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THE CRESTED MYNA, OR CHINESE STARLING, IN THE PACIFIC NORTHWEST

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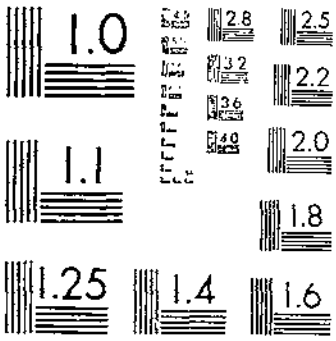

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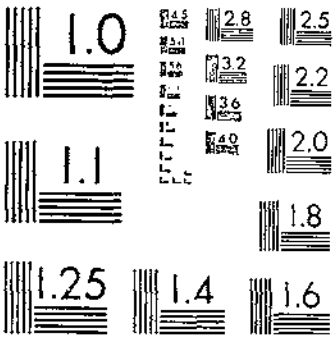

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TECHNICAL BULLETIN No. 467 APRIL 1935

THE CRESTED MYNA, OR CHINESE STARLING, IN THE PACIFIC NORTHWEST

By

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UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

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TB 467 (1935)

Technical Bulletin No. 467 April 1935

UNITED STATES DEPARTMENT OF AGRICULTURE

WASHINGTON, D. C.

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Division of Wildlife Research, Bureau of Biological Survey

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INTRODUCTION

The crested myna, or Chinese starling, a bird native to central and southern China, is one of several members of the starling family (Sturnidae) that have been established at points outside their native habitat. Their introduction into new lands has been either as cage birds that later managed to escape into the wild, or as avian immigrants brought in for the control of an insect pest, or perhaps for purely sentimental reasons. Three species of starlings are now established in the United States or its Territories, as follows: The European starling (*Sturnus vulgaris*), over much of the middle-eastern and northeastern sections of continental United States and southern Canada since its successful introduction about 1890 and later, as reported by Kalmbach and Gabrielson (*16, p. 4*);[1] the Indian, or house, myna (*Acridotheres tristis*), in Hawaii; and the crested myna (*Aethiopsar cristatellus*), in the Philippines.

THE CRESTED MYNA IN BRITISH COLUMBIA

The crested myna has become thoroughly established also in North America, with the city of Vancouver, British Columbia, as its main stronghold and central point of dispersal. Nothing is definitely known

[1] Italic numbers in parentheses refer to the Bibliography, pp. 25–26.

regarding its manner of introduction into British Columbia nor the exact time when it arrived. According to Munro (*24, p. 32*), one story relates that a large wicker cage containing a number of these birds, consigned to a Japanese resident, was broken open in transit from one of the oriental liners and that the birds escaped. Phillips (*26, p. 55*) suggests "that some irate skipper had tired of his noisy passengers and put them ashore at the first port of call." Other accounts suggest that its establishment resulted from a deliberate attempt by some oriental resident to perpetuate memories of the homeland. Grinnell (*11, p. 170*) relates that "it is frequently brought into North America from the Orient as a cage bird." Cumming (*6, p. 188*) notes that about the time of its North American introduction, the bird was being imported into European countries in large numbers and sold under the trade name "Hill Mynah." At the time of its importation there was neither Federal law nor international treaty to regulate the introduction of exotic birds or mammals into Canada or the United States.

According to Caldwell and Caldwell (*3, p. 12*), writing on the crested myna and other birds of central and southern China, the myna's "sociable and confiding nature [has] greatly endeared it to the Chinese people." As a cage bird it has found favor not only at home but in other lands also, including Taiwan (Formosa), where, according to Wood (*35, p. 132*), it has been liberated and is now in the wild. Because the myna is so common as an introduced cage bird in Japan, it has been frequently referred to in British Columbia as the "Japanese starling."

EARLY RECORDS OF OCCURRENCE

Kermode (*19, p. 20*), states that his first record of this myna was a specimen he himself collected in 1904, near the waterfront in the city of Vancouver. (Kermode's report was reviewed by Taverner (*19*).) When the matter was thus brought to attention, a resident of the city reported that he had seen two pairs of the birds as early as 1897. This earlier date is further confirmed by T. P. O. Menzies, secretary-curator of City Museum of Vancouver, who wrote Marcia B. Bready (*1, p. 37*) that V. W. Mitchell also reported seeing two pairs at Vancouver the same year. Brooks and Swarth in 1925 (*2, p. 126*) also reported that the bird was known to be there in 1897.

Brooks is quoted by Wood (*35, p. 133*) as first seeing the bird in British Columbia sometime during 1903, and stating that it was then scarce. It must have been extremely uncommon for a number of years, as R. E. Gosnell, secretary of the Bureau of Provincial Information, does not include it in his published list of birds (*10*), known to occur in the Province in 1903. Neither does Kermode (*18*) list it. Macoun and Macoun (*21*) make no mention of the crested myna in Canada in 1909. As late as 1923 Eliot (*8*) fails to place it in the British Columbia list.

LATER RANGE AND ABUNDANCE

In 1920 Kermode (*19, p. 21*) estimated the number of crested mynas in Vancouver frequenting the main winter roost at about 1,200. This was at the busiest part of the city, at the intersection of Carroll and

Cordova Streets. In January 1921 Munro (*23, p. 16*) wrote that the birds had then spread to the southeast as far as New Westminster. Peak numbers in the Vancouver district in 1925 were placed by Cumming (*6, p. 188*) at 6,000 to 7,000. As early as the 1921 Christmas bird census, Racey (*27, p. 20*) found the myna the dominant land bird in Vancouver. The territory occupied at that time included Vancouver and its environs, a district extending perhaps 20 miles east and west and about the same distance north and south. Within these limits are North Vancouver, across Burrard Inlet; Sea Island, Lulu Island, and other parts of the Fraser River delta; New Westminster and Coquitlam on the east; and Ladner on the south.

Cumming (*6, p. 189*) reported in 1925 that the movement of the species has been to the southeast, where land had been cleared along the Pacific highway. He further stated that the younger birds probably kept the lead, as specimens collected were usually birds of the previous year. More recent information indicates an expansion of occupied territory and also suggests that erratic wanderers may be seen far from their designated range. Kelly (*17, p. 14*) records that the Vancouver colony at that time exceeded 20,000 birds and that individuals had been seen across the international boundary as far south as Bellingham, Wash.

Menzies in March 1927 wrote Mrs. Bready (*1, p. 37*) that—

> These birds have increased considerably during the past few years and now form a very large colony at the corner of Carroll and Cordova Streets, the most busy section of this city (Vancouver) where there are absolutely no trees and where they nest in the eaves of the buildings. They have gradually spread, in small colonies, as far east as Coquitlam and south toward the borders of Washington. The numbers have increased to thousands, but always seem to keep in colonies and are never far from the habitations of man. Away from the Carroll Street colony, all small colonies use the old burnt forest stumps as their nesting place and defend these favorite stumps in a very aggressive manner, taking complete charge, but otherwise do not seem aggressive to other birds nesting in the close vicinity.

Munro (*25, p. 30*) writes that a great increase of the species had taken place in 1930 and that the center of abundance remained within the agricultural area adjoining the mouth of the Fraser River, but that the overflow from this area had worked eastward, "* * * New Westminster being the farthest point at which the species is, or has been, at all common and Chilliwack, 80 miles from Vancouver, the farthest outpost where single individuals have been observed." He added that wherever found, the birds were restricted to agricultural areas.

Gabrielson (*9, p. 105*), Wood (*35, p. 135*), and Cooke (*4, p. 2; 5, p. 2*) all report that a single individual was observed in Portland, Oreg., in February 1924. This may have been an escaped cage bird, though Gabrielson visited all the known dealers of cage birds in the city, but could learn nothing of its origin.

On August 13, 1929, about 1 mile from the head of Lake Washington on Sammamish River, Wash., Frederick W. Cook (letters of August 1929 and March 1933) observed under favorable conditions a flock of 12 crested mynas. On two later trips to the same locality he was unable to find the birds, and they have not been seen there since that date.

INVESTIGATIONS OF PRESENT STATUS

Under special authorization from the United States Department of Agriculture, the senior author, late in the summer of 1931 and in succeeding months, undertook to determine the present status of this introduced bird, particularly with reference to its possible spread into the United States. He had opportunity to prosecute the field studies during parts of August, October, and December 1931, and in May and June 1932.[2] Laboratory examination of the contents of stomachs and deductions therefrom were made subsequently by the junior author.

STARLINGS IN OTHER LANDS

Wood (*35, p. 132*) shows that before the crested myna was successfully introduced into the Philippine Islands and Taiwan, three or more attempts had been made in the Philippine Islands by the Spanish Government between 1849 and 1852 to establish the species. The hope was that the birds would reduce the numbers of locusts that were and still are a serious agricultural pest there. It appears that the myna's spread has largely been confined to towns in the vicinity of Manila.

The history of the introduction and spread into foreign lands of other members of the starling family shows that in the majority of cases more harm than good has resulted. Stoner (*32, p. 328*) shows that the common house myna (*Acridotheres tristis*) is now a pest where it has been introduced into the Hawaiian Islands, New Zealand, and Fiji. Some stir was recently occasioned in California by the liberation of several house mynas which, when discovered to be at large and nesting out of doors, were promptly and properly sought out and destroyed (*29, p. 740*).

While much can be said in favor of the European starling (*Sturnus vulgaris*) in eastern North America, the value of its acquisition is highly questionable because of its phenomenal increase and spread, its consequent effect on native species of birds, and its too frequent depredations on fruit orchards and other agricultural crops. Its filthiness at the winter roosts in the downtown districts of cities has added no little to its public condemnation. When it is realized that a number of unsuccessful attempts were made before the European starling was established in this country, it seems much too early to say that the crested myna will not extend its range from the Vancouver district toward the United States, even though there appears to be at present a recession of range, or at least no increase in the numbers of the species. If conditions should become more favorable to the birds, and the crested myna as now established on the Pacific coast should further menace the security of our native birds or threaten serious damage to fruit crops, it probably would not be difficult to destroy the advance scouts, because the species is easily recognized by its notes and its appearance in flight. There appears to be only one direction, however—southeast—by which the myna can advance from its present range, nevertheless successful prevention of its spread will require strict vigilance.

[2] Acknowledgment is made of the assistance on the Canadian side of the boundary, of R. A. Cumming a resident naturalist of Vancouver since 1908, and so well acquainted with the haunts of the myna as to be able to gather facts and material during intervals when the senior author could not be on the ground. The information he furnished has contributed largely to the value of data collected in these investigations.

B36.M

CRESTED MYNA, OR CHINESE STARLING.

Adults in flight and adult and young perching.

DESCRIPTION AND HABITS OF THE CRESTED MYNA

COLOR, FLIGHT, AND GAIT

The crested myna (pl. 1) is a bird about the size of the robin (*Turdus migratorius*), and is easily recognized in its short-range flight by a conspicuous band of white on the wings. At a greater distance it may be distinguished from either the robin or Brewer's blackbird (*Euphagus cyanocephalus*), with which it sometimes consorts, by its shorter tail and somewhat labored straightaway flight, which lacks the grace or undulatory movements of these two birds. Perched for observation, it shows a more erect profile than do the other two species, and exhibits its peculiar crest, or tuft of short feathers, which inclines forward over the base of the beak. The plumage is black, with the exception of the white wing patches, which usually do not show when the bird is at rest, although they are sometimes partly displayed in the mating season. Some of the larger tail feathers are also tipped with white. Iris, feet, and beak are yellowish in the adult. The two sexes are practically indistinguishable out of hand. This myna usually goes about in a walking gait, not hopping, when feeding on the ground.

CALL NOTES

The call notes and singing cadences of the crested myna have been variously commented upon by writers on bird topics, sometimes to the rank disparagement of the bird's vocal efforts, sometimes in compliment to its musical qualities. Scheffer finds the whistling notes always cheerful, in the nesting period even quite musical. Several calls may be recognized, the longer ones including a rolling trill, and all are distinguishable from the songs of our native birds by their peculiar "foreign accent." At roosting time in the winter season there is more or less chatter from flocking numbers. In his acquaintance with these introduced birds, Scheffer has noted no calls in imitation of native species. In its own habitat the myna is sometimes credited with being a mocker and, it is said, according to Caldwell and Caldwell (*3, p. 12*), and Wilkinson (*34, p. 123*), can even be taught to talk.

NESTS AND NESTING HABITS

The nesting time of the crested myna in the Vancouver district covers about 10 to 12 weeks in May, June, and July. It is difficult to learn by direct observation just when the season of brood rearing naturally closes; for, because of the birds' association with human habitations, many nests are inadvertently broken up from time to time, and the nesting pairs are forced to seek new sites and try again. Sometimes, too, the birds or their nests are disturbed with hostile intent by city dwellers who do not care to have the foreign intruders about the premises. The crested myna is not so confiding and persistent as the English sparrow (*Passer domesticus*), but where persecuted or unduly disturbed, it will usually abandon its homemaking to try elsewhere.

A nesting pair has been observed to feed its young as late as the first week in August, but most of the broods are out much earlier. Whether the species is commonly two-brooded is a matter difficult to determine without banding studies. Wilkinson (*34, p. 124*), writing on Chinese birds, says of the native crested myna: "There are

two broods a year so that each family is likely to number about eight by the end of the breeding season." This statement seems inconsistent with the senior author's observations on the length of time it takes to rear a brood in British Columbia, as will appear farther on in this report.

For nesting sites, the crested myna apparently requires a nearly enclosed space. It does not incline to build, like the robin or the English sparrow, on supports partly in the open or with semishelter. In fields and woods, the nests are usually made in the tree holes that sometimes result from decay in the dead stubs, but more frequently from excavations made by flickers (*Colaptes cafer*) or other woodpeckers. As many as half a dozen or more such holes occupied by mynas may sometimes be seen in a single tree trunk on logged-off and burned-over land that has a covering of low, second-growth trees and shrubs. About the city the nests are commonly made in enclosed shelters formed by the cornices, eaves, chimneys, and drain spouts of buildings. Sometimes they are in the boxing of guy wires on line poles. Mynas will also occupy tree boxes placed for them or for other birds.

The nests themselves are mere collections of trashy materials assembled from any available source not too remote for economy in flight, such as bits of grass and weeds, foil, cellophane, and other candy and gum wrappings, feathers, snake skins, rubber bands, and fine rootlets. The eggs fairly closely resemble those of the robin, being of about the same size, unmarked, and colored light blue or greenish blue. The number in a clutch is commonly 4, occasionally 5 or 6.

The following summary was made of notes kept by Scheffer and Cumming on the nesting of a pair of crested mynas in a tree box placed in a garden at Vancouver: The pair first appeared at the nesting site on April 14 and spent 14 days in building the nest, the first egg being laid April 28. Five days were required to complete the clutch, one egg each day. On the evening of May 15, the first egg was found to be hatched, and all the eggs were pipped, an incubation period of 14 days. The young birds left the nest and perched on a branch 27 days after hatching. After that they were fed or were aided in feeding by the parent birds for about 7 days, when, on June 19, they were able to shift for themselves. The actual elapsed time, therefore, from the first appearance of the mynas at their nesting site until the fledglings were able to care for themselves was 66 days, a surprisingly long period and one that would seem to preclude the habitual rearing of a second brood in this locality and latitude. Accurate observations by Cumming through several years of intimate field acquaintance with the species seem to strengthen conclusions formerly reached by Scheffer.

DISPERSAL, FLOCKING, AND ROOSTING HABITS

For a time after dispersal from the nests, late in summer and early in fall, crested mynas are associated in small groups, probably family parties remaining about the old nesting sites or in flight to and from feeding grounds. This habit was particularly noticeable at the time of the first visit of Scheffer to the Vancouver district, in August. It is in considerable contrast to the flocking habits of Brewer's black-

birds, which assemble in great numbers at this season. Apparently this family grouping of the mynas has given rise to the Chinese name for the species, "Pako", which, according to Wilkinson (*34, p. 124*), is said to mean "eight brothers."

Though sometimes observed feeding with other birds, particularly Brewer's blackbirds, in the gardens and grainfields of the Fraser River delta, the myna has shown no disposition to drift with them in migration, and at roosting time, it clannishly associates with its kind. When rougher weather comes on, these birds resort more and more to close-foliaged trees for shelter or roosting at night, and for accommodations for larger groups than family parties.

The large myna roost in the heart of Vancouver city, near the waterfront, in the glare of street lights and the confused noise of traffic, has been the subject of much comment and many reports for several years. This section is but little occupied by the birds each year until early winter, when they begin to assemble at evening in large numbers. Almost from the earliest recalled time of the arrival of the mynas, their noisy roosts have been associated with the Christmas season, and the birds have been known locally as "Christmas birds."

Fewer birds than had been anticipated came in to this roost each evening during the observation period in 1931, and this may reflect a numerical decrease in the species since the earlier reports. Not more than 500 were resorting there at the time the census was taken—the second week in December. First arrivals at the roost were noted between 3 and 4:30 p. m., and from that time until nearly dark the mynas drifted in by twos, threes, half dozens, or as many as 15 to 20 in a flock. Apparently the larger groups had assembled en route. Most of the birds came down one street, from the east, flying remarkably low, scarcely over the tops of the cars, and swung up steeply to perch about eaves and cornices of the buildings, where new arrivals joined in the noisy chatter of greeting from those earlier on the roost. After a time some would fly to the ground or pavement in search of bits of food.

The myna notes were mostly chatter, but occasionally a clear whistle sounded very much like that of the cardinal. There was much jostling for place and noisy confusion while the birds were settling down. Later in the evening, after they seemed settled, some disturbance running down the roosting lines would revive the chatter.

In the morning the mynas left the roost as soon as it was fully light and scattered to feed. In a walk of 3 miles eastward into the suburbs, Scheffer and Cumming observed the birds singly or by twos and threes on small trees or on house roofs in the residential district. It may be remarked here that these birds do not resort so much to the more formal premises of the closely settled urban district as to those of the suburbs, where there are outbuildings and gardens.

RELATION TO OTHER SPECIES

So far as field observation for this study goes, the crested myna does not seriously affect other birds, their young, or their eggs, except in the case of the species it wishes to dispossess of nesting sites. While Scheffer observed robins and other birds nesting unmolested in myna territory, others have noted some interference with native birds in open nests. Racey (*27, p. 12*) and others report instances of the myna destroying young and eggs of robins and other native species.

In conflict with the flicker, the myna shows tact and persistence. If a new home of the former is under construction in a tree stub, the mynas will wait patiently for its completion, coming around occasionally to note progress. When it is ready for use, several pairs of the intruders may contest for its possession, giving the impression that they are "ganging up" on the unfortunate home builder. The result is always the same—eviction of the woodpecker tenants. When the myna wishes to build its home where a native bird has already made progress in rearing a family, it tosses out both eggs and young with little ceremony.

POSSIBILITY OF INCREASE AND SPREAD

A discussion of whether the myna will extend its range into the United States involves a consideration of natural barriers and climatic factors, as well as the habits and history of the species. To the west and south of the occupied territory in British Columbia is the wide stretch of the Strait of Georgia with only a point of land crossed by the international boundary line, and to the north are mountain ranges and a forested interior where the myna would not find close settlement and the human habitations it seems to prefer. Thus the most ready opportunity for natural extension of this introduced bird's range appears to be east by southeast. In this direction, urged by the force of crowding numbers, an aggressive bird would find its way into the fertile valleys of northern Washington, by way of Blaine and Bellingham. From present reckoning, it appears that with few exceptions, the myna has not been able in recent years to hold the slight advances formerly gained toward Blaine. The birds are clannish and probably not strongly inclined to pioneer.

Instead of increasing in numbers, the crested myna in the Vancouver district at present is apparently diminishing, or at best is stationary. This may be accounted for partly by destruction of its former nesting sites, with the extension of city streets into the wilderness of brush and blackened tree stubs. More recently, man's use of these unsightly, rotting tree trunks as fuel, has forced the mynas to withdraw their outposts and to adapt themselves to more strictly urban conditions for nesting.

When it is considered that its natural habitat is southern or central China, the crested myna is not especially favored climatically by residence in the coastal region of British Columbia. It is to be recalled, too, that other regions into which it has been introduced, and where it has subsequently thrived and reared more than one brood a year, are tropical or subtropical—the Philippines and Taiwan. Its near relative, the house myna (*Acridotheres tristis*) of India, has likewise increased and prospered when introduced into the Hawaiian Islands (*26, p. 55*). Natural reasons, therefore, and direct observation in the field indicate that in British Columbia, at least, the crested myna will not be able to duplicate its life history in its native land, where it is said sometimes to rear two or three broods a season.

Some apprehension has been felt in ornithological circles, and perhaps reflected in the agricultural press, that this introduced myna might follow in the train of the English sparrow and the European starling (*Sturnus vulgaris*) and become a widespread nuisance in parts of our country. Wood in 1924 (*35, pp. 134–136*) reported:

So far as known, *A. cristatellus* has on the Pacific Coast no enemies or other agent likely to check its spread or limit its numbers. One may confidently expect that in the course of time this prolific and resourceful bird will breed in hundreds of thousands and literally occupy the land . . . descend upon orchard and field in devouring myriads. . . . all the factors of adequate food supply, climatic conditions, nesting opportunities, and freedom from natural enemies combine to insure his steady march both inland and along the ocean front.

Phillips (*26, p. 55*), observes, however, that this myna seems to suffer from the cold weather and will probably be confined to the immediate coast.

In the present field review of the situation, a decade subsequent to this forecast of the crested myna's increase and spread, conditions do not appear to be so serious as was feared. While the food supply seems adequate for the bird, and freedom from natural enemies is apparent, the present writers, instead of considering that climatic conditions and nesting opportunities favor the crested myna in British Columbia, are of the opinion that if the bird were once established in California, or possibly even in Washington or Oregon, the story might be quite different.

FOOD HABITS IN BRITISH COLUMBIA

LABORATORY ANALYSES OF STOMACHS

For the laboratory study of the food habits of the crested myna, 142 stomachs, collected in the 8 months from May to December at or near Vancouver, British Columbia, were available. R. A. Cumming, of Vancouver, collected 72 of these for the Bureau of Biological Survey in 1931 and 1932, and the other 70 for the University of California in 1925, and these were subsequently presented by that institution to the Bureau. In the laboratory examination of the stomachs, made at Washington, D. C., by the junior author, 5 of the 142 were discarded as being too nearly empty to represent normal food proportions. Of the remaining 137, 20 were from juvenile birds, and 117 from adults.

Although the available material is not so extensive as could be desired for a thorough understanding of the myna's food habits, even for so restricted a locality, yet it seems sufficiently representative of the period from late spring and summer to early winter to denote certain definite feeding tendencies of the birds in their new home.

FIELD OBSERVATIONS

The laboratory studies bear out the field observations that the crested myna is one of the most omnivorous of feeders, with a partiality for fruits and for foods from such unsavory sources as garbage heaps and manure piles. A feeding ground much favored by these birds is the Fraser River delta, just south of Vancouver. Much of this is cultivated by Chinese gardeners, who were utilizing considerable manure and permitting the accumulation of numerous garbage heaps. Morning and evening many birds, particularly those that roost or nest in the southern part of the city, may be seen in flight to or from the delta gardens, singly or in small numbers. Once on the feeding grounds they may flock together in small groups or in numbers up to a hundred or more. It is not uncommon for the birds

to feed about an abattoir, pigpen, corral, or pasture, and while foraging frequently to associate with crows (*Corvus brachyrhynchos*), English sparrows, and gulls (*Larus* spp.). When disturbed while feeding with a mixed flock of other birds, the mynas usually take flight separately. In the city they commonly pick up scraps about back yards, and are said formerly to have subsisted to a considerable extent on undigested grains from horse droppings. The replacement of horses by automobiles has probably served as a check on their increase. A summary of the percentages of the myna's food items indicates that within reasonable limits availability is the chief determining factor in choice of food.

FOOD OF ADULT BIRDS

The laboratory studies indicate that, so far as food is concerned, the crested myna is thoroughly adaptable to rapidly changing conditions. Thus its food preferences and range of diet should cause the bird to thrive best in or near cities and agricultural centers—often in the very places where its presence in too great numbers might be least desirable. The average food consumption of 117 adults for the 8-month period showed 38.89 percent animal and 61.11 percent vegetable matter (table 1). Only in September did the animal food amount to more than half the total, when larvae, pupae, and recently emerged adult house flies comprised about 54 percent of the stomach contents, and raised the animal part of the food for the month to nearly 66 percent. As would be expected, the colder months showed the lowest percentages of animal matter—25 percent in November and 27.75 in December. During these months very few house flies are available, though the number of stomachs taken was too small to permit reliable deductions as to the normal winter food.

TABLE 1.—*Percentages by month of the various items in the food of adult crested mynas, based on analyses of 117 stomachs, and averages for the 8-month period for which data are available* [1]

Month	Stomachs	Animal food	Vegetable food	Flies (house and others)	Moths and caterpillars	Wasps, bees, and ants	Bugs	Beetles	Grasshoppers and other orthopterans	Miscellaneous insects
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
May	11	39.64	60.36	1.64	0.82	2.72	1.18	3.64	0.00	8.18
June	31	39.10	60.90	.58	13.35	1.74	2.78	3.53	.23	.55
July	8	36.87	63.13	2.38	10.00	5.75	2.00	(2)	.13	.12
August	23	40.83	59.17	4.17	4.83	2.05	3.22	1.17	.04	.04
September	11	65.91	34.09	54.20	.00	2.09	3.82	.27	.00	.27
October	26	45.04	54.96	17.28	1.96	.44	.72	.52	3.08	.04
November	4	25.00	75.00	7.00	.00	(2)	(2)	.00	.00	.00
December	4	27.75	72.25	1.00	(2)	(2)	(2)	.50	.00	00
Monthly average	16	38.89	61.11	11.04	4.00	1.85	1.72	1.24	.45	1.15

[1] See also fig. 2, *A*.

[2] Trace

TABLE 1.—*Percentages by month of the various items in the food of adult crested mynas, based on analyses of 117 stomachs, and averages for the 8-month period for which data are available*—Continued

Month	Spiders and harvestmen	Earthworms	Miscellaneous animal food	Garbage	Wild fruits	Cultivated fruits [2]	Leafy vegetables and flower heads	Grain	Vegetable debris and manure [3]	Average items per stomach
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Number*
May	1.09	6.00	1.64	43.19	0.00	1.36	15.45	0.18	0.91	10.82
June	2.55	1.16	2.38	1.90	53.95	11.20	2.52	.19	1.00	8.40
July	4.88	.00	.00	3.37	61.37	.00	.12	.00	.88	4.89
August	2.83	22.18	.30	(4)	44.39	8.83	1.47	.00	4.48	11.30
September	3.30	.00	.18	1.82	8.73	4.63	9.27	5.00	6.18	9.54
October	2.84	1.04	1.28	23.52	15.92	6.20	10.20	.00	8.00	14.08
November	4.75	.25	1.50	19.00	.00	3.26	20.75	6.75	36.75	20.50
December	.25	2.00	.00	24.00	38.00	2.00	2.75	1.25	28.25	12.50
Monthly average	2.82	4.08	.91	14.00	27.80	4.70	8.57	2.54	11.56	11.50

[1] Part listed as cultivated may have been wild or unharvested.
[2] Includes 0.35 percent miscellaneous weed seeds.
[4] Trace.

ANIMAL FOOD

A large item in the animal food of adults for the period was garbage, amounting to 14.6 percent of the total. This varied from 43.19 percent in May to a mere trace in August. At the season when fruits are ripe, these replace garbage in the diet. Further, it appears that during the summer months, when developing flies and other insects are abundant and easily obtainable from garbage heaps and manure piles, these insects are taken in preference to the garbage itself. The garbage consisted of about 8.7 percent of animal debris, largely table scraps of meat and bones, and about 6 percent of vegetable scraps. The 4 summer months—June to September—the period when fruits and insects were most available, revealed the smallest consumption of garbage: 1.9 percent for June; 3.37 percent for July; a trace for August; and 1.82 percent for September. These 4 months stand in marked contrast in this regard to May, October, November, and December, when the average garbage percentages were, respectively, 43.19, 23.52, 19, and 24. The garbage-eating habit appears to be characteristic of mynas where established in other parts of the world also. Wood (*35, p. 133*) writes of them in British Columbia that "in the town proper they act as scavengers and devour all sorts of refuse foodstuffs."

INSECTS

Insects of various orders occupied a prominent place as food in all the 8 months except November and December, and averaged 22.44 percent of the total. The monthly percentages of the insect diet were as follows: May, 18.18; June, 23.06; July, 29.38; August, 15.52; September, 60.83; October, 24.04; November, 7; December, 1.5. Insects appear to be preyed upon strictly in proportion to their abundance and availability. Thus, in May, soft-bodied caddis flies with a few May flies were the dominant insect items and averaged 7.18 percent of the total, and only slightly less than half the insect food of the month. In succeeding months no trace of these insects was noted.

During June, July, and August, lepidopterous larvae, pupae, and adults made up the major items of insect food, while in September, house-fly larvae, pupae, and emerging adults amounted to more than all other items of the food, aggregating 53.65 percent. October, with a 14.36 percent house-fly diet, likewise showed this to be the major article of the insect food. Pupae and larvae of other dipterous forms were the principal insect items in November and December.

If only its propensities for insect consumption are considered, much can be said in favor of the crested myna. The species does feed upon many insects that are decidedly injurious to human interests. Along with these, however, it makes an unusually large proportion of its food of parasitic wasps and other beneficial insects.

In July, hymenopterous insects, mainly ichneumonoid wasps (Amblytelinae and *Apanteles* sp.), aggregated 5.75 percent of the food, a mark against the bird, because these are parasitic on other insects. One myna had feasted on 16 of these parasitic wasps.

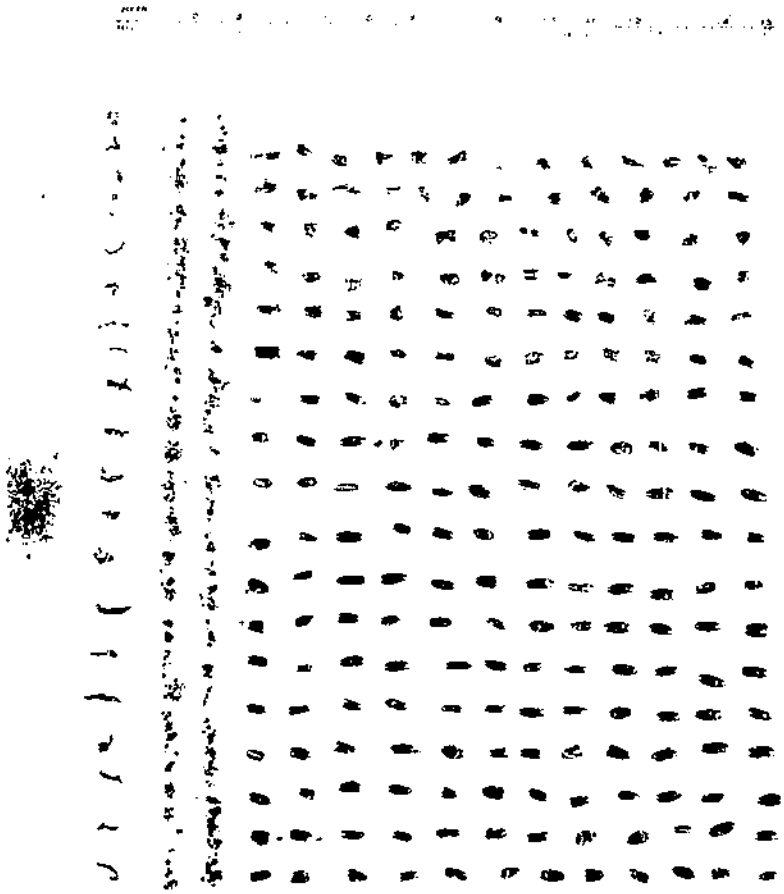
DIPTERA

House flies, ranking as the principal insect item for the entire 8-month period, made up 9.01 percent of all the food consumed. No fewer than 225 pupae, 20 larvae, and 1 adult of the house fly were found in one stomach (pl. 2) and more than 200 larvae and pupae were found in two others. Three additional July stomachs each contained more than 100 of these flies.

Other dipterous forms were taken each month and averageed 2.03 percent of the total. In each of 5 months these flies (mainly pupae or larvae) amounted to at least 1 percent, and in November 6.75 percent of the total food. Diptera other than house flies consisted mainly of winter midges (Trichoceridae), taken largely in November and December, probably of neutral value; large dung flies (*Scatophaga* sp.), the adults of which are predacious on other flies; small dung flies (Borboridae); stiletto flies (Therevidae), the larvae of which are predacious on wireworms and other insect larvae; flower flies (*Helina* sp.); root gnats (Sciaridae); and crane flies (Tipulidae). Though many forms of the last-named family are very destructive, these insects unfortunately constituted merely a trace in the total food.

LEPIDOPTERA

The larvae, pupae, adults, and eggs of lepidopterous insects (moths) took second place in the insect food of the myna and averaged 4.99 percent for the 8 months. The bird probably renders its greatest service in the consumption of these insects, as practically all species identified in the stomachs are decidedly destructive to agriculture. Three groups of moths—tent caterpillars (*Malacosoma* sp.), cutworms (Noctuidae), and measuring worms (Geometridae)—made up the larger part of this kind of food. In July they provided 19 percent of the food of the 8 adults and 12.82 percent of that of the 11 juveniles. During June, August, and October, lepidopterous insects constituted 13.35 percent, 4.83 percent, and 1.96 percent, respectively, of the monthly food, but in May only 0.82 percent, and in one December stomach, a mere trace. Neither September nor November stomachs showed any trace of these insects. One very full June stomach contained 9 whole pupae and fragments of 6 additional



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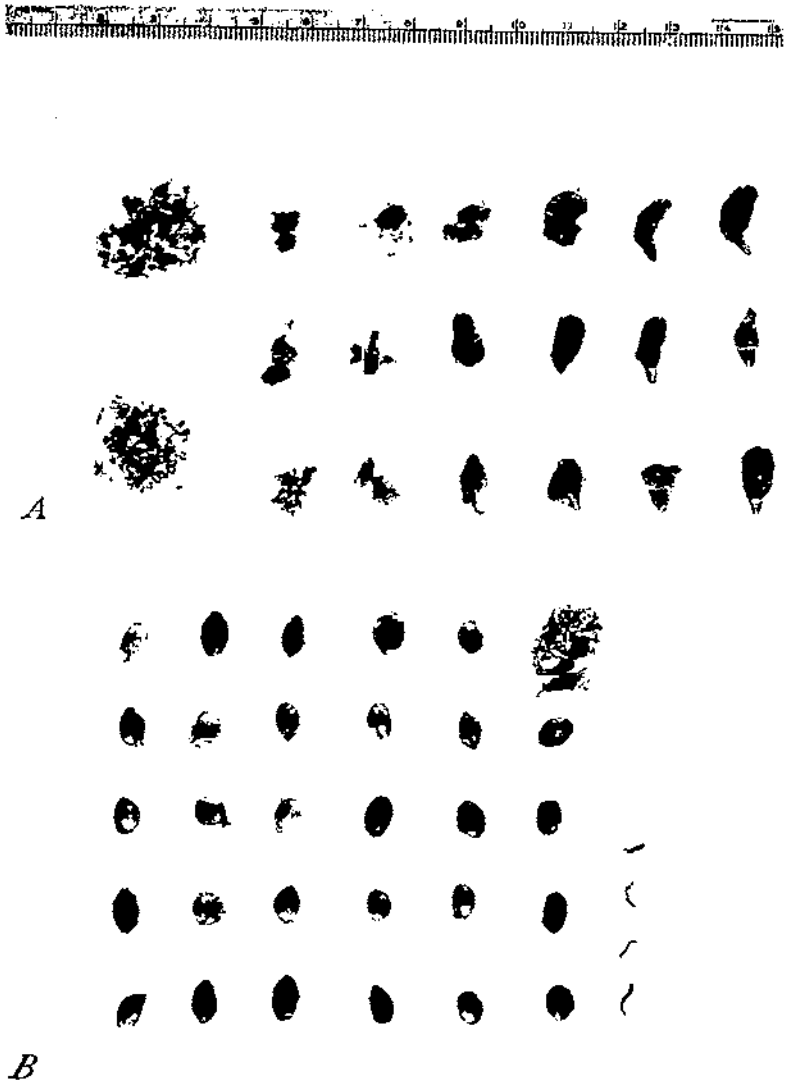
FOOD OF ONE ADULT CRESTED MYNA

Approximately 96 percent consisted of the remains of house flies (1 adult, no fewer than 225 pupae, and 20 larvae; 1 bluebottle fly, 1 leaf roller, and 1 rove beetle, and (the mass at the left side of the picture) grass, 2 seeds of lambsquarters, 1 seed of cinquefoil, undetermined floral parts, and other plant fiber.



A, Analysis of the food of one crested myna taken in June, consisting of [illegible] tent caterpillars and fragments of [illegible] to 8 more; and (the large mass in the upper left-hand corner) undetermined fruit pulp. B, Stomach contents of one juvenile crested myna taken in July [illegible] 29 wild cherries made up 96 percent of the food; the mass in the upper right hand corner is pulp of the wild cherry; the 4 larvae at the lower right are of Stable flies.

pupae of tent caterpillars (pl. 3, *A*); while 1 July stomach contained 5 noctuid adults, more than 430 eggs, and 1 larvae. In these two stomachs, lepidopterans made up 78 and 85 percent, respectively, of the meals. Lepidoptera were taken as part of the food by 53 of the 137 birds; in contrast to this, Diptera were found in 68 stomachs.

It is interesting to note that previous investigations of the crested myna have not revealed more than a mere trace of moths or caterpillars in the stomachs. In 24 stomachs collected in March, May, and June and examined by J. A. Munro (letter, Feb. 26, 1932) only 1 lepidopterous larva was found. Munro (*24, pp. 32–33*) writes that the crested myna is reported by some to eat tent caterpillars, but "in the analysis of 10 starlings (*A. cristatellus*) taken during the month of June when the tent caterpillar plague was at its height there was no evidence that any of these had been eaten."

Cumming (*6, pp. 189–190*) asserts that he has examined some "dozens of stomachs" and writes: "Extended investigation over a number of years proves conclusively that they [mynas] are of no economic value to this Province." Cumming includes a report on 86 stomachs, which he collected in nearly equal numbers during each month of the year and which were examined by H. C. Bryant, then of the University of California. In this series, Lepidoptera apparently constituted only a trace of the total food. Cumming further wrote that "it may also be noted that they [mynas] seldom partake of the tent caterpillar or the cutworm in any of the stages; these insects being most destructive within their range." Wood (*35, p. 134*) writes of two reliable reports of Chinese starlings observed destroying tent caterpillars in British Columbia.

HYMENOPTERA

Hymenopterous insects made up 1.85 percent of the total food and ranked third in importance in the orders of insects taken. Some were taken each month, and they were found in 59 adult and 14 juvenile stomachs, or in 53.3 percent of all examined, and ranged from a mere trace to 36 percent of the meal of an adult and as much as 87 percent of the meal of one juvenile.

One adult bird had eaten 16 ichneumonid wasps (*Amblyteles* sp.); another had feasted largely on digger wasps (*Chlorion* sp.). These insects with other ichneumonids and sphecoids, which constituted the largest item in the hymenopterous food, are largely parasitic in habits, and their destruction should probably be considered more a detriment than a benefit to agriculture.

Ants (Formicidae) of several species were eaten by 13 of the adult birds, but amounted to more than 1 percent only in the month of August. Gall-producing hymenopterans were found in a number of stomachs.

HETEROPTERA AND HOMOPTERA

True bugs amounted to only 1.72 percent of the total adult diet. These insects, largely homopterans, were present in stomachs in each of the 8 months. Only in the 5 hottest months, however, did they average more than 1 percent of the total food. Bugs of either or both orders were found in 69 stomachs and were identified as heteropterans in 36 and as homopterans in 53. With these insects occurring in more than half the stomachs and totaling only 1.72 percent, it is

evident that they were usually taken in small numbers. The stinkbugs (Pentatomidae, mainly *Neottiglossa undata* and *Euschistus* sp.), the shield-backed stinkbugs (Scutelleridae, mainly *Eurygaster* sp.), and the corizid bugs (Coreidae, mainly *Corizus* sp.) made up the larger part of the Heteroptera. Negro bugs (Cydnidae), plant bugs (Lygaeidae, mainly *Nysius* sp.), and leaf bugs (Miridae) also were found in a number of stomachs. Aphids had been eaten by 29 birds and made up the major item of Homoptera. One September stomach revealed more than 600 of these plant lice, which amounted to 31 percent of the contents. Spittle bugs (Cercopidae) and leaf hoppers (Cicadellidae) were occasionally taken in small numbers.

COLEOPTERA

It was somewhat surprising to find a ground-feeding bird taking so few beetles—this order of insects amounting to only 1.24 percent in the total adult diet. Only during May, June, and August, when the birds consumed 3.64, 3.83, and 1.17 percent, respectively, of these forms, did Coleoptera comprise more than 1 percent of the food. These occurred in slightly more than half the adult stomachs and were divided among many families representing many species. A fair number of the coleopterans taken were larval forms that breed in manure piles and garbage heaps. Adult dung beetles (Scarabaeidae), weevils (Curculionidae), and ground beetles (Carabidae) were most frequently taken. Smaller numbers of click beetles (Elateridae), rove beetles (Staphylinidae), leaf beetles (Chrysomelidae), Histeridae, and water scavengers (Hydrophilidae) were also fairly common.

In its relatively slight consumption of beetles the crested myna stands in marked contrast to its cousin of eastern North America, the European starling, which makes nearly a fifth of its total diet of beetles.

ORTHOPTERA AND OTHER INSECTS

As no other order of insects formed as much as 1 percent of the adult myna's food, the economic problems involved in their consumption are trivial. From this study it appears that the absence of any appreciable number of certain insect orders represents the unavailability of these orders in any great numbers. Further evidence of this is the fact that orthopterous insects, mainly short-horned grasshoppers (Acrididae), and pygmy locusts (Tettigoniidae) amounted to less than 0.5 percent of the food, yet in October these insects made up more than 3 percent of the contents of 25 stomachs. Grasshoppers were found in the stomachs of 13 adults; in one well-filled stomach in October they formed 62 percent of the contents, and in another, 15 percent. During May, caddis flies (Trichoptera) and May flies (Ephemeridae) amounted to 7.18 percent of the month's food, yet in succeeding months no trace of them was noted.

ARACHNIDS

Spiders and harvestmen apparently were captured whenever encountered, as they were taken in limited numbers each month and formed 2.82 percent of the total food of the adults and 2.8 percent of that of the juveniles. This adult arachnid food was made up of 1.65 percent of spiders and 1.16 percent of harvestmen. The former occurred in 53 percent and the latter in 29.9 percent of the adult

stomachs. The harvestmen were nearly all Phalangiidae, while the many species of spiders represented several families, of which the wolf spiders (Lycosidae) and the jumping spiders (Attidae) were most frequently encountered. One September bird had taken 20 spiders and 3 harvestmen, while an October bird had secured 15 wolf spiders, 1 undetermined spider, and 7 harvestmen. During the 6 months June to November, these arachnids had been eaten to the extent of from 2.5 to nearly 5 percent of the monthly food. The wolf spiders are generally considered less distinctly beneficial than most of the others taken. Most of these forms, however, live largely on flying insect pests caught in their silken webs. Mites occurred in 8 of the October stomachs, and as many as 71 were taken by one bird.

Earthworms

Earthworms (Lumbricidae) appeared to be extremely variable as an article of food for the crested myna. This variableness would probably have been less apparent had a larger series of stomachs been available. They averaged 4.08 percent in the food of the 117 adult birds, varying from 22.18 percent in August to 0.25 percent in November, and with no trace in July and September. Contents of May, June, October, and December stomachs consisted of 6, 1.16, 1.04, and 2 percent, respectively, of earthworms. In August, 10 of the 23 birds had feasted on these worms, 5 birds making them more than three-fourths of their meals. Of the 117 adult birds, 25 had fed on earthworms.

Miscellaneous Animal Food

Terrestrial isopods or sowbugs (Oniscidae, mainly *Porcellio* sp.) were conspicuous items in a number of stomachs, occurring in approximately 12 percent of the total, but only in May, June, and October did they form more than 1 percent of the food. In 31 June stomachs sowbugs averaged 2.35 percent of the contents; 3 of the stomachs, however, showed 15 to 30 percent.

Other miscellaneous items of animal matter, aggregating less than 1 percent of the total food of adults, consisted of millepedes, in 6 stomachs; centipedes (mainly Geophilidae), 5 stomachs; mollusks (mainly bivalves), 2 stomachs; mites, 11 stomachs; hair, 7 stomachs; carrion, 1 stomach, and fish and other bone fragments (probably garbage), 2 stomachs each. Kelly (*17, p. 14*) found that eggs of other birds occasionally form a part of the myna's diet. Munro (letter, 1932) reports finding fragments of a bird's egg in a stomach collected in May.

VEGETABLE FOOD

Fruit

A complaint already directed at the myna and one that in future bids fair to be heard much more, if this species becomes established in the horticultural areas of the Pacific Coast States, is that it is destructive to fruits. The 117 adult stomachs examined over the 8-month period (May to December) showed that approximately one-third (32.49 percent) of all food consumed was gleaned from this source. The major portion of this consisted of wild fruits and berries or of unharvested cultivated crops, though doubtless some of the fruit taken was garbage. Regardless of the source or the economic status of fruits in this limited series of stomachs, the bird's propensities along

this line are shown, and in the case of a species so gregarious, its capacity for harm is indeed great. Though it is not yet known whether the bird will feed upon cultivated fruits as eagerly as upon wild varieties, there seems no reason to doubt that it will. This economic argument against the bird is further strengthened when it is realized that leafy vegetable material—cabbage, lettuce, weeds, etc.—made up 8.57 percent of the food. If such an omnivorous feeder should become unduly abundant in an extensive farming area, as its near relative the European starling (*Sturnus vulgaris*) has in much of the eastern United States, agriculture would suffer.

The percentage of fruit consumption during the 8 months (table 1) shows considerable variation, partly no doubt because of local conditions and the limited number of stomachs available for examination. Some fruit, wild or cultivated, was taken each month. It was found in nearly three-fourths (86) of the adult stomachs, and occurred in every stomach collected during June, July, and August. The percentages for the various months are as follows: May, 1.36; June, 65.24; July, 61.37; August, 53.22; September, 13.36; October, 22.12; November, 3.25; December, 40. The fruits taken, in the order of their percentage bulk, and the number of occurrences are: Elderberry (*Sambucus* sp.) 6.59 percent, in 25 stomachs; cascara (*Rhamnus* sp.) 5.73, in 7 stomachs; dogwood (*Cornus* sp.) 4.66, in 14 stomachs; wild cherries (*Prunus* sp.) 2.79, in 7 stomachs; berries (*Rubus* sp.) 2.45, in 11 stomachs; apple and pear (*Pyrus* sp.) 1.45, in 9 stomachs; blueberries (*Vaccinium* sp.) 1.27, in 8 stomachs; miscellaneous and unidentified fruits 8.03 percent, in 36 stomachs. The miscellaneous fruits consisted mainly of mountain ash (*Sorbus* sp.), crowberry (*Empetrum nigrum*), sumach (*Rhus* sp.), nightshade, or tomato (Solanaceae), and snowberry (*Symphoricarpos* sp.). Fruits amounted to 100 percent in 4 stomachs; 90 to 100 percent in 11; 70 to 90 percent in 16; 50 to 70 percent in 15; and 25 to 50 percent in 20. These figures show that when fruit is found it is usually taken in considerable quantity.

Munro (*23, pp. 15–16*) reported "alarming damage to strawberries and other small fruits" by the myna in the Vancouver district during the summer of 1920. The same writer in 1922 refers (*24*) to reports of fruit damage in the rural districts near Vancouver. In a letter in which he gives the results of stomach examinations of 24 birds taken from March to June, Munro reports pulp and seeds of raspberry in 2 stomachs, undetermined berries in 1, salmonberries in 2, and apple pulp in 2. Fruit formed a conspicuous item in each case. Cumming (*6, p. 189*) reported fruit found in 14 of 86 stomachs examined by Bryant. From his own examination, Cumming (*6*) regarded the bird as a detriment to agriculture. Scheffer (*31, p. 84*) found the mynas feeding largely on cascara fruits (*Rhamnus* sp.) in August. Wood (*35, p. 133*) wrote that in the Vancouver district the birds "when possible * * * eat loganberries, raspberries, pears, and cherries, especially the last." He further reported that as early as 1911 Brooks "watched a tree being stripped of its crop of cherries, a stream of mynas coming and going to and from their nests, carrying the fruit to their young." Phillips (*26, p. 55*) stated that "they have begun to destroy a good deal of fruit, especially cherries, blackberries, and apples." Henderson (*13, p. 232*) has made further reference to this habit.

Leafy Vegetables

Complaints also have been directed against the myna for its depredations on truck-garden crops. Caldwell and Caldwell in their book on South China Birds (*3, p. 12*) state that—

> Great numbers of Mynas may be seen following the furrow when a field is being plowed for spring planting. The food during much of the year consists of worms, slugs, insects and small fruits, though at times a flock of Mynas will alight upon the growing garden of the truck raiser, doing great damage to young leaves.

In the present study, leafy vegetable material, including cabbage and lettuce, as well as uncultivated leafy fragments, amounted to 8.57 percent of the total food. Approximately half of this was regarded as of cultivated origin, though accurate separation could not always be made, as some leafy substance was probably also taken as garbage. Some of this material was obtained during each of the 8 months, but most of it was consumed in spring and fall. May, September, October, and November stomachs contained 15.45, 9.27, 16.2, and 20.75 percent, respectively, leafy vegetable material, while July showed only 0.12 percent and August only 1.47 percent. This leafy material occurred in approximately half the adult stomachs, and varied from a trace to three-fourths of the food, constituting more than half the meals of 6 birds. Nineteen October birds had ingested leafy vegetation, and 1 had swallowed a piece of green cabbage leaf 5½ by 2½ inches in size. Next to cabbage and lettuce, fragments of the heads of composite plants (Asteraceae) and grass were most commonly noted. The same type of material was noted by Munro also, as he found dandelion heads in 2 of 4 March stomachs and leafy fragments in 2 collected in June. According to Cumming (*6, p. 189*), Bryant found that 20 of the 86 birds he studied had eaten grass and leaves. In the present study, grass amounted to less than 1 percent of the total food. Wood (*35, p. 134*) reports that 5 of 8 stomachs collected for him at Vancouver in March and examined by Bryant contained green plant food.

Grain

Various grains in the food of the myna comprised 2.54 percent of the total. Though most of it was waste material, probably picked up as undigested grain from horse droppings or gleaned from stubble, it is probable that part was a toll exacted from poultry raisers. Munro (*23, pp. 15–16*) writes that in winter the mynas "feed largely on horse droppings, but they are also unwelcome pensioners on city poultry raisers, visiting the runs daily at feeding time." In his examination of 24 stomachs, he found grain (mainly oats) in 9. Bryant, as reported by Wood (*35, p. 134*), and Cumming (*6, p. 189*) likewise found that more than one-third of the stomachs examined contained grain. Menzies in a letter to Mrs. Bready (*1, p. 38*) showed that grain was found in 38 of 86 stomachs. This was probably the same series that Dr. Bryant examined.

In the present study grain was found in 23 of the 117 stomachs of adults, or in about 1 of 5. This consisted mainly of oats, wheat, rye, and barley. In only two cases did grain amount to more than 50 percent of the meal. The lower proportion of grain in the food as found in the present investigation, in contrast to findings by earlier workers,

may possibly be explained by the decrease in the number of horses in and near the city of Vancouver. It is noted that no grain was taken in July and August and only a trace in June. Percentages for the remaining months are as follows: May, 6.18; September, 5; October, 0.96; November, 6.75; and December, 1.25.

Miscellaneous Vegetable Food

Weed seeds were present in an insignificantly small quantity and in only 1 month (August) did they constitute as much as 1 percent of the food. Seeds were found in about a fifth of the stomachs and represented a variety of the common weeds of the region. The quantity taken, however, was too small to have appreciable economic significance.

Unidentifiable vegetable debris and manure constituted 11.21 percent of the total food of the crested myna. This consisted of slaughterhouse debris or finely ground silage in a number of cases. Part may have been well-digested leafy fragments or ground heads of composite plants. Small bits of unidentifiable vegetable matter were noted in more than half the stomachs examined, while in only 5 did it equal a fourth of the contents. Manure made up 87 percent of the contents of 1 December stomach, and a third to a half of the contents of 3 stomachs taken in November. The average percentage for manure and vegetable debris is probably unduly high because of the small number of stomachs for the 2 months. It does not seem likely that a larger series of stomachs would consistently give the same result.

FOOD OF JUVENILES

Of the 20 stomachs available for a study of the food of young crested mynas, 8 were taken in May, and 1 on June 1. These 9 represented birds 3 to 14 days old, apparently all nestlings. Ten were taken in July and one on the last of June, when the young were foraging for themselves. In considering the food percentages of the 20, the two groups are classed as May nestlings (9) and July juveniles (11).

From the economic standpoint, the food of nestlings of passerine birds is nearly always more favorable than that of the adults, largely because of their very much greater consumption of insect food. During the first week or so of their lives, nestling birds consume enormous quantities of food, the mass of which in some cases each day may equal the weight of the bird. Since the nestlings frequently outnumber the parents 2 to 1, it is important to know their food tendencies.

ANIMAL FOOD

As will be seen from table 2, the food of the nestling mynas stands in marked contrast with that of the young 2 months later and also with that of the adults of the same month—May. The nestlings are predominantly protein feeders, and approximately three-fourths (74.22 percent) of their food was animal matter, and more than half of it (53.67 percent) insects. In contrast with this, the July juveniles had drawn upon the animal kingdom to the extent of only slightly more than one-fourth (27.73 percent) of the month's food, though most of this (26.09 percent) was insects. Adults collected during May had taken 39.64 percent animal matter, and less than half of this (18.18 percent) was insects.

Insects

The insects taken were undoubtedly those most available and readily obtainable. During May, the large carpenter ants (*Camponotus* sp.) must have been very abundant, as these, with a few other Formicidae, made up a third (33 percent) of the nestlings' food, and in one stomach they amounted to as much as 87 percent. The abruptness of change of diet following the nestling period is evidenced by the fact that the stomach of only one of the July birds showed even a trace of ant food. Other hymenopterous insects made up 1 percent of the nestlings' food and 7.73 percent of that of the July juveniles. Five of the eleven July birds had eaten hymenopterous food, and one had taken 11 ichneumon wasps, which amounted to 74 percent of its meal.

The second item of importance in the insect diet of nestlings consisted of earwigs (*Forficula auricularia*). This destructive importation from Europe occurred in 3 of 9 well-filled stomachs, each containing 5 to 18 individuals, the percentages of the total food being 15, 19, and 20, respectively. Only 1 of the adult birds during the same period had feasted on these insects. Earwigs formed no part of the July food.

Coleopterous foods (beetles) formed 5.11 percent of the contents of nestling stomachs, as against 3.64 percent in the May adults, and only a trace in the case of the July juveniles and adults. Beetles were fed each nestling and ranged from 1 to 13 percent of the meals. As in the adult food, the beetles represented a wide range of species, with a slight preponderance of ground beetles (Carabidae), which are largely predacious in their feeding habits.

Lepidopterous material constituted the major insect item in the July juveniles, forming slightly less than half the bulk of insects consumed. Caterpillars are especially useful in the food of very young birds. These larvae, together with adult moths and their pupae, were found in the stomachs of 5 of the 9 nestlings and 4 of the 11 juveniles, and amounted to 3 and 12.82 percent, respectively, of the average monthly food for the two groups. Four larvae were fed to 1 nestling, while fragments of adult moths formed 96 and 25 percent, respectively, of the food of 2 July birds. These moths and their developing young were largely cutworms (Noctuidae).

While the nestling myna's consumption of flies was nearly double that of the adults taken during the same month, this season is too early to permit a heavy or uniform consumption of these insects. Consequently, flies were taken in May by only 4 juveniles and 5 adults, and amounted to 2.67 percent and 1.64 percent, respectively, of the food. The July juveniles had made house-fly larvae 4.73 percent of their food. In 1 stomach 22 larvae, 15 pupae, and 12 emerging adults formed 38 percent of the contents.

Practically the same species of bugs (Heteroptera) were fed the young as were found in the stomachs of the adults, except that the stinkbugs (Pentatomidae) and shield bugs (Scutelleridae) were given in greater numbers. Eight of these were found in 1 stomach. These odoriferous creatures with a few other heteropterans amounted to 2 percent of the nestling diet.

Other Animal Food

Spiders were found in 7 of the 9 nestling stomachs and amounted to 5.33 percent of the total food, while in adult birds taken in May they amounted to considerably less than 1 percent. No fewer than 20 wolf spiders, 1 spider not determined, and fragments of about 10 more (Lycosidae) were found in 1 stomach. Only 3 of the July juveniles had fed on arachnids.

Sowbugs (Oniscidae) constituted 3.78 percent of the nestling and 1.55 percent of the May adult food, and earthworms 3.67 and 6 percent, respectively. July stomachs of juveniles and adults contained but a trace of these creatures. Among unusual miscellaneous items fed to the nestlings were a small stickleback (*Gasterosteus* sp.), the common mussel (*Mytilus edulis*) (in 2 stomachs), and pieces of sessile barnacle (Balanidae).

VEGETABLE FOOD

The adult birds collected in May had made 43.19 percent of their meals on garbage, while the nestlings of this same month had been fed this item to the extent of only 10.44 percent. As with the adults, this consisted mainly of table scraps and waste material, with little discrimination in selection. One 14-day-old bird had even been fed a 3-inch rubber band! Neither adults nor juvenile birds collected in July had consumed much garbage, the former showing 3.37 percent and the latter 1.64 percent. This change of food was undoubtedly brought about during this month through the availability of large quantities of fruits, on which all but one bird had feasted.

Fruit

Though the nestling period is too early in the season for the consumption of fruit in any appreciable quantity, the single nestling taken in early June had been fed 83 seeds and fruit pulp of berries (*Rubus* sp.), these forming 27 percent of its meal. Three other juveniles taken late in May had 1 to 3 grape seeds each in their stomachs. It is quite probable that both of these fruits were picked up at a garbage pile; however, it is not impossible that the grape seeds represented overwinter unharvested fruit. Three young about ready to leave the nest had been fed fruits of honeysuckle (*Lonicera* sp.), one stomach containing no fewer than 50 seeds and considerable fruit pulp. Of the total nestling food, 11 percent was fruit pulp while in the adults this formed only 1.36 percent in May, and consisted entirely of apple taken by only one bird.

The frugivorousness of the species is well shown by a study of the July juveniles. Of the 11 birds, 9 had feasted on several species of wild fruits, 6 having made fruit more than 90 percent of their diet, and the other 3 had taken fruits to the extent of 45, 60, and 87 percent, respectively. The principal fruits taken were wild cherry (*Prunus* sp.), which amounted to 46.09 percent of the total; elderberry (*Sambucus* sp.), 8.91 percent; dogwood (*Cornus* sp.), 7.91 percent; and miscellaneous fruit, 0.91 percent. The stomach of 1 juvenile was gorged with 29 cherries, 4 fly larvae (*Muscina* sp.), fragments of 1 earthworm (Lumbricidae), plant fiber, and garbage debris (pl. 3, *B*).

Of the entire number of mynas eating fruits, the juveniles, when they begin foraging for themselves, show the highest individual percentages. The force of this would probably be realized if a large flock of these hungry young were to light in a cherry orchard. At this stage of development the fact that the young of many birds are exceedingly difficult to frighten away, makes protection still more laborious.

Miscellaneous Vegetable Food

Grain amounted to 5.91 percent of the July juveniles' food but there was merely a trace of it in the food of the nestlings. On the other hand, in these two groups, leafy vegetable material was found only in stomachs of the nestlings, where it amounted to 4.33 percent. Miscellaneous undetermined vegetable debris and manure made up 6 percent of the food of the nestlings and 1.82 percent of that of the July young (table 2 and fig. 1, *A* and *B*).

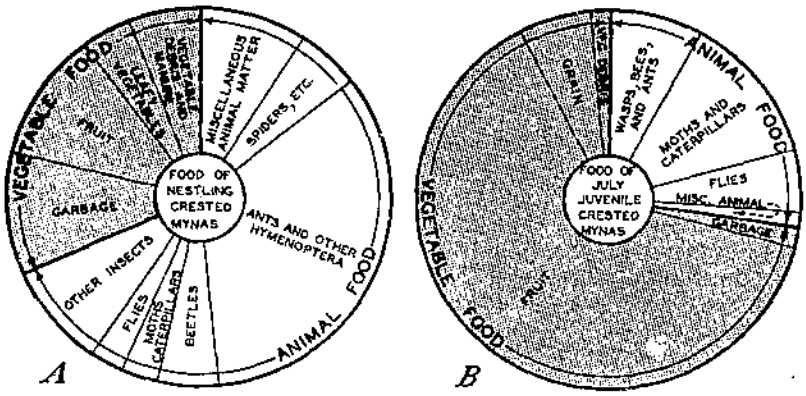


FIGURE 1.—Comparison of food of (*A*) nestling crested mynas and (*B*) July juvenile crested mynas, showing the relative proportions of the various items by bulk.

TABLE 2.—*Percentages of the various items in the food of the juvenile crested myna, based on the examination of 20 stomachs, together with comparable data on the food of the 10 adult mynas for the same period—May and July* [1]

FOOD OF JUVENILE BIRDS

Month	Stomachs	Animal food	Vegetable food	Flies (house and others)	Wasps, bees, and ants	Moths and caterpillars	Bugs	Beetles	Earwigs	Miscellaneous insects
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
May	9	74.22	25.78	2.07	31.00	3.00	2.11	5.11	6.00	0.78
July	11	27.73	72.27	5.18	7.73	12.82	.00	.09	.00	.18
Average	--------	50.98	49.03	3.93	20.87	7.91	1.10	2.60	3.00	.48

FOOD OF ADULTS

May	11	39.64	60.36	1.64	2.72	0.82	1.18	3.64	0.27	7.91
July	8	36.87	63.13	2.38	5.75	19.00	2.00	(2)	.00	.25
Average	------	38.25	61.75	2.01	4.24	9.91	1.59	1.82	.14	4.08

[1] See also fig. 1.

[2] Trace.

TABLE 2.—*Percentages of the various items in the food of the juvenile crested myna, based on the examination of 20 stomachs, together with comparable data on the food of the 19 adult mynas for the same period—May and July*—Continued

Month	Spiders and harvestmen	Earthworms	Miscellaneous animal food	Garbage	Wild fruits	Cultivated fruits [2]	Leafy vegetables, flower heads, etc.	Grain	Vegetable debris [3] and manure	Average items per stomach
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Number*
FOOD OF JUVENILE BIRDS										
May	5.33	3.67	5.50	10.44	7.11	3.80	4.83	(4)	6.00	15.00
July	.27	(4)	.45	1.64	63.82	.00	.00	5.91	1.82	6.10
Average	2.80	1.84	3.01	6.04	35.47	1.95	2.17	2.96	3.91	10.55
FOOD OF ADULTS										
May	1.09	6.00	1.64	43.19	0.00	1.38	15.45	6.18	6.91	10.82
July	4.88	.00	.00	3.37	61.37	.00	.12	.00	.88	4.89
Average	2.99	3.00	.82	23.28	30.69	.68	7.79	3.09	3.90	7.86

[2] Part listed as cultivated may have been wild or unharvested.
[3] Includes 0.35 percent of weed seeds.
[4] Trace.

VARIETY OF ITEMS IN THE FOOD

The omnivorousness of the crested myna is shown by the large variety of food items taken as well as by the number of items found in the stomachs of individual birds. The number of items found in the stomachs varied from 1 to 39; the average number per bird per month varied from 4.89 in July, when the food consisted largely of fruit, to 20.5 in November, and for the 8-month period the average was 11.5 separate items. The average number of items in juvenile stomachs was 6.1 in July and 15 in May.

Birds that consume hard foods rely upon gravel to help grind it. Of the 137 crested-myna stomachs examined, 73 showed from a mere trace of gravel to as much as 6 percent. This is not classed as food, but is figured as a percentage of the total stomach content. Undoubtedly much of it was taken accidentally. In adult birds, the monthly averages varied from a mere trace in September to 1.82 percent in May and for the 8-month period averaged 0.56 percent per bird. The juveniles showed a slightly higher percentage of this abrasive material, namely 3.44 in May and 0.64 in July.

Probably all species of birds swallow feathers either purposely or accidentally during the process of preening. Feather fragments were found in 47 of the 117 adult myna stomachs and in 6 of the 20 juveniles. Usually there was only a slight trace of feathers in the stomachs examined.

FOOD OF CHINESE AND EUROPEAN STARLINGS COMPARED

The present limited study of food habits of the crested myna indicates that the species has much in common with its near relative the European starling (*Sturnus vulgaris*), which has become so abundant in much of eastern North America, though the proportions of the component food items differ. The reports of Kalmbach and

Gabrielson (*16*) and of Kalmbach (*15*) show that about half the yearly food of the European starling is drawn from the animal kingdom. In the present comparison, only those starling stomachs collected during the same 8 months (May to December) that the mynas were collected are considered. The percentages of the various contents are shown in table 3 and the proportions are shown graphically in figure 2, *A* and *B*.

The food of the introduced European starling from May to December averaged 62.29 percent animal and 37.71 percent vegetable, while almost the reverse was the case in the myna—38.89 percent was animal and 61.11 percent vegetable. Both birds appear to be highly omnivorous and both consume a great variety of food, but the myna seems to show somewhat greater extremes in this regard. It is not nearly so insectivorous, less than one fourth of its total food being of insect origin, while nearly half of the starling's food for the same period consisted of insects. Weevils, ground beetles, May beetles, and miscellaneous beetles made up more than a fifth (20.24 percent) of the

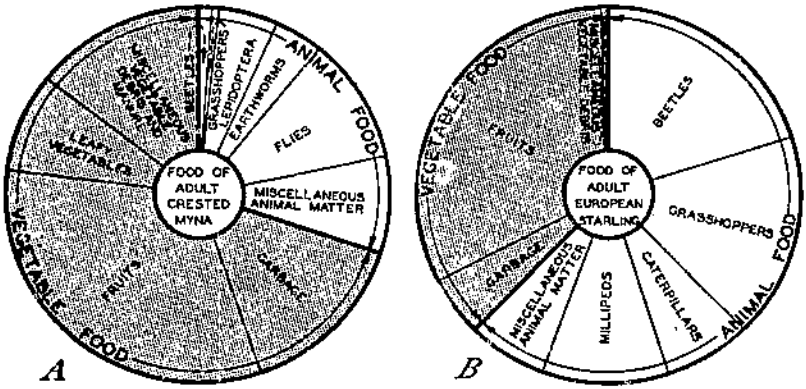


FIGURE 2.—Comparison of May to December food of (*A*) adult crested myna and (*B*) adult European starling, showing the relative proportions of the various items by bulk. Information in percentage figures shown in table 3.

starling's food during the 8 months, while these insects averaged only 1.24 percent in the case of the myna. Grasshoppers were taken to the extent of 17.54 percent by the starling but to only 0.45 percent by the Vancouver birds. Caterpillars made up 7.09 percent of the starling food, while lepidopterous adults, larvae, and pupae in nearly equal proportions formed 4.99 percent of the adult myna's food. Flies and hymenopterans (wasps, bees, ants, etc.) were very minor items in the starling diet, yet they amounted to 11.04 percent and 1.85 percent, respectively, in the west-coast birds. Millepedes reached the surprising total of 10.59 percent of the starling diet, but formed only a mere trace of the myna's. Garbage was nearly three times as important as an item of myna food as it was with its relative in the East. Perhaps availability may account for most of these differences. Both species appear to be about equally frugivorous, though the myna shows a high percentage of fruit consumption during the summer months, but less in fall. A noticeable and probably an important difference in the food of the two birds is noted in the quantity of leafy vegetable material taken. Apparently this is a minor item with the starling, while it averages 8.57 percent of the crested myna's food.

In the main, it appears that from the economic relation these two species of birds bear to agriculture, the crested myna possesses fewer redeeming qualities and has more obnoxious traits than does the European starling. In the opinion of the authors it would be false economy not to take the necessary steps to hold this species in check and prevent its entrance and establishment in the Pacific Coast States.

TABLE 3.—*Food percentages of the crested myna* (Aethiopsar cristatellus) *and the European starling* (*Sturnus vulgaris*) *in North America during the 8 months, May to December*[1]

Kind of food	Myna	Starling	Kind of food	Myna	Starling
	Percent	*Percent*		*Percent*	*Percent*
Animal	38.89	62.29	Earthworms	4.08	(2)
Vegetable	61.11	37.71	Miscellaneous animal food	8.44	6.56
Grasshoppers, etc.	.45	17.54	Garbage	14.60	5.04
Ground beetles	.25	7.33	Fruits	32.49	32.74
Other beetles	.99	12.91	Leafy vegetables	8.57	(2)
Moths and caterpillars	4.90	7.09	Grain	2.54	.20
Flies and hymenopterans	11.04	1.85	Miscellaneous vegetable debris and manure	11.56	.60
Millepedes	(2)	10.59			

[1] See also fig. 2. [2] Trace.

SUMMARY

The crested myna, or Chinese starling, was introduced into British Columbia about 1897 by persons unknown, possibly by an oriental resident of the Vancouver district. The first specimens taken by a naturalist were collected in 1904. The increase of the bird in its new home was slow, peak numbers having been reached about 1925 to 1927, and there appears to have been no increase during the next few years. Apparently only one brood a year is raised in the Vancouver district.

Climatic conditions do not appear to favor the crested myna in British Columbia, as regards either increase in abundance or extension of range. Its further dispersal to the north seems barred by high mountains and forested interior; to the west and south are ocean straits; hence any further spread would apparently have to be to the east or southeast.

The crested myna is a bird about the size of the robin, but its tail is shorter. Its general color is black, with white wing patches conspicuous in flight. A short crest, or tuft of feathers inclining forward over the beak, gives it its specific name. Its calls and singing cadences are clear whistling notes, usually of a pleasing musical quality.

The bird places its nests in tree holes from which it may have evicted other birds and in nearly enclosed cavities about the eaves and cornices of buildings. The nests are roughly constructed of any trashy material available. The Chinese bird is most aggressive toward native species when it wishes to use their nesting sites. It will then throw out their eggs and young. About human habitations it is less confiding than the English sparrow, and it is much more restricted and less adaptable than the latter in its choice of nesting sites.

Of clannish habits, after the nesting season the birds keep together in family parties until colder weather, when they flock in large numbers for feeding and roosting. One roost in the city of Vancouver recently numbered 500 to 600 birds, but formerly it was reported to have been larger.

In the laboratory study of the food habits of the crested myna, which was undertaken after the field studies of 1931–32, 117 adult and 20 juvenile stomachs were examined. These were collected over the 8-month period from May to December. Stomach analyses and field observations show that the bird is decidedly omnivorous, with a partiality for fruits and for foods from such unsavory sources as garbage dumps and manure piles. Availability seems to be the chief factor in its choice of food. The average monthly diet of adults was 38.89 percent animal and 61.11 percent vegetable matter, with fruits of various species aggregating 32.49 percent, insects 22.44 percent, garbage 14.6 percent, and leafy vegetable material 8.57 percent. The nestlings are predominantly insectivorous. During the latter part of summer self-feeding juveniles and adults are highly frugivorous.

The potentiality for harm of such a gregarious and omnivorous feeder is high. Should the species become unduly abundant in the Pacific Coast States, agricultural interests there might be seriously affected. Consequently, every precaution should be taken to check the spread of this species and to prevent its establishment in the United States.

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