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A PROPOSED SYSTEM OF AGE TERMINOLOGY IN BIRD BANDING

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Since its innovation in 1899 by Christian Mortensen in Denmark, modern bird banding, as a tool in ornithological research, has shown a tremendous development in numbers of birds banded, in methods of obtaining birds for banding, and in the variety of purposes for which bird banding and bird-banding data have been used. Bird-banding data have produced important information in many fields of ornithology. As is generally true with methods and tools of scientific research, experience and extensive use of bird banding, and the data derived therefrom, have shown the way to improved methods and procedures. In this paper there is proposed a system of age terminology which we believe can contribute to a more accurate and more diversified use of the results of bird banding. The proposed system is not offered as a criticism of systems previously employed or proposed, but rather as a step towards a greater utilization of the banding method in ornithological research.

Originally bird banding was considered, at least to a considerable extent, only as a general source of information on migratory movements. Sex, age and plumage were often recorded as interesting data, but, until relatively recent times, emphasis on age data has not been such as to cause the development of a system allowing a maximum of accuracy and uniformity in recording. Such interesting fields as partial and differential migration within a species, dispersal of young before fall migration, movements of non-breeding first-year birds and other non-breeding parts of the population, age-group studies, survival and mortality studies, return to birth-place as breeding birds, return to previous nesting sites, population estimates and many others, require age and plumage data as accurately and uniformly recorded as possible. Similar are the requirements of the growing fields of experimental migration and homing experiments.

Bird banding is an integral part of ornithological research and investigation. It therefore is tenable that the terminology of bird

banding should not deviate from that employed in other fields of ornithology. Consequently in the construction of the system proposed in this paper attention has been focused on (1) providing a system which will allow a maximum of precision and accuracy in age designation based primarily on plumage characteristics and (2) using a terminology compatible with usage in other phases of ornithology. In the preparation of this paper the authors, although accepting all responsibility for its contents, wish to acknowledge the helpful comments, criticisms and suggestions of Dr. John W. Aldrich, Mr. F. C. Lincoln, Dr. Alden H. Miller, Dr. George M. Sutton, Dr. A. M. Woodbury, Dr. J. J. Hickey, Mrs. Margaret M. Nice, Mrs. Amelia R. Laskey, Mrs. Ruth Thomas, Dr. Josselyn Van Tyne, Dr. Jean M. Lindsdale, Dr. Charles D. Michener, Dr. Gustav A. Swanson, Dr. John T. Zimmer, Mr. David Lack, M. Ch. Dupond, Dr. G. C. A. Junge, Prof. Torsten Gislen, Herr Viking Fontaine, Miss E. P. Leach, Prof. George H. Lowery Jr., Dr. Hannes Laven. Whenever possible the terminology is based on that of Dwight since his system of plumage nomenclature has had general acceptance in ornithology. It is emphasized that the system proposed herein is in fact a *proposed* system. It is not the suggestion of the authors that it is to be used in reporting birds banded to the U. S. Fish and Wildlife Service until such time as it may be adopted, with or without further modification, by that agency.

AGE DESIGNATIONS FOR BIRDS

1. *Natal* (*nat.*). In natal down or before juvenal feathers become prominent. Few, if any, young birds are banded in this plumage. In the case of precocial species the young in the natal period may be designated as *downy young* (*dy. yg.*)

2. *Juvenal* (*juv.*). In juvenal plumage or in postjuvenal molt. Birds in this group should be classified, if possible, into subgroups as follows:

2a. *Nestling-juvenal* (*juv. n.*). In juvenal plumage in the nest. This is applicable to altricial (nidicolous young) species only.

2b. *Fledgling-juvenal* (*juv. fl.*). In juvenal plumage, out of nest, but being cared for by parents or, as may occur in some species, in *postjuvenal molt* and being cared for by parents. This term is applicable to both altricial and precocial (nidifugous young) species.

2c. *Independent-juvenal* (*juv. ind.*). In juvenal plumage or in postjuvenal molt, out of nest and not being cared for by parents. This age term is applicable to both altricial and precocial species.

In 2b and 2c the state of being cared for by parents or not being cared for by parents often is difficult or impossible to ascertain. If

there is any reason for doubt, the bird should be recorded as an *independent-juvinal* (*juv. ind.*).

In many species the bird becomes indistinguishable from the adult as soon as it completes the postjuvinal molt, for operators who have not developed special knowledge or technique for recognizing the differences. In all such species only the age terms *adult* (*ad.*), *fledgling-juvinal* (*juv. fl.*), and *independent-juvinal* (*juv. ind.*), will be required for the vast majority of non-nestling birds at the time of banding.

3. *First-winter* (*w. 1*). In first winter (postjuvinal) plumage or in first prenuptial molt or if the age can be established with certainty as first winter in any other way. If the bird is indistinguishable from the adult it should be recorded as *adult* (*ad.*).

There are many species in which the first winter plumage is readily distinguishable from both the adult and the juvinal plumages. For these birds the first prenuptial molt usually changes the first winter plumage to a first nuptial plumage which is indistinguishable from the adult plumage, in which case the bird should be recorded as an adult unless there is evidence that the prenuptial molt is still in progress. The White-crowned Sparrow, *Zonotrichia leucophrys* (J. R. Forster), is an example.

4. *First-nuptial* (*n. 1*). In first nuptial plumage or in first post-nuptial molt. This condition occurs when the bird is approximately one year old, or slightly before, during and shortly after the breeding period of the adults of the species. If there is no prenuptial molt it is suggested that *first-winter* (*w. 1*) be used until spring or the beginning of the breeding season, and thereafter *first-nuptial* (*n. 1*). If the bird is indistinguishable from the adult it should be recorded as *adult* (*ad.*).

There is a valid criticism of this usage in that many birds, such as gulls, do not breed in what is designated here as "first nuptial" plumage although the first-year birds do possess this plumage at the time of the breeding season. Because of the variability of the age at which breeding begins, both among and within species, any adjustment to distinguish between "nuptial" and non-breeding "summer" plumages becomes unwieldy and, in some cases, is bound to produce inaccuracies. We, therefore, adhere to the usage of Dwight who applies "nuptial plumage" to both breeding and non-breeding birds.

5. *Second-winter* (*w. 2*). In second winter plumage or in second prenuptial molt; *i.e.*, from completion of first postnuptial molt to the completion of the second prenuptial molt, if such occurs, or, in general, from autumn to spring of the second year of the bird's life. If the bird is indistinguishable from the adult it should be recorded as an *adult* (*ad.*).

CHART I. COMPARISON OF SOME AGE-TERM SYSTEMS
Age Terms for Birds in Successive Periods of their Lives;
Abbreviations; Arrows indicate Life Period Covered by each Term.

SOURCES	STAGES OF DEVELOPMENT											Note (a)
	Eggs hatch Precocial birds leave nest	Juvenal feathers prominent	Altricial birds leave nest	Parental care ends	Postjuvental (first autumn) molt ends	First preadult (first spring) molt ends	First postadult (second autumn) molt ends	Second preadult (second spring) molt ends	Second postadult (third autumn) molt ends			
THIS PAPER	natal nat.	nestling- juv. n	nestling- juv. n	juv. fledging- juv. fl.	independent- juv. ind.	first winter w. 1	first nuptial n. 1	second winter w. 2	second nuptial n. 2	adult ad.		
MISC.			first year bird of the year			(?)	(?)	second year	(?)	third year		
WOOD, H. B. (1946)	nestling nes.	juvenile juv.	fledging fl.	juvenile juv.	immature im.	*	im m a t u r e	im.	*	*	adult ad.	
BIRD BANDING NOTES (1946)	nestling nsl. downy young dy. yg.	juvenile juv.		immature im.	immature im.	*	(?)	second year	(?)	third year	adult ad.	
MANUAL FOR BIRD BANDERS (1929)	juvenile juv.			im m a t u r e	im m a t u r e	*	*	*	*	*	adult ad.	
MANUAL FOR BIRD BANDERS (1947)	nestling N natal N	juvenile J		im m a t u r e	im m a t u r e	*	im m a t u r e	*	*	*	adult ad.	A

BIRD RINGING COMMITTEE, BRITISH TRUST FOR ORNITHOLOGY (2)	nestling nes.	juvenile juv.	i m m a t u r e im.		adult ad.
	young (?) (precocial)		*	*	*
USUAL GERMAN DESIGNATION (3)	(im Nest)	junge Vögel juv.	>(?)<		alte Vögel ad.
	Dunnenkleid	Jugendkleid	1. Ruhekleid 1. R. K. *	1. Drukkleid 1. B. K. *	2. Ruhekleid 2. R. K. * 2. B. K. * etc.
DROST (1930 etc.) for species with spring molt	Dunnenkleid	Jugendkleid	1. Jahreskleid 1. Ja. K. *	1. Jahreskleid 1. Ja. K. *	2. Jahreskleid 2. Ja. K. * etc.
	Dunnenkleid	Jugendkleid			
BELGIAN SYSTEM (4)	jeune au nid en duvet	jeune	jeune		adult
	nästunge dununge pull;	ung fagel jun.	ung fagel jun.		gammal fagel adult
SWEDISH SYSTEM (5)			>(?)<		

(?) The end of the year cannot be indicated exactly in this nomenclature since it falls between the prenuptial molt and the postnuptial molt in those species in which there is a prenuptial molt, or preceding the postnuptial molt in those species in which the prenuptial molt is lacking.

* Some birds in this period may be indistinguishable from adults, even if in fact they are not adults, in which cases they should be recorded as adults. In this sense the adult period may begin at any stage of development after the first prenuptial molt, depending on the species and the individual within the species. This symbol is inserted in all of the age-term systems included, in order to fit them into this diagram with the elasticity required in fixing the stage of development at which a bird enters the adult period.

(a) For birds which, after the second postnuptial molt, have plumages distinguishable from the adult, the age terms "third-winter," "third-nuptial," "fourth-winter," etc. should be applied until the plumage is no longer distinguishable from the adult plumage.

- (1) This molt does not occur in certain species; in these cases *w. 1* (or *w. 2*) should be used until spring, or the beginning of the breeding season; thereafter, *n. 1* (or *n. 2*).
- (2) Personal communication, Miss E. P. Leach, Bird-Ringing Committee of the British Trust for Ornithology.
- (3) Personal communication, Doctor Hannes Laven, Tropeninstut, Hamburg.
- (4) Personal communication, M. Ch. Dupond, Bruxelles-Laeken, Belgium.
- (5) Personal communication, Herr Viking Fontaine, Naturhistoriska Muséet, Göteborg.

6. *Second-nuptial (n. 2)*. In second nuptial plumage or in second postnuptial molt; *i.e.*, from completion of second prenuptial molt to the completion of the second postnuptial molt, or, in general, and in those species in which there is no prenuptial molt, from the spring of the second year to the autumn of the third year of the bird's life. If the bird is indistinguishable from the adult it should be recorded as an *adult (ad.)*.

This system of numbering the successive winter and nuptial plumages can be extended to later plumages if those plumages can be distinguished from the adult plumage.

7. *Adult (ad.)*. In adult plumage or any plumage that cannot be distinguished from adult plumage, unless, by some other means the bird is determined to be not yet adult.

7a. *Adult eclipse (ad. e.)*. Applicable only to the eclipse plumage of male ducks.

A review of these age terms is presented in Chart 1 in comparison with other systems of age nomenclature.

Nearly all of the above age terms represent periods in the bird's life which either begin or end, or both begin and end with the completion of a molt. These division points, the ends of the molts, usually are not exactly determinable except for birds that can be examined several times at successive short intervals of time during the latter part of the molt. Some of the reasons for this indeterminability are as follows: There is a wide range in the time required for a molt to be completed, between species and within species; the latter is due, particularly in the postjuvinal molt, at least in part, to the time of hatching and the region in which the bird is reared. Between species, within species and between the successive molts of the individual bird there is a wide range in the proportion of the feathers in a plumage that are not replaced by new feathers at the molt and are carried over to make part of the next plumage. This is particularly true of the postjuvinal molt where the time of hatching, relative to the normal time of migration of the species in the region where reared, probably has an influence; for some species of resident birds the time of hatching, relative to some time in the autumn beyond which the process of the molt for the species in that particular region does not seem to extend, is known to influence the extent of the replacement of feathers at the postjuvinal molt. Also, among species there is a wide variation in the extent of the prenuptial molts which vary from no molt at all in many species to major changes in the appearance of the bird in others.

In spite of the probability of being unable to determine from inspection of the plumage just how far in time the bird is from the end of a molt, the presence or absence of partially developed feathers,

considered together with the characteristics of its plumage and the time of the year, usually will allow a ready and reasonably accurate determination of the age group in which the bird belongs. Since these considerations also have to be taken into account when using any other system of age nomenclature which is based on the external appearance of the bird, the system proposed herein is new only in that it offers new age terms based upon accepted plumage names by means of which the age of a bird can be precisely stated when its appearance will permit it to be placed in one of these age categories.

For banders who concentrate on the study of one or a few species in which the first winter plumage is not distinguishable from the adult plumage, and who have the requisite skill, it is suggested that consideration be given the method of age determination recently described by Miller (1946), *viz.*, by exposing and observing the skull by making a small incision through the skin on the head. This would be an important accessory method in determining for the birds of these species handled during the late fall and early winter, whether they are first-winter birds or adult birds of unknown age.

Drost (1930, 1931, 1932, etc.) has described many useful plumage criteria for European species; similar devices should prove useful in America.

The proposed system is one to *allow* as accurate a record as possible within the knowledge of the bander or other bird student who wishes to record the age of a bird. As in all scientific work accuracy must be paramount; a guess is worse than no data at all. *For each banded bird the system proposed herein must be applied only so far as the bander is certain of his data.* If the bander is unable to ascertain to which of the age groups the bird belongs, age should be indicated by a question mark.

It is suggested that in reporting and recording bird-banding data brief notes, such as "streaked breast," "spotted breast," "post-juvinal molt" etc., which will indicate the basis for the age designation, should be entered. The present schedule sheets for reporting banded birds to the Fish and Wildlife Service have ample room for such notations. Such notations would add immeasurably to the confidence a research worker could place in the data when working with them.

The sexual-competency criterion for the adult stage cannot be used because it usually is impossible to determine at the time of banding and because some individuals of some species are known to breed before they acquire the normal adult plumage. The bander, lacking some other reliable means, must judge a bird to be an adult whenever its plumage cannot be distinguished from the adult plumage, even though, in fact, its plumage may be composed partly or entirely of juvenal or other pre-adult feathers.

The above terminology is offered for general consideration and discussion and, if found acceptable, adoption by the Fish and Wildlife Service, bird-banding associations, bird banders, in fact, anyone who has occasion to record a bird's age. If it is not generally acceptable, it is hoped that the discussion will be kept active until some acceptable terminology is evolved.

It is believed that this proposed nomenclature for the ages of birds is an improvement over previous systems for the following reasons:

1. It follows a system of plumage nomenclature, and hence age nomenclature, that has been generally accepted for nearly half a century.
2. It provides for all of the distinguishable plumages through which a bird may pass.
3. It does not give new connotations to age terms which properly have loose and general meanings.
4. Its use will acquaint banders and others with the proper terms to use in the discussion of plumages.
5. Its adoption by the Fish and Wildlife Service and its use by all banders will make the Fish and Wildlife Service files of reports of birds banded more valuable for research problems on birds of various ages after the practice has been in effect for a number of years.

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APPENDIX 1

A SUGGESTED METHOD FOR ADAPTING THE PROPOSED SYSTEM
TO THE PRESENT SYSTEM OF FILING DATA

It should be stated again that this system of age nomenclature should not be used on the Fish and Wildlife schedule sheets nor on the Return Cards unless that agency instructs bird banders to do so. If the Fish and Wildlife Service should adopt this proposed system the following suggestions in regard to a code for punching the return cards (Bird-Banding Return, Bi—137) for use in the sorting machine may be helpful.

Column 48 on these cards is used for indicating age. The numbers in this column run from 0 to 9, inclusive. The present code uses four of these numbers, 0 to 3, as follows: 0—age unknown or unstated, 1—adult, 2—immature and 3—juvenile (nestling or fledgling). A code which would accommodate the use of these cards to the proposed age terms would be:

- 0 — age unknown or unstated.
- 1 — adult (ad.)
- 2 — nestling-juvenal (juv. n.)
- 3 — fledgling-juvenal (juv. fl.)
- 4 — independent-juvenal (juv. ind.). If on the left end of the return card or on the schedule sheet, the age has been indicated by the simple term *juv.* the person punching the card should assume that the bird was in its independent-juvenal (juv. ind.) age period, unless there is some evidence to the contrary.
- 5 — first-winter (w. 1)
- 6 — first-nuptial (n. 1)
- 7 — second-winter (w. 2)
- 8 — second-nuptial (n. 2)
- 9 — age designations not included in the above nine items. Natal, third-winter, third-nuptial, etc., and adult eclipse may be reported and would be lumped together under this code number. The researcher should consult corresponding schedule sheets and written halves of return cards for the age information that is given in these cases.

APPENDIX 2

DIRECTIONS FOR GENERAL USE OF THE PROPOSED SYSTEM

The authors are aware of the fact that few, if indeed any, bird-banding operators can readily identify the plumage of every bird which they trap and wish to band. The proposed system is one designed to *allow* as accurate a record as possible *within the knowledge of the bander*. As in all scientific work accuracy must be paramount; a guess is worse than no data whatsoever. *For each banded bird the system proposed herein must be applied only insofar as the bander is absolutely certain of the data.* It is therefore suggested,

should the system be adopted, that the description of it be accompanied by the following summary code:

- (1) Identify the bird to species, or to the subspecies if the subspecies is determinable by the appearance of the bird. If specific identification is uncertain, the bird should not be banded.
- (2) Determine and record the sex. If it is underterminable or *uncertain*, sex should be indicated by a question mark.
- (3) Determine whether the plumage is *natal*, *juvenal*, or a later plumage. If the bander is unable to ascertain to which of the plumage groups the bird belongs, age (or plumage) should be indicated by a question mark unless the age is determinable in some other way.
- (4) Few, if any, birds are banded in natal plumage. Although natal down may be present on some which are banded, there will usually be enough juvenal feathers present to designate them as *juvenal* (juv. n., if still in nest, etc.).
- (5) Precocial (nidifugous) young, when large enough to band, are designated as *fledgling-juvenal* (juv. fl.) or *independent-juvenal* (juv. ind.).
- (6) The altricial (nidicolous) young, when in the nest and large enough to band, are always *nestling-juvenal* (juv. n.).
- (7) Birds in plumages later than the juvenal should be designated as *adult* (ad.) unless they can be definitely identified more precisely (such as *first-winter*, *first-nuptial*, etc.).
- (8) Only the terms *fledgling-juvenal* (juv. fl.), *independent-juvenal* (juv. ind.), and *adult* (ad.) will be required for the vast majority of non-nestling birds at the time of banding.
- (9) Brief notes, such as "streaked breast," "spotted breast," etc., indicating a basis for age designation are desirable.

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THE SPACING OF REPEATS

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Since the determination of lengths of stay of banded migrating birds depends on a knowledge of the length of time to, at least, the first repeat after banding, it will be useful to indicate the sort of distribution which repeats show and to call to the attention of banders with extensive records the desirability of analysing their records with this item in view.

The ensuing table shows the time in days for the Slate-colored Junco from the preceding capture to the repeat noted. Time is taken only to the day and when both captures occur on the same day, the elapsed time is counted as zero.

I have set out the raw data in Table I in detail because it exhibits clearly the essential point that the distribution of repeats in time is