute periods twice each day for the first 10 days of life at approximately 0800 and 1800. Survival was calculated through the end of each experiment.

Transmitters were implanted, all chicks were placed in an indoor pen for 2 weeks, and then all were moved to an outdoor pen for the final 2 weeks. Chick densities in the indoor pen were 0.24 chicks/m^2 for Experiment 1 and 0.12 chicks/m^2 for Experiment 2. Densities in the outdoor pen were 2.06 chicks/m^2 for the first experiment and 0.92 chicks/m^2 for the second. Chicks were fed grower diets containin 22% protein and a metabolizable energy level of 2970 kcal/kg (Cain et al. 1984). The feed contained no antibiotics.

RESULTS

All surgeries were successful, and all chicks survived to the end of the experiments. During preliminary trials, game-farm pheasant chicks easily overdosed and died when induced with methoxyflurane for over 5 min. whereas chicken chicks did not. The weight of chicken chicks ($\bar{x}$ = 34.6 g) was greater than the pheasant chicks ($\bar{x}$ = 17.3 g). Optimal induction time was estimated to be approximately 30 sec. for the pheasant chicks.

Pheasant chicks receiving methoxyflurane during the 2 experiments averaged an overall induction time of 30 sec. (range = 20-60 sec). All anesthetized chicks were alert with 5 min. after anethesia only. Chicks anesthetized and implanted with transmitters were also alert within 5 min. after surgery. These chicks did not walk normally for about 1 hr., but thereafter exhibited no apparent adverse behavioral or physiological effects. Chicks not receiving an anesthetic were alert and walked normally within 5 min. after surgery.

In our experiments, approximately 10% of the chicks began to eject or had ejected their transmitters by 4 weeks. However, there were no external signs of infection on any chicks. The sites of ejected transmitters exhibited dry skin and skin sloughing prior to transmitter loss.

We found no significant differences in weight with repeated measures ANOVA between implanted and control groups (Fig. 1) (F = 0.92; 1, 32 df; P = 0.34) in Experiment 1. Chicks pecked at the head, tail, and wing regions of others, but rarely pecked at transmitter antennae. No significant difference was detected between pecks received and pecks given between implanted and control groups (X^2 = 0.040, 1 df, P = 0.84).

In Experiment 2, the control group gained weight faster than the treatment groups based on the overall ANOVA (Fig. 2) (F = 3.62; 3, 72 df; P = 0.02). Significant differences occurred at days 9 (F = 4.10, P = 0.01), 11 (F = 3.12, P = 0.03), 14 (F = 3.76, P = 0.01) and 21 (F = 3.62, P = 0.02). However, there was no significant difference in weight at 28 days (F = 2.43, P = 0.07). We observed no significant difference in pecks received or pecks given between the control and treatment groups (X^2 = 3.29, 3 df, P = 0.35).

Variability in weight among chicks within treatments increased with time in both experiments and there were no differences in the increases between treatments and controls. In Experiment 1, the coefficient of variation (CV) increased from an average of 7.8% at day 1 to 15.1% at day 23. The CV in Experiment 2 increased from an average of 10.8% at day 1 to 13.3% at day 28.

DISCUSSION

Methoxyflurane is rapidly absorbed by fatty tissues, is slowly released into venous blood, and prolongs induction and recovery periods (Byles and Dobkin 1971). Therefore, methoxyflurane may have greater limitatons when used on birds with a smaller body size. Methoxyflurane was effective when administered less than 60 sec. per chick. Unanesthetized birds showed minimal evidence of pain during surgery. With experience, surgery was conducted on unanesthetized chicks in < 5 min., and the chick was ready for immediate release. In field applications, use of an anesthetic such as methoxyflurane could prolong the period betwen removal from and return to the wild and parental care.

Subcutaneously-implanted transmitters in birds have caused skin to rupture and infection to occur in some species (AOU 1988). Ejection of implants could be reduced by tightly suturing the surgical and antenna exit site to prevent air from entering and causing drying of the tissue. A means of anchoring the transmitter at the fore end (Mauser and Jarvis 1991) might reduce the ejection rate. Another consideration might be use of implants potted in Elvax paraffin, which contains an ingredient to prevent formation of a cyst around the implanted transmitter (Madison et al. 1985). We did not evaluate these alternatives.

The results of the experiments suggest small effects of implantation on growth rates. Observed differences in growth rates were only slight

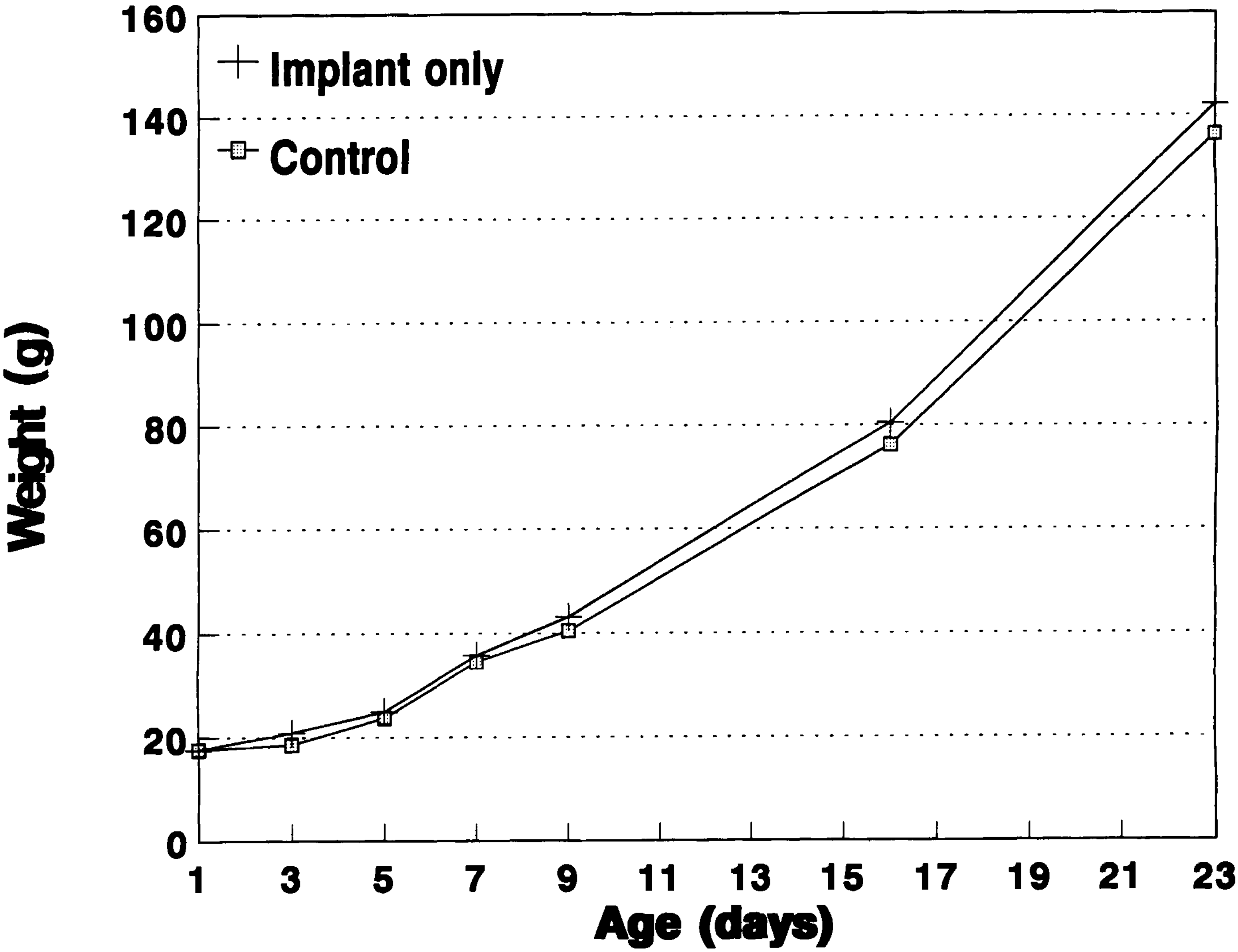

Fig. 1. Growth of game-farm pheasant chicks implanted with radio transmitters (n = 17), compared with a control group (n = 17), May-June, 1990.

during days 9-21 and final weights at 28 days were not different between control and treatment chicks. This result could be indicative of catch-up growth among treated chicks that initially grew more slowly. Most likely, it was due to the increasing variance in weights among all chicks. This variation influenced our ability to detect treatment differences, especially toward the end of the experiments.

Pecking is a normal behavior in pheasant chicks (Hoffmeyer 1969), and implanted chicks expressed and received normal pecking behavior. This suggests that implanted chicks would not experience a change in social dominance within wild broods.

We could not show effects of surgery and implantation on weight gain, behavior, or survival of captive, day-old pheasant chicks that we expect would be ecologically significant under natural conditions. Implantation of a transmitter in pheasant chicks was relatively simple and fast, and induction and surgical trauma caused no immediate problems. Transmitter ejection was a minor problem that can be controlled by careful procedure. We concluded that quick release of wild chicks to the parental hen is best accomplished without an anesthetic; a procedure that would be consistent with AOU (1988) guidelines.

It is possible that chicks implanted with transmitters and returned to the wild could initially be at a disadvantage because of their lower weights, particularly with regard to predator avoidance. However, our observations of normal movement and social behavior suggests tha they would behave normally with a brood in the wild. We concluded that the technique was feasible for field studies and have successfully used the implantation technique without anesthesia in assessing posthatch mortality of pheasant chicks under natural conditions (Ewing 1992).

ACKNOWLEDGEMENTS

We thank C.E. Korschgen, K. Kenow, and G.D. Zenitsky for sharing their expertise on the surgical implantation technique. A.L. Perkins assisted in the collection of growth and behavior data. T.Z. Riley provided advice and coordinated the project for the Iowa Department of Natural Resources (IDNR). Funding was provided by IDNR through Proj. W-115-R, and additional support was provided by the Iowa Cooperative Fish and Wildlife Research Unit, and the Department of Animal Ecology. This is Journal Paper J-15882 of the Iowa Agriculture and Home Economics Experiment Station, Ames, IA; Proj. 2401.

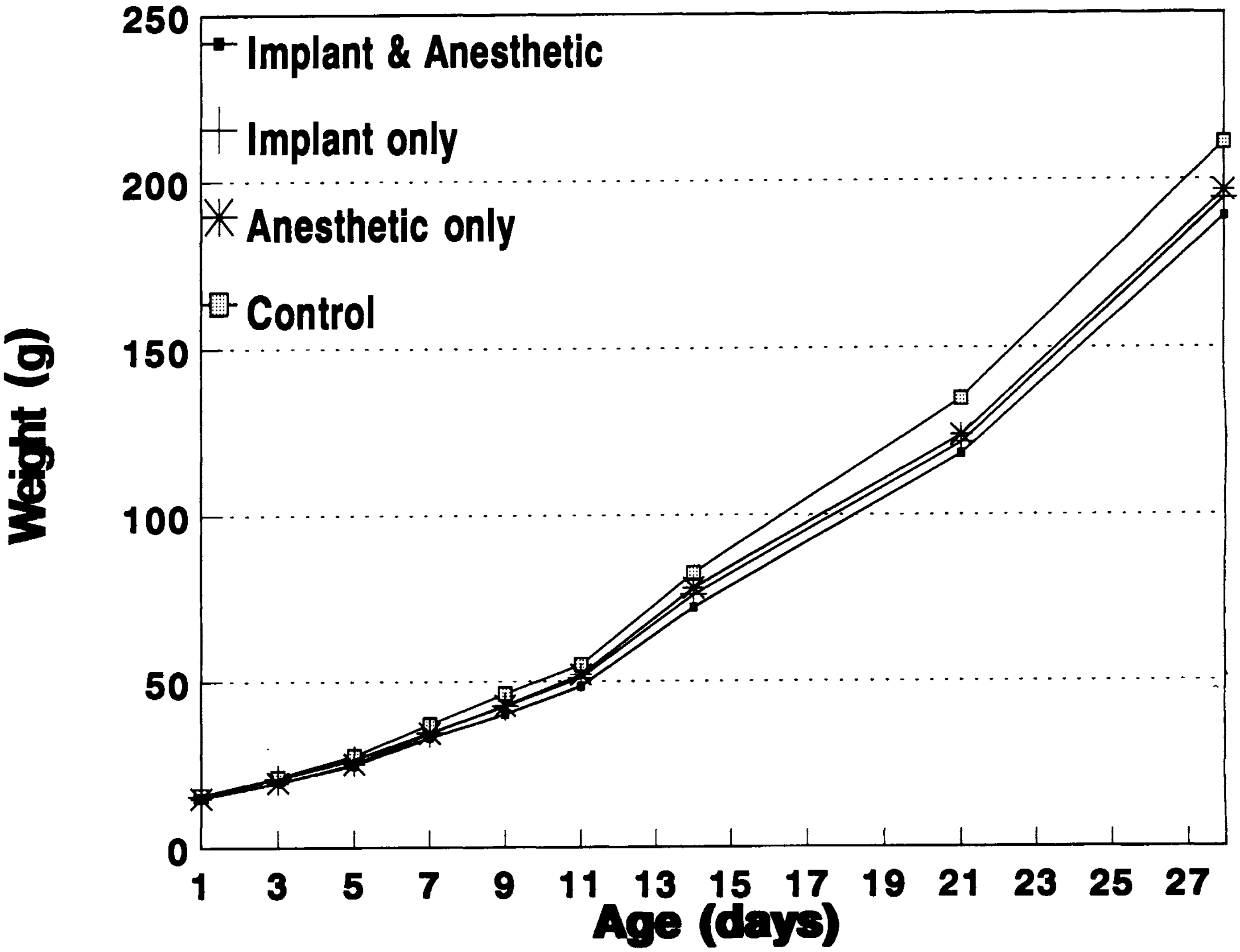

Fig. 2. Growth of game-farm pheasant chicks in a control (n = 20) compared among groups treated by radio-transmitter implant only (n = 18), anesthetic only (n = 20), and radio-transmitter implant and anesthetic (n = 18), May-June, 1990.

REFERENCES

AMERICAN ORNITHOLOGISTS' UNION. 1988. Report of committee on use of wild birds in research. Auk 105 (1. Suppl.): 1A-41A.

ARNALL, L. 1961. Anesthesia and surgery in cage and aviary birds (I). Vet. Rec. 73:139-143.

BYLES, P.H., and A.B. DOBKIN. 1971. The pharmacodynamics of methoxyflurane. Pages 75-80 *in* L.R. Soma, ed. Textbook of veterinary anesthesia. The William & Wilkins Co., Baltimore, MD.

CAIN, J.R., J.M. WEBER, T.A. LOCKAMY, and C.R. GREGER. 1984. Grower diets and bird density effects on growth and cannibalism in ring-necked pheasants. Poultry Sci. 63: 450- 457.

DWYER, T.J. 1972. An adjustable radio-package for ducks. Bird Banding 43:282-284.

EWING, D.W. 1992. Survival and movements of pheasant chicks in northern Iowa on differing agricultural landscapes. M.S. Thesis. Iowa State Univ., Ames, IA 79 pp.

GREEN, C.J. 1979. Animal anesthesia. Laboratory Animal Handbook No. 8. Lab. Anim. Ltd., London, England. 241 pp.

GREENWOOD, R.J., and A.B. SARGEANT. 1973. Influence of radio packs on captive mallards and blue-winged teal. J. Wildl. Manage. 37:3-9.

HOFFMEYER, I. 1969. Feather pecking in pheasants - an ethological approach to the problem. Danish Rev. Game Biol. 6:1-36.

HOUSTON, R.A. and R.J. GREENWOOD. 1993. Effects of radio transmitters on nesting captive mallards. J. Wildl. Manage. 57:703-709.

KÅLÅS, J.A., L. LÖFALDI, and P. FISKE. 1989. Effects of radio packages on great snipe during breeding. J. Wildl. Manage. 53:1155-1158.

KENWARD, R.E. 1987. Wildlife radio tagging. Academic Press, London, England. 222 pp.

KORSCHGEN, C.E., S.J. MAXSON, and V.B. KUECHLE. 1984. Evaluation of implanted radio transmitters in ducks. J. Wildl. Manage. 48:982-987.

MADISON, D.M., R.W. FITZGERALD, and W.J. MCSHEA. 1985. A user's guide to the successful radiotracking of small mammals in the field. Pages 28-39 *in* R.W. Weeks and F.M. Long, eds. Proc. Fifth Internat. Conf. on Wildlife Biotelemetry, Chicago, IL.

MANDELKER, L. 1987. Anesthesia and surgery. Pages 148-203 *in* E.B. Burr, ed. Companion bird medicine. Iowa State Univ. Press, Ames, IA.

MARCSTRÖM, V., R.E. KENWARD, M. KARLBOM. 1989. Survival of ring-necked pheasants with backpacks, necklaces, and leg bands. J. Wildl. Manage. 53:808-810.

MARKS, J.S., and V.S. MARKS. 1987. Influence of radio collars on survival of sharp-tailed grouse. J. Wildl. Manage. 51:468-471.

MARTIN, M.L., and J.R. BIDER. 1978. A transmitter attachment for blackbirds. J. Wildl. Manage. 42:683-685.

MAUSER, D.M., and R.L. JARVIS. 1991. Attaching radio transmitters to 1-day-old mallard ducklings. J. Wildl. Manage. 55:488-491.

OLSEN, G.H., F.J. DEIN, G.M. HARAMIS, and D.G. JORDE. 1993. Implanting radio transmitters in wintering canvasbacks. J. Wildl. Manage. 56:325-328.
PERRY, M.C. 1981. Abnormal behavior of canvasbacks equipped with radio transmitters. J. Wildl. Manage. 45:786-789.
PIETZ, P.J., G.L. KRAPU, R.J. GREENWOOD, and J.T. LOEKMOEN. 1993. Effects of harness transmitters on behavior and reproduction of wild mallards. J. Wildl. Manage. 57:696-703.
RAIM, A. 1978. A radio transmitter attachment for small passerine birds. Bird Banding 49:326-332.
ROTELLA, J.J., D.W. HOWERTER, T.P. SANKOWSKI, and J.H. DEVRIES. 1993. Nesting effort by wild mallards with 3 types of radio transmitters. J.Wildl. Manage. 57:690-695.
SAMUEL, M.D., and M.R. FULLER. 1994. Wildlife radiotelemetry. Pages 370-418 in T.A. Bookout, ed. Research and management techniques for wildlife and habitats. Fifth ed. The Wildlife Society, Bethesda, MD.
SMITH, H.R. 1980. Growth, reproduction and survival in *Peromyscus leucopus* carrying intraperitoneally implanted transmitters. Pages 367-374 *in* C.J. Amlaner Jr. and D.W. MacDonald, eds. A handbook on biotelemetry and radio tracking. Pergamon Press, New York, N.Y.
SOUTHWICK, E.E. 1973. Remote sensing of body temperature in a captive 25-g bird. Condor 75:464-466.
SYKES, P.W., J.W. CARPENTR, S. HOLZMAN, and P.H. GEISSLER. 1990. Evaluation of three miniature radio transmitter attachment methods for small passerines. Wildl. Soc. Bull. 18:41-48.
THOMAS, V.G., and E.D. BAILEY. 1973. Influence of date of egg production and diet on pheasant chick development. Can. J. Zool. 51:1149-1154.
ZENITSKY, G.D. 1993. Growth and behavior of redhead ducklings implanted with dummy radio transmitters. M.S. Thesis, Iowa State Univ., Ames, IA. 156 pp.