

Appendix VII

Marking Techniques

This appendix was transcribed from the 1982 edition of the Handbook of Biological Techniques (WGFD 1982:311-324). Several marking methods and materials have been improved or replaced since the original appendix was compiled. For example, many advancements have been achieved in telemetry technologies and capabilities over the past 20 years. However, some of the older, more basic methods may still prove useful in specific circumstances and where budgets are limited. Consult the following references for more recent information on marking methods:

Nietfield, M.T., M.W. Barrett, and N. Silvy. 1994. Wildlife Marking Techniques. Pages 140-168 in T.A. Bookhout (ed). Research and Management Techniques for Wildlife and Habitats. Fifth ed. The Wildlife Society, Bethesda, MD. 740pp.

Samuel, M.D., and M.R. Fuller. 1994. Wildlife Radiotelemetry. Pages 370-418 in T.A. Bookhout (ed). Research and Management Techniques for Wildlife and Habitats. Fifth ed. The Wildlife Society, Bethesda, MD. 740pp.

*Gustafson, M.E., J. Hildenbrand and L. Metras. 1997. The North American Bird Banding Manual (Electronic Version). Version 1.0
<http://www.pwrc.usgs.gov/BBL/manual/manual.htm>*

*Gustafson, M., L. Metras, B.H. Powell, G. Smith, F. Soehnlein, J. Tautin, and H.R. Berry, Jr. 1998. Recommendations for improving bird banding permit policies and procedures. USFWS, Office of Migratory Bird Management. 725 FW 1, Policies and Responsibilities.
<http://www.pwrc.usgs.gov/BBL/resources/permapp2.htm>*

and the following web links:

Resources for Banders – <http://www.pwrc.usgs.gov/BBL/homepage/resource.htm>

All About Bird Bands – <http://www.pwrc.usgs.gov/BBL/homepage/btypes.htm>

All about Bird Markers – <http://www.pwrc.usgs.gov/BBL/homepage/aboutaux.htm>

I. BIG AND TROPHY GAME

- A. Ear Tags – Serially numbered aluminum ear tags imprinted with a return request have been successfully used on big game. One tag in each ear is recommended. These tags should be ordered through the Supervisor of Biological Services. Tagging records of animals marked in the winter must be submitted by July 1.

For individual marking and identification of moose, 2.5 X 2.5 in. pendant-type plastic livestock ear tags have been used. Numbers or coded symbols can be placed on both sides (front and back). Tags are available in a variety of colors.

Colored nylon or plastic streamers have generally proven unsuccessful as they quickly become frayed and tattered.

Hornocker (1970) used colored aluminum cattle tags on mountain lion with good retention. Tags were placed close to the base of the ear, in the upper or leading edge. Each ear was also tattooed.

Bears have been successfully marked using hollow braid polypropylene rope as color markers. High success was achieved when they were used as an anchor for color coordinated polyvinyl-chloride tape flags (Craighead et al. 1960; Pearson 1971).

Tattoos have been used to permanently mark bears, allowing an individual to be identified even if the ear tags are lost. The tattoo is generally applied to the upper lip with a livestock tattooing machine. The tattoo should be well inked to ensure it is permanent.

- B. Neck Bands – Neck bands are recommended to individually mark animals for observation. Many studies have used the neck band described by Knight (1966) for big game. This band has a long life, good retention, and is highly visibility.

Neck bands are constructed of plastic impregnated nylon (“Saflag” – Safety Flag Company of America, Pawtucket, RI) and nylon webbing. Strips of Saflag (3 X 36 in.) are sewed to the nylon webbing material for strength. Symbols or numbers cut from contrasting colors of Saflag may be sewn to the neckband.

Neck bands for females can be purchased pre-sewn or with riveted ends, ready to slip over the head of the animal. Neck bands can be fitted on males by attaching the ends after they are placed around the neck. Collars may be closed with rivets or hog rings. When excessive swelling of the male neck is expected during rut, an expandable collar should be used. No reports of expandable collars used on mule deer were found in the literature but it is assumed the collar Hawkins et al. (1967) described for white-tailed deer would work with mule deer.

Rope collars have been used for elk (Craighead et al. 1969) and may be suitable for other large ungulates. The collars were constructed of 38-in. lengths of 0.5-in. braided polyethylene rope (Puritan Cordage Mills, Inc., Marine Division, Louisville, KY) through which 7 3X9-in. flags of colored Saflag materials were strung and secured with No. 3 hog rings. Nylon rope collars have also been used successfully on mountain lions. (Seidensticker et al. 1973).

Collar size was temporarily reduced for juvenile animals with a strong rubber band made of a 0.375-in. (3/8-in.) section of 0.5-in. surgical tubing. As the neck size increases, the restricting band worked toward the pendant and later disintegrated.

Saflag material remained in readable condition during 5 years of observation. Lost collars, as determined by recaptures, averaged 7.3% per year. Individual collars could be identified at distances of approximately 4 mi. in good light with a 60X spotting scope.

Blunt (1965) reported proper fit is important to avoid undue wear and damage because discomfort will result in an animal attempting to remove the source of irritation. Suggested sizes of neck bands suited to various species are listed in Table 1.

Table 1. Neck band sizes appropriate for big game species.

Species	Sex	Inside Circumference (inches)	Type
Pronghorn	Male	25-26	Open
	Female	22	Pre-sewn
Elk	Male		
	Female	31	Pre-sewn
Mule Deer	Male	22	Open-expandable to 28.5 inches.
	Female	22	
White-tailed Deer	Male	21	Open-expandable to 28.5 inches.
	Female	17.75-19.75	
Moose	Male		
	Female	34.5-35.5	Pre-sewn
Bighorn Sheep	Male	23-24	Open
	Female	23-24	Open

- C. Dyes – The use of various dyes has met with some success. Nyansol “D” black dye, applied in the fall or early winter by aerial spray showed quite well until the spring molt (Hepworth 1966; Creek 1967). Fish planting tanks built for light aircraft were used to transport and “dump” the dye on pronghorn.

II. GAME BIRDS AND SMALL/MEDIUM MAMMALS –

A. Standard Marking and Banding Techniques –

1. Rationale – Many questions about the activities of wild or pen-reared birds can be answered by banding or marking them prior to release. Marking is generally done for one or more of the following purposes:

- a. To determine the amount and distribution of harvest on pen-raised and released stock.
 - b. To determine daily and seasonal movements of individual mammals and birds, and in some cases, flocks of birds.
 - c. To provide a basis for determining survival rates and mortality causes for pen-raised wild-trapped birds and mammals.
2. Application – A variety of marking techniques have been developed and all have their place in management. Three basic types of marking are used. The first type generally requires the marked bird must be recaptured or harvested to retrieve the information. Included in this type of marking are leg bands, patagial tags and other inconspicuous markers. Conspicuous markers are the second type. These typically involve color or number combinations that enable observers to follow the movements and determine the fate of individual birds or flocks. Patagial streamers, poncho markers, neck, bands, plastic leg bands, dyes and colored feathers are included in this group. In some cases, conspicuous markings will be lost with first subsequent molt. The third marking system involves a means of locating birds via an attached transmitter and following their movements for the life of the transmitter. This practice allows one to locate a particular bird almost at will.

Every technique has its limitations and these should be understood before technique is selected. Care should be exercised to prevent introducing a mortality bias. For example, using a highly conspicuous marker on birds that depend on camouflage for protection may increase predation. Poorly designed markers may restrict movements of some birds or cause them to become snared on brush. Heavy transmitters may also increase mortality. One should avoid marking techniques that produce a false mortality. Bands or tags that are easily lost or damaged may lead the observer to believe the marked bird is dead. At the very least, analysis and interpretation of data become biased. For example, if a bird is marked with an orange streamer that fades to yellow or white, it could be confused with other birds marked with yellow or white markers. Symbols used on markers should also be designed to minimize confusion when they are viewed at a distance.

Marking techniques should be suitable for the intended purpose of the study. If the marker is a leg band and several thousand will be released and recovered over a period of years, accurate records should be kept to avoid duplicating numbers or symbols. Similarly, returned bands should be carefully logged and recorded to prevent duplications, omissions, or other errors. Always record causes of mortality when bands are recovered so legal harvests can be separated from other mortality. Small markers are not suitable for identifying individual marked birds from a distance. Leg bands, for example, cannot be read on birds that typically inhabit tall grass or during incubation. When patagial tags are used, place them on both wings for positive identification and ease of reading. If birds are to be observed primarily in flight, patagial markers should be affixed under the wings.

Maintaining marked birds in a population has several benefits. Some type of marker should generally be placed on wild birds that are transplanted and on pen-raised stock that are released. This will enable managers to obtain information about harvest rates, distribution, movements, and other biological data. After sufficient information has been gathered from the initial marking effort, assuming no further changes in management are proposed, further marking is unnecessary.

Each band or patagial marker should be stamped, “Return to WGFD” or similar direction. To assure accurate identification and facilitate information handling, standardized band prefixes should identify the district where the bird was released, species, and year. The first digit or alpha denotes the district, the second digit denotes species, and the third denotes the year of release according to the schedule below:

First Digit = District	Second Digit = Species	Third Digit = Year *
Jackson = 1 (or JN)	Pheasant = 1	2001 . . . = 1
Cody = 2 (or CY)	Turkey = 2	2002 . . . = 2
Sheridan = 3 (or SN)	Chukar/Gray Partr. = 3	2003 . . . = 3
Green River . . . = 4 (or GR)	Sage-Grouse = 4	2004 . . . = 4
Laramie = 5 (or LE)	Blue Grouse = 5	2005 . . . = 5
Lander = 6 (or LR)	Ruffed Grouse . . . = 6	2006 . . . = 6
Casper = 7 (or CR)	Ruffed Grouse . . . = 7	2007 . . . = 7
Open = 8	Open = 8	2008 . . . = 8
Open = 9	Open = 9	2009 . . . = 9
Open = 0	Open = 0	2010 . . . = 0
		Blank . . = Year not Specified

* Year designations rotate every 10 years (e.g., 2011 will be designated as a “1”). Since upland game birds seldom survive more than 1-2 years (sage-grouse somewhat longer), this rotation poses no risk of duplicate markers in the field.

Example: 516-000 = District 5 (Laramie) release, pheasant, 2006.

- a. Materials – Table 2 lists approximate sizes of aluminum and plastic leg bands appropriate for use on upland game birds in Wyoming. Self-piercing tags for patagial markers and streamers are also listed. Sizes are approximate and should be tested prior to ordering supplies of tags.

Wild birds can also be marked with highly visible markers such as poncho markers, patagial streamers (Fig. 1), neck bands or streamers (Fig. 2) or dyes. Patagial markers appear to perform the best. Plasticized polyvinyl chloride appears to be the best material for markers.

- b. Dyeing – Applying Dyes to feathers is only a temporary means of marking birds, but is sometimes possible without having to capture the bird. Several types of

dyes and paints and their characteristics are listed in Table 3 (Modified from Taber and Cowan 1969:Table 18.1). Dyeing white or light-colored feathers yields the best results.

Dyes can be applied by spraying with portable spraying devices, or by remotely dispensing from devices set up where birds are known to congregate, for example, at strutting grounds. Dyes can be applied using a variety of innovative means such as squirt guns, weed sprayers, backpack pumps, etc. depending on the species and how close individuals can be approached.

Table 2. Leg band sizes for game birds.

Species	A.O.U. Leg Band		National Band and Tag Co. Equivalent			
			Metal		Plastic	
Pheasant	♀6	♂7A	♀10	♂14	♀5	♂7
Sage Grouse	♀6	♂7A	♀12	♂16	♀6	♂8
Sarp-tailed Grouse		6		12		6
Ruffed Grouse		6-5		12-14		6-7
Blue Grouse		5		12		6
Gray Partridge		3A		10		5
Chukar Partridge		5-6		12		6
Turkey		9		24-28		12-14
Mourning Dove		3A				
Virginia Rail		3				
Sora Rail		3				
Common Snipe		3				
Canada/Cackling Goose		8				
Mallard		7A				
Gadwall		6				
Pintail		6				
Green-winged Teal		4				
Blue-winged Teal		5				
Cinnamon Teal		5				
American Wigeon		6				
Shoveler		6				
Wood Duck		5-6				
Redhead		6				
Ring-necked Duck		6				
Canvasback		7A				
Scaup		6-5				
Common Goldeneye		6				
Bufflehead		5-6				
Ruddy Duck		7A				
Hooded Merganser		5				
Common Merganser		7A				
Red-breasted Merganser		5-6				

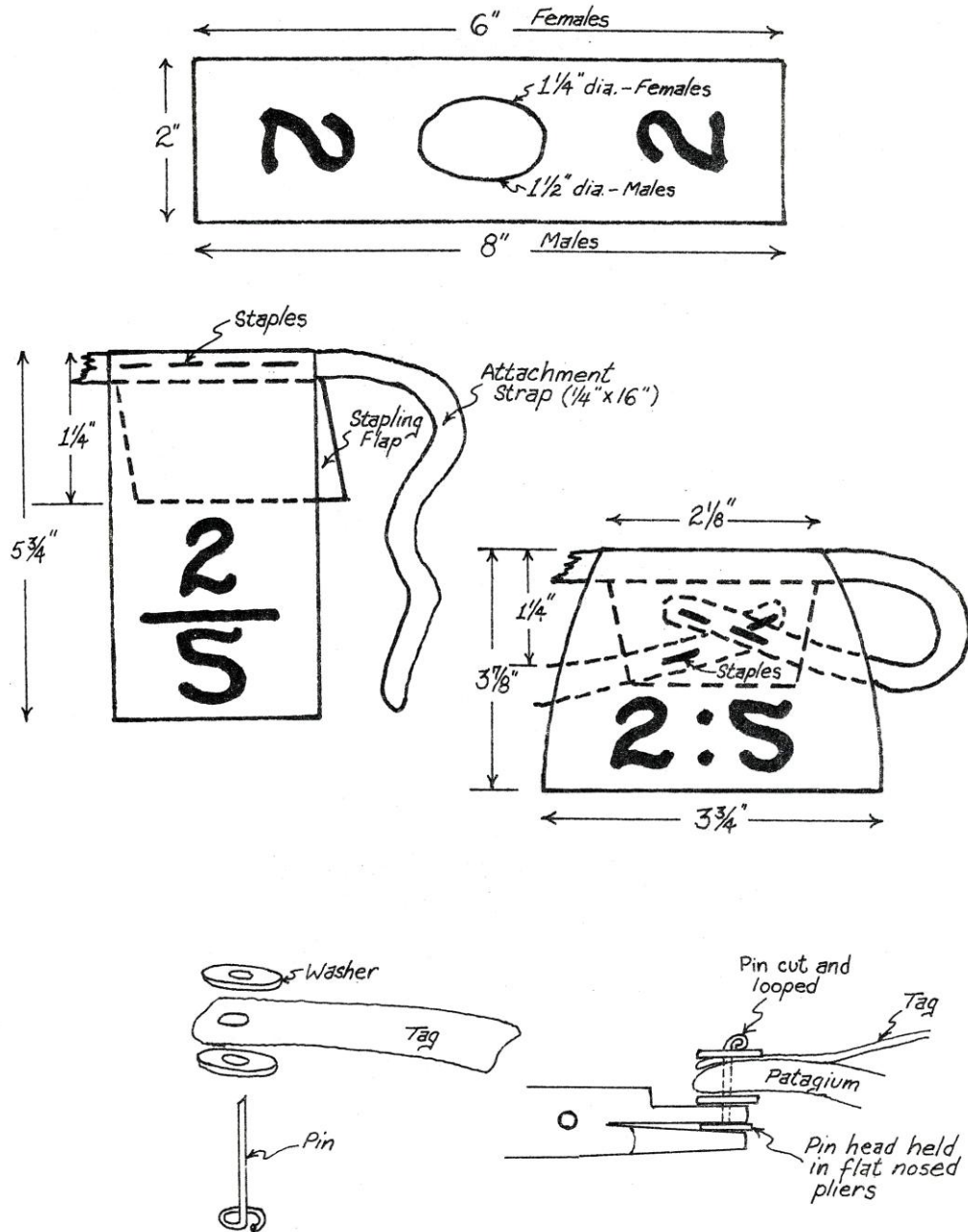


Fig. 1. MARKING AND BANDING. Poncho marker (top); back-tag marker (center); and patagial type marker (bottom).

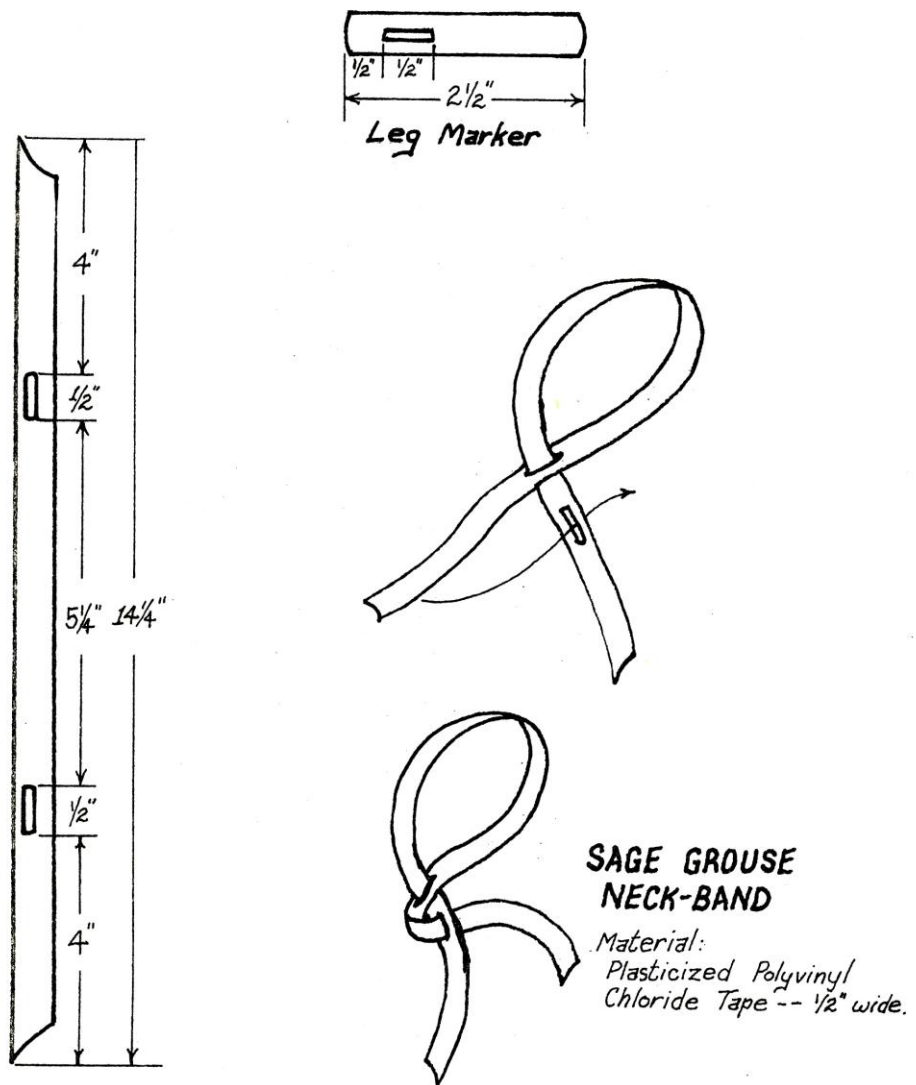


Fig. 2. MARKING AND BANDING. Plasticized polyvinyl chloride 0.5-in. tape, illustrating the neck band and leg marker.

- c. Telemetry – Various radio and satellite telemetry devices have been used to track movements and activities of virtually all species of upland game birds. Consult Samuel and Fuller (1994) and other literature for current information on the use of telemetry to monitor and study upland game birds.
3. Disposition of Data – All bands must be ordered through the Biological Services Section, which maintains the banding databases for the Department. Be sure to anticipate and budget for banding supplies during the fiscal year (1 July – 30 June) in which banding will be conducted.

All data from trapping and marking operations are to be maintained in a permanent file. Data and results are summarized in annual job completion reports prepared for the species being studied, or in a special report if a job completion report is not normally submitted.

Table 3. Characteristics of some dyes that have been used to mark birds and small mammals.

Coloring Agent	Species that have been marked using the referenced coloring agent	Other species on which coloring agent may be used.	Special Techniques	Duration of Color	Authority [Refer to Taber and Cowan (1969) for complete references]
Rhodamine B, Malachite Green and picric acid in alcohol	Snow and Ross' Goose	Any light-colored bird. If mortality is not important in the study, investigate usage on small mammals, hares, rabbits	Dipped wings and tails in dye.	Observable 3 to 6 months in the field.	Kozlik et al. 1959
Malachite Green, Brilliant Green, Rhodamine B extra, Purple Batik: in 33% alcohol + 66% H ₂ O	Pheasant	Sage grouse, sharp-tailed grouse, gray partridge, chukars, ruffed grouse	Applied with spray gun. Wetting agents useful with some dyes.	Observable 2+ months on the ground, 3-6 months on flushed birds.	Wadkins 1948
Rhodamine B, Suramine, Methyl Violet, Vistoria Green, in saturation in 95% ethanol	Ruffed grouse	Sage grouse, sharp-tailed grouse, gray partridge, chukars, ruffed grouse	Dipped tails of adults and rolled young in shallow pan or sprayed with atomizer.	Observable in the field (on shed feathers) and in the hand up to 8 months.	Gullion et al. 1961

Table 3. Continued.

“Airplane Dope” in white, yellow, red	Waterfowl; Mourning dove	Any species. Some “reflective” or fluorescent colors have been used on rabbits, color selection is more important with mammals.	On tail and outer primaries. Apply thin coat and hold feathers spread until dry to avoid sticking. On small species avoid loading wingtips.	Observable about 2 months when flushed.	Sowls 1955 Swank 1952
Aniline dyes in mixture of equal parts water and 95% grain alcohol	Sage grouse		Applied with remote control spray.	Not observed	Moffitt 1942
Aniline dyes in water, grain alcohol, acetic acid	Mourning dove; scaup	Any bird. Investigate possible usage on mammals	Birds dipped and held for drying.	Over 3 months.	Winston 1954
Nyanzol A: 20 gm/l of water hydrogen peroxide mixture in ratio of 2:1	Squirrel	Any mammal.	Apply as rings in broad bands on animal’s body	Until molt.	Fitzwater 1943
Ammonium hydroxide (4%); 1 part to 2 qts. 3% hydrogen peroxide plus soap as above.	Pocket gopher	Recommended for mammals with dark pelage.		Until molt.	Morejohn and Howard 1956
Human black hair color (dye) with oil bases: apply with equal part 3% hydrogen peroxide plus granulated soap until liquid is thick.	Pocket gopher	Recommended for mammals with light pelage.		Until molt.	Morejohn and Howard 1956
			General – Dyeing techniques would normally influence mortality less if applied to nocturnal species.		

III. OTHER MARKING TECHNIQUES FOR GAME BIRDS –

- A. Plasticized Polyvinyl Chloride 0.5 Inch Tape (June 1963b) – A plasticized polyvinyl chloride tape material is available in several colors in 0.5-in. width. This material can be used in two ways: as a neck band and as a leg marker.
1. Plastic Tape Neckband – The plastic neck band has two 4-in. tails that hang down for visual identification. The loop is made using a “jess knot” (Craighead and Stockstad 1956), with the loop 5.25 in. in circumference (for sage grouse) to slip over the bird’s head. Downing and Marshall (1959) devised a new knot or method of attachment to secure the plastic 0.5-in. tape neck band, which requires little pulling to secure the knot. This method involves passing a folded end of the marker through a hole in the opposite end to a point at which a pair of notches in each edge of the tape allows it to unfold and lock into place (Fig. 2).
 2. Plastic Tape Leg Marker – The plastic leg marker (Campbell 1960) is used with color combinations to mark individual birds for visual observation. It is a strip of the plasticized 0.5-in. tape, 2.5 in. long, with a slit to allow the aluminum leg band to pass through, and is placed on the outside of the leg (Fig. 2). This polyvinyl chloride 0.5-in. tape material has been used effectively on sage grouse in a population dynamics study (June 1963b). The neck markers have lasted up to the life of the bird (up to 7 years) with minimal loss or detachment.
- B. Poncho marker (Pyrah 1970) – A poncho-type field identification marker (Fig. 1) has been constructed of Naugahyde (U.S. Rubber) upholstery material cut into pieces 2 in wide and 6 in. long for female sage grouse, and 8 in. long for males. Naugahyde is available in many colors. Black plastic paint (vinyl and plastic, Fabspray, Nu-color of America) was used to write numbers on the Naugahyde poncho marker. The poncho marker is simply slipped over the heads of grouse before the birds are released. A round, 1.25-in. diameter hole is cut in the center of the markers to be fitted on female grouse; and a round, 1.5-in. hole is cut for males.

C. Back Tag Marker (Gullion et al. 1962, Labisky and Mann 1962) – A back tag type field identification marker (Fig. 1) can be constructed from several materials such as Masland Duran, U.S. Naugahyde, U.S. Fiberthin, Coverlight and Armor Tite. The back tags do not significantly affect the behavior or well-being of the birds. Back tags can be made into 2 general shapes with additional variations. These general shapes are rectangular and bell-shaped. The rectangular shapes are 2.125 in. wide and 7 in. long including a 1.25 in. stapling flap in the length. The bell shape is 3.75 in. wide at the base, 2.125 in. (2 1/8 in.) wide at the top, and 5.125 in long including a 1.25-in. stapling flap. The attachment strap is made of good quality leather or Fiberthin, 16 in. long and 0.25 in. wide.

The back tag marker is attached to the bird with the attachment strap in front of the wing, from the above side down under and backward, upward and across, and under the back tag being stapled to the stapling flap.

Use of back tags increased the vulnerability of grouse to predation, significantly shortening their survival and increasing the rate of population turnover (Gullion et al. 1962).

- D. Patagial Markers – Numbered “Jiffy” wing tags fitted with plastic streamers (Fig. 1) have proven an effective means for marking wild turkeys. This type of marker is highly visible and has a reasonable life expectancy. Different colored streamers can be used to denote specific trap or release sites. Color combinations may also be used to identify individual birds. One or both wings can be marked in this manner.
- E. Teflon Plastic (FEP Fluorocarbon) Material – Penney and Sladen (1966) tested use of Teflon plastic as flipper bands on penguins. This product offers many possibilities for use as a marking material. Samples of FEP Fluorocarbon film (3000 XF) were obtained from the DuPont Film Department, Rocky River, Cleveland, OH. The Teflon was available as transparent or colored film in sheets or strip rolls of varying thickness. It is pliable, yet exceptionally tough over a wide range of temperatures ranging from -180° to

+260° C. Low surface tension makes the material highly resistant to water adhesion and weather. It can be pre-shaped by dipping into boiling water and then quickly chilling.

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