THE COMPARATIVE EFFICIENCY OF 30 AND 36 MM. MESH IN MIST NETS

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Since the introduction of mist nets into this country almost 20 years ago, the use of nets for banding, collecting, and population studies of birds and bats has been growing rapidly. Mist nets have proved invaluable to field workers attempting to capture species not readily baited into conventional traps. In response to this increase in the use of nets, a wider variety of types has gradually become available; nets of varying length, height, mesh size, and denier are now being imported and used for an assortment of special purposes. The varieties of net lengths and heights are designed to fit particular field conditions, and the different mesh sizes and deniers are intended to catch and hold birds and bats of various sizes and weights.

At Powdermill Nature Reserve, a research station of Carnegie Museum located near Rector in the southwestern mountains of Pennsylvania, we have used nets almost exclusively in a bird-banding program begun in 1961. In the first years we used only 12-meter, 4-shelf, 36 mm. mesh nets (the "Type A" distributed by the Northeastern Bird-banding Association) as this was the type most commonly employed by banders for general, small bird purposes. When similar but finer mesh nets (30 mm., the "Type H" from NEBBA) became available, we tried some of these as well. The use of a few 30 mm. nets seemed to be increasing our total catch of the smaller species such as warblers, kinglets, and hummingbirds. This could not be proved, however, because we had not kept records of which birds had been caught in which size mesh. In 1965, therefore, we decided to run a simple experiment with the two mesh sizes to find out whether, in fact, we were catching a predominance of small birds in the finer mesh. We felt it would be useful to know if these mesh sizes were selective, not only for our own and others' banding and field studies, but also for workers conducting exacting population studies.

The net lane chosen for the experiment was one that had been in essentially year-round operation since 1963, and which had proven to be particularly productive during the migration seasons. The lane was 120 meters long (ten 12-meter nets) and extended from the edge of a dirt road, through an old field densely grown up in hawthorn (*Crataegus* sp.) and crabapple (*Pyrus coronaria*), across a small swampy area approximately 30 meters wide, and into a more open old field in a slightly earlier stage of hawthorn-crabapple succession. The two mesh sizes, 30 and 36 mm., were alternated on the poles, and the nets were turned every two weeks, so that each net location held each mesh size for half the duration of the experiment. This alternation of the nets was necessary to allow for the differences in habitat along the net lane. The experiment was run during most of the migration seasons of 1965, from March 1st through June 2nd, and again from September 16th through No-

vember 10th. The nets were operated an average of eight hours per day for a total of 79 days. Each bird (banded or unbanded) that was removed from the experimental nets was recorded by species and the mesh size in which it had been caught. At the end of the season, the number of each species was tallied for the two mesh sizes.

During the test period 1,345 birds representing 86 species were caught in the ten nets. Because of the large number of species in the series, it was decided that an analysis of the data by body size groups would be more meaningful than a comparison on a species-by-species basis.

Unfortunately it is not yet known how to measure with complete accuracy all the factors involved in a bird's being caught and held in a net. Such measurements as body weight, width of skull, and length of wings, legs, toes, and claws can be taken easily; it is much more difficult to measure the stiffness of feathers and the shape of the head, body, wings, legs, tail, etc. The velocity of the bird when it hits the net and its subsequent behavior are also important, as are the conditions of the net (wet or dry, etc.) and the weather (particularly the wind). In view of this complexity, we decided it would not be feasible to consider all the factors involved. Instead we sought a convenient index of body size, which is probably the most important single factor affecting net efficiency. The index of body size chosen is the band size recommended for each species by the U. S. Fish and Wildlife Service.

The 86 species caught during the study were accordingly grouped into eight categories by band size: X, 0, 1, 1B, 1A, 2, 3, and 5. The numbers of birds were then tabulated and compared by percentage of total catch per band size for each of the two mesh types. The number of each species caught is presented in Table 1, and the comparison of percentages is shown in Table 2 and Figure 1. The vernacular names used here are those of the A. O. U. Checklist (1957), and they are arranged in Table 1 by A. O. U. numbers.

Statistical analysis of the figures in Table 2 by the Chi-square test showed that in band size groups X, 0, and 1, significantly greater numbers of birds were caught in the 30 mm. mesh (p. values less than five percent); in band sizes 1B and larger, significantly greater numbers were caught in the 36 mm. nets (p. values less than two percent.) It is interesting to note also that the dividing line between the relative efficiencies of the two mesh types lies between band sizes 1 and 1B; there is no overlap, no group of birds in which (statistically) equal numbers were caught in both mesh sizes. It was expected, of course, that the smaller mesh would catch more smaller birds, and vice versa, but the statistical analysis showed what a surprising difference mesh size actually made.

The effect of the two types of nets was also seen in the total catch: 724 birds or 54 percent for the 30 mm. mesh, versus 621 or 46 percent for the 36 mm. mesh. This difference, although seemingly small, is also statistically significant (p. value less than one percent.) We caught, therefore, a better proportion of the birds that passed through Powdermill during migration in 1965 in the 30 mm.

TABLE 1. NUMBER OF EACH SPECIES CAUGHT IN 30 AND 36 MM. MESH NETS

Band size	Species	30 mm.	36 mm.
X	Ruby-throated Hummingbird	15	5
0	Yellow-bellied Flycatcher	3	4
	Traill's Flycatcher	2	3
	Least Flycatcher	6	8
	American Goldfinch	25	24
	Field Sparrow	36	29
	Chipping Sparrow	4	4
	Slate-colored Junco	26	23
	White-eyed Vireo	1	1
	Black-and-white Warbler	1	1
	Golden-winged Warbler	8	2
	Nashville Warbler	7	4
	Orange-crowned Warbler	1	0
	Tennessee Warbler	8	4
	Parula Warbler	0	1
	Cape May Warbler	3	4
	Yellow Warbler	7	6
	Black-throated Blue Warbler	3	0
	Myrtle Warbler	11	5
	Magnolia Warbler	21	7
	Chestnut-sided Warbler	1	1
	Blackpoll Warbler	1	0
	Black-throated Green Warbler	3	2
	Palm Warbler	4	2
	Prairie Warbler	1	0
	Yellowthroat	39	5
	Hooded Warbler	2	1
	Wilson's Warbler	13	3
	Canada Warbler	10	2
	American Redstart	1	2
	House Wren	16	3
	Long-billed Marsh Wren	2	0
	Brown Creeper	1	0
	Black-capped Chickadee	52	34
	Golden-crowned Kinglet	35	12
	Ruby-crowned Kinglet	73	36
	Blue-gray Gnatcatcher	4	4
1	Eastern Phoebe	3	0
	Savannah Sparrow	1	1
	Tree Sparrow	8	9
	Lincoln's Sparrow	9	9
	Swamp Sparrow	37	24
	Indigo Bunting	14	6
	Red-eyed Vireo	13	10
	Philadelphia Vireo	4	2
	Warbling Vireo	1	0
	Solitary Vireo	0	1
	Ovenbird	3	4
	Northern Waterthrush	3	3
	Kentucky Warbler	0	2
	Connecticut Warbler	1	1
	Mourning Warbler	2	1
	Carolina Wren	1	0
	Eastern Bluebird	2	0

Table 1. (cont.)

Band size	Species	30 mm.	36 mm.
1B	Downy Woodpecker	5	3
	White-crowned Sparrow	0	2
	White-throated Sparrow	12	23
	Song Sparrow	17	41
	Scarlet Tanager	2	3
	Cedar Waxwing	2	3
	Yellow-breasted Chat	2	12
	House Sparrow	0	1
	Tufted Titmouse	4	7
	Veery	0	2
	Gray-cheeked Thrush	18	16
	Swainson's Thrush	29	33
	Hermit Thrush	10	6
1A	Common Nighthawk	0	1
	Brown-headed Cowbird	0	3
	Baltimore Oriole	1	0
	Fox Sparrow	3	2
	Rufous-sided Towhee	2	16
	Cardinal	7	11
	Rose-breasted Grosbeak	1	0
	Catbird	35	59
	Wood Thrush	2	5
2	Yellow-billed Cuckoo	0	1
	Black-billed Cuckoo	0	2
	Hairy Woodpecker	1	0
	Starling	1	1
	Red-winged Blackbird	4	15
	Brown Thrasher	12	12
	Robin	3	10
3	Yellow-shafted Flicker	0	8
	Blue Jay	3	7
5	Screech Owl	0	1

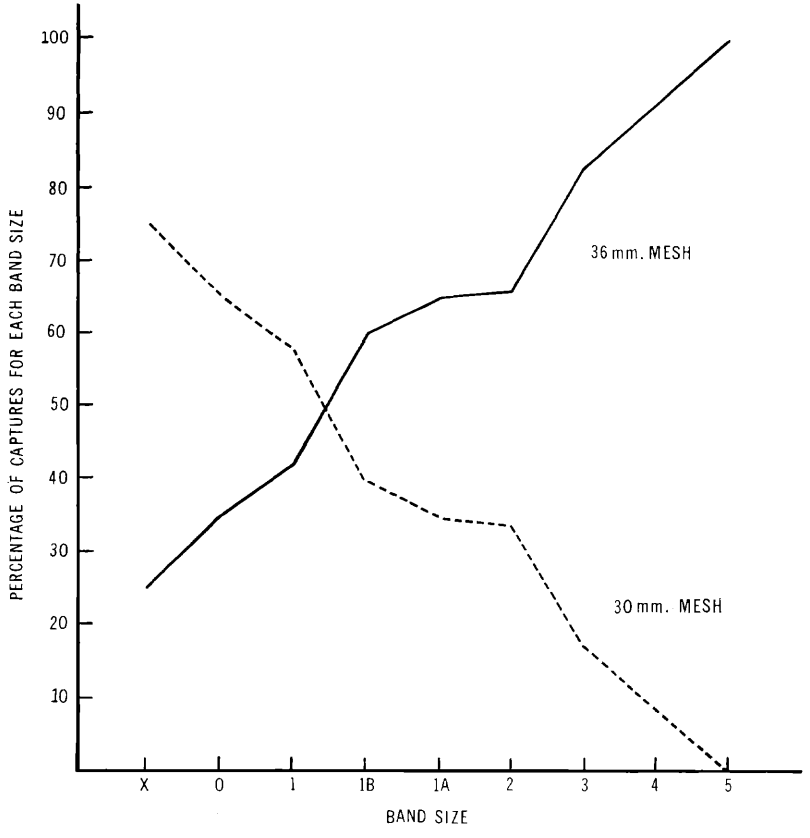
nets than in the 36 mm. The total number of X-0-1 birds caught in the experimental nets was 863, of which 63 percent were taken in the 30 mm. mesh, compared to 482 in the sizes 1B and larger, of which also 63 percent were taken in the 36 mm. mesh.

The applications of the results of this study are several. We have been able to show that banders who wish to catch the broadest possible range of species in their area should use several mesh sizes in their net lanes; the proportionate numbers of each mesh will be determined by the size composition of the particular avifauna. Persons conducting general population surveys would also do best to use a variety of net types, and those concentrating on a single species should use the most efficient mesh size for that species. It is hoped that studies similar to ours will be conducted with other mesh sizes so that in the future banders and field ornithologists will have information available on the comparative efficiencies of the

TABLE 2. PERCENTAGE OF INDIVIDUALS, BY BAND SIZE GROUPS, CAUGHT IN 30 AND 36 MM. MESH NETS

Band Sizes	30 mm: N	%	36 mm: N	%	p. values	Totals
X	15	75	5	25	$<.05$	20
0	431	65	237	35	$<.001$	668
1	102	58	73	42	$<.05$	175
1B	101	40	152	60	$<.01$	253
1A	51	35	97	65	$<.001$	148
2	21	34	41	66	$<.02$	62
3	3	17	15	83	$<.01$	18
5	0	0	1	100	-	1
Totals:	724	54	621	46	$<.01$	1345

FIGURE 1. Percentage of individuals, by band size groups, caught in 30 and 36 mm. mesh nets.



entire range of mist net types. Data based on the sampling of an avifauna quite different from that at Powdermill would also be useful.

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GENERAL NOTES

Recovery of an Ontario-Banded Song Sparrow in Wisconsin.—On March 31st, 1963, the authors conducted mist-netting operations in a thicketed hollow on Ussher's Creek, Willoughby Township, Welland County, Ontario, Canada, (43°02′-079°03′). This location is approximately five miles south of Niagara Falls, Ontario. During the several hours devoted to this operation on that date, twelve Song sparrows, (*Melospiza melodia*), among other *Fringillidae*, were captured and banded.

According to an IBM punch-card received by us on June 20th, 1965 from the U. S. Banding Office, one of the above banded Song sparrows (No. 59-25824) was retrapped and released at Oconomowoc, Wisconsin, U. S. A., (Lat.-Long. 430-0882) on March 28th, 1965 by N. F. Smith, 541 W. La Belle Ave., Oconomowoc, Wisc.

Briefly, this is a spring recovery of a banded Song sparrow, two years (less three days) from date of banding, at a location 472 miles (direct-air) due west of the point-of-banding.

At time of original banding, the bird was described as being an adult of unknown sex, with a "medium" amount of subcutaneous stored fat in the breast (or jugulum) cavity. In point of fact, all of the twelve Song sparrows processed were carrying deposits of fat, some lesser but mostly greater, than the subject bird. Also recorded, was a wing chord measurement of 65 millimeters.

Later during the breeding year of 1963, an adult bird judged to be an incubating female, was captured and banded at this same site. At that time, a singing, territory-defending bird judged to be a male, was seen on the site. It too, was unbanded. It is therefore reasoned that some, and perhaps all of the twelve birds banded on March 31st, were moving through the banding site during spring migration.

The banding and subsequent biennial recovery of this Song sparrow, places it at the exact same south to north orientation point (43°0′ N. Latitude) on virtually the same calendar date during two spring movements, notwithstanding the 472 mile westward deflection.

Using *"The A. O. U. Check-list"*, Fifth Edition, as our authority, the banding point was at the extreme eastern fringe of the breeding range of *M. m. euphonia.*