KARYOTYPES AND DEVELOPMENTAL STAGES OF
HARPYRHYNCHUS NOVOPLUMARIS SP. N.
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KARYOTYPES AND DEVELOPMENTAL STAGES OF HARPYRHYNCHUS NOVOPLUMARIS SP. N. (ACARI: CHEYLETOIDEA; HARPYRHYNCHIDAE), A PARASITE OF NORTH AMERICAN BIRDS

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ABSTRACT: Descriptions are given of karyotypes, developmental instars, and host associations of the cheyletid mite Harpyrhynchus novooplumaris sp. n. The karyotypes strongly suggest the haplo-diploid method of sex determination, with \( n = 2 \). There is a strong possibility that the species is automictous. The developmental stages for both sexes of the mite consist of egg, larva, protonymph, deutonymph, and adult; all stages subsequent to the egg exhibit sexual dimorphism and are easily distinguishable from each other. Adult females and male deutonymphs are relatively immobile and occur at the bases of feathers, in the region of the head, neck, and breast; the other stages move freely over the skin of the host. Oviposition occurs at the base of a feather, the eggs being laid serially and enclosed in a semilustrous sheath that envelopes the female as well. A brown creeper examined thoroughly for degree of infestation had 85 attached female mites; the maximum number of eggs per female was 48. Lack of success in collecting ovipositing females at season other than the spring suggests that the parasite’s reproductive season is correlated with that of its hosts. On two separate occasions both \( H. \) novooplumaris and \( H. \) brevis were collected from the same host specimens. \( H. \) novooplumaris has to date been taken from the type host (the brown creeper, Certhia familiaris), and from six additional host species, representing four families of passeriforms. The mite occurs across North America, from Maryland to California.

The cosmopolitan mite family Harpyrhynchidae includes the two genera Harpyrhynchus Dubinin and Harpyrhynchus Mégnin, containing about twenty dozen described species of avian parasites. The most recent general references to the family are those of Fritsch (1954), Dubinin (1957), and Lawrence (1959a, b, c). Most harpyrhynchids appear to be host-specific, but some (e.g., Harpyrhynchus vidulans [Nitzsch], \( H. \) brevis Evings, H. plumatus Fritsch, and the new species herein described) are found on a variety of hosts. This paper represents a first step toward a monographic revision of the world fauna of the family, providing a description of karyotypes, developmental stages, and some aspects of the biology of a harpyrhynchid, Harpyrhynchus novooplumaris sp. n.

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MATERIALS AND METHODS

Birds were collected with a .22 caliber rifle using dust shot, or a .410 gauge shotgun using various shell sizes, placed individually in polyethylene bags, and kept overnight in a refrigerator at 5 to 7 C. The following morning the birds were removed from the bags and examined under a dissecting microscope for the presence of ectoparasites. When a bird was found to harbor Harpyrhynchus, the area and intensity of infestation were noted. The intensity of infestation per host of attached females was categorized as light (1 to 10), medium (11 to 50), or heavy (\( \geq 51 \)); in one case a complete count of females was obtained. Feathers bearing attached females with associated eggs and embryos were removed from the host and placed in a petri dish with moist filter paper. Embryos of appropriate age were then dissected for chromosome study. Chromosomal preparations were made on differently aged embryos via the squashes and aceto-orcein stain (Oliver, 1965). Embryos of yellow-orange color were generally too far advanced for useful chromosome analysis, but white, opaque eggs containing young, relatively undifferentiated embryos gave adequate preparations. Chromosome data are based on hundreds of cells from many embryos.

Numerous postembryonic specimens were preserved in 70% ethyl alcohol for subsequent mounting and determination.

Each positive host was also examined thoroughly for cysts and immature harpyrhynchid developmental stages, and then washed with detergent. Washings were strained through a Buchner funnel and the mites collected were preserved in 70%
alcohol, cleared in Neshit's solution, and mounted in Hoyer's medium. Examinations were made by means of phase contrast microscopy.

Measurements of chromosomes and mitoses were obtained with a Utrac microtome eyepiece. Pictures of chromosomes were taken with Kodak Verichrome film (VP402); illustrations of development stages were prepared with the aid of a microprojector.

Nomenclature of avian hosts follows Wetmore, 1961.

DESCRIPTS

Karyotypes

All cells examined with either two or four chromosomes per cell, but only one ploidy level per embryo (Figs. 1, 2, respectively). Chromosome length variable, depending on stage of mitosis; typical propshists chromosome 3.0 to 6.5 μ, metacphones chromosome 2.2 to 3.6 μ. One pair (or one chromosome in the haploid cells) approximately 0.5 μ shorter than the other.

No consistent morphological features were found on the chromosomes to enable us to distinguish the chromosomes of this species from those of other known harpgryynchids (Oliver and Nelson, 1967). No primary or secondary constrictions were seen, and thus it appears likely that the chromosomes are either euchromatic or holocentric.

Eggs

About 200 μ in diameter, surface smooth, white when first laid, later becoming yellowish. Laid in compact strings, two eggs wide, in manner illustrated by Frisch (1954) for H. planaris Frisch.

Female

Larva: Setal terminology either new or that of Dubinin (1957); setae given where appropriate.

Gnathosoma dorsally (Figs. 3, 19) with sub-rectangular basal region bearing pedipalp supracoxal seta anterolaterally on each side, as well as pair of movable, mediolaterally flanged, enlarged palpal segments. Peritreme of this and succeeding stages prominent, chambered, situated near dorsal junction of gnathosoma and idiosoma.

Gnathosoma ventrally (Figs. 4, 31) with basal area bearing faint median line and pair of hypostomal setae (h₁); palpars with two free, sclerotized segments and membranous terminal segment; pair of pharyngeal, membranous pharyngeal sheaths (c₁) enclosing pharyngeal styles, extending almost to tips of free palpal segments; palpal spur (sp₁), arising from penultimate palpal segment, well-sclerotized, two-pronged, and curved laterally; pair of palpistyle setae (k₁ and k₂) situated respectively on terminal and penultimate sclerotized palpal segment. Position of pharynx (ph₁) shown by dotted lines.

Palps dorsally (Fig. 19) with two modified palpal setae; more anterior (p₁) stout, somewhat flattened, bearing row of lateral, limb-like teeth; the more posterior (p₂) prominent, whilplike and slightly biciliate, extending at least as far as posterior margin of gnathosoma.

Idiosoma dorsally (Fig. 3) subcircular in outline, with prominently striated integument, surrounding weakly sclerotized, roughly pectinate dorsal shield, slightly concave anteriorly and slightly convex posteriorly. Dorsal idiosomal setae p₁, p₂, p₃, and p₄ (terminology of Dubinin, 1957: 77) subcircular in length and pectinate.

Idiosoma ventrally (Fig. 4) with two pairs of ventral setae, e₁ and e₂, located respectively at base of leg I and just anterior of median unscerotized, unstriated area. Three pairs of legs: legs I and II with five obvious segments (most basal partially fused with body) plus terminal segment (pretarsus) composed of claw and bristle, pectinate coxodendron. Leg III reduced to two-segmented strob (or with only one obvious segment, basal segment being completely fused with idiosoma), and bearing four apical, whilplike setae, one almost half as thick as other three of these latter, the most posterior somewhat thicker than others, and approximately as long as idiosoma one pair of subterminal, posterior idiosomal setae (k, Dubinin, 1957) present, in contrast to condition in male larva (Fig. 12) where two pairs of posterior idiosomal setae are present. Fereak opening (pr₁), often difficult to observe, present dorsolaterally or laterally, posterior of leg II.

Figure 3-6. Harpgryynchus nesopulmans, female larva and protonymph. 3, 4. Larva, dorsal and ventral view. 5, 6. Protonymph, dorsal and ventral view. Abbreviations (Figs. 3-18): h₁, first hypostomal seta; IV, leg IV; k, posterior idiosomal setae; p₁, p₂, p₃, and p₄, dorsal and lateral idiosomal setae; pr₁, idiosomal pore; e₁, ventral idiosomal setae. Scale line represents 100 μ in this and all succeeding illustrations.
TABLE I. Harpyphyllus nosophilus sp. n.
Measurements of developmental stages.

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1 ± = Standard error of the mean; C.V. = Coefficient of variability. Character measurements (in inches) are coded as follows: A = Greatest width of gasterion; B = Greatest width of obusaeum; C = Length of idiosoma; F = Level of pedicel to posterior margin; D = Greatest width of dorsal shield; E = Greatest length of dorsal shield. Large standard errors for body size measurements (B and C) are due to the inclusion of both engorged and unengorged specimens.

TABLE II. Harpyphyllus nosophilus sp. n.
Ratio of character means for each developmental stage to mean larval measurements.

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Notes:
1. Character measurements in inches; C.V. = Coefficient of variability. Character measurements (in inches) are coded as follows: A = Greatest width of gasterion; B = Greatest width of obusaeum; C = Length of idiosoma; D = Level of pedicel to posterior margin; E = Greatest width of dorsal shield; F = Greatest length of dorsal shield. Large standard errors for body size measurements (B and C) are due to the inclusion of both engorged and unengorged specimens.

Remarks:
Some measurements of this and all succeeding developmental stages are given in Table I. The striking sexual dimorphism in body size that occurs during the course of development is evident from Table II, which gives the ratio of the five characteristic means for larval measurements for each postlarval stage.

Protosternum: Caenostoma dorsally (Figs. 5, 20) basically similar to that of larva, with addition of two modified palpal setae, g, and g1; palpal setae g, unchanged. g1, considerably shortened, pediculate and subocular in length to ge; ge, whiplike, with few fine setae, slightly longer than palpal segment from which it arises.

Deutonyms ventrilly (Figs. 6, 32) similar to that of larva, with addition of second pair of hypostomal setae (hs) posterior to median setae.

Idiosoma dorsally (Fig. 5) suboval in outline, dorsal shield somewhat broader than in larva, with number of small pores. Dorsal idiosomal setae p1, p2, p3, p4, and p5 unchanged from larval condition, but p6 and p7 greatly reduced in size, subocular and devoid of setae.

Idiosoma ventrilly (Fig. 6) with additional pair of small ventral setae, cv, situated posterior to cv, and cv, in advance of second unciliated, un

striated area. Four pairs of legs: legs I and II similar to each other and reduced from larval condition, with tendency toward fusion of leg segments, particularly in leg II, and with prominent lobe arising from basal segment of leg I. Leg III reduced to single segment, partially fused with idiosomal integument; leg setae reduced in length and thickness, almost as long as gnathosoma. Leg IV barely visible; lightly sclerotized stump without setae. Posterior idiosomal setae (k) and lateral pore present as in larva.

Dentognath: Gnathosoma dorsally (Figs. 7, 21) and ventrally (Figs. 8, 33) basically similar to that of preceding stages, with $g_3$ and $g_6$ relatively thicker.

Idiosomal shape (Fig. 7) as in protonymph, with further slight widening of dorsal shield, further tendency toward anterior and posterior median concavity, and addition of numerous pores. Dorsal idiosomal setae as in protonymph, but $p$ may be thickened, elongated and pectinated, as shown in illustration.

Idiosoma ventrally (Fig. 8) with same setation as in protonymph but $s$ somewhat more reduced. Legs I and II similar to those of protonymph, leg III with four setae a little more strongly developed, the most posterior slightly longer than gnathosoma. Leg IV better developed, located more laterally than in protonymph, with two to four setae (usually four), the longest slightly longer and stouter than those of leg III. Posterior idiosomal setae (k) thicker and longer in protonymph; lateral pore present.

Adult: Gnathosoma dorsally (Figs. 9, 22) and ventrally (Figs. 10, 23) basically similar to that of preceding stages. Small, weakly sclerotized platelet (Fig. 34, plk) appearing on terminal palpal segment. Prominent muscle attachments visible on dorsal wall of idiosomal base and on modified palpal segment.

Idiosoma pear-shaped (Fig. 9), with further widening of dorsal shield, which often has prominent crescent as illustrated for holotype. Dorsal idiosomal setae $p$, $s$, thickened and pectinate; $a$ and $p$ reduced in size, smooth. Idiosomal striations anterodorsally and posterodorsally less well connected than in preceding stages.

Idiosoma ventrally (Fig. 10) with same setation as in deutonymph, although one number of setal pair may be lost and both may arise from same socket, as illustrated for holotype. Ventral un-sclerotized areas less distinct than in preceding stages. Legs I and II similar to those of deutonymph, although lobe may project from base of leg II. Legs III and IV with four setae strongly developed, longest setae of leg IV slightly longer than those of leg III; leg IV situated dorsally, instead of ventrally or laterally as in protonymph and deutonymph. Lateral pore lost in this stage; posterior idiosomal setae (k) further thickened and shifted dorsoventrally to lie on either side of median, transverse lumps.

Reproductive aperture a longitudinal slit, situated posteroventrally. Genital armature consisting of dorsal and ventral sclerotizations at either end of reproductive aperture. Ventral armature (Fig. 10) comprising two median, anteriorly diverging sclerotized areas covered by membranous flap. Dorsal armature, subtegumental, consisting of pair of tubelike structures extending posteriorly from Y-shaped support (shown distally in Fig. 8). Integumental folding evident posterior and lateral of genital area.

**Male**

* Larva: Gnathosoma dorsally (Figs. 11, 25) and ventrally (Figs. 12, 27) similar to that of female larva (cf. Figs. 3 and 19), with modified palpal seta $g$, stout, flattened and laterally lobed, $a$ long and whiplike, extending backward to or slightly beyond posterior margin of gnathosoma.

Idiosoma somewhat more compact than that of female larva, legs and body setation identical to that of female with exceptions of posterior idiosomal setae (k), of which two pairs present (cf. female larva; Fig. 4); these setae prominent and approximately equal in length, located terminally and slightly ventrally, respectively. Paired k setae found in all succeeding instars except adult male, in which both lost. As in female larva, pore situated dorsolaterally, just anterior of seta $a$ and slightly posterior of leg II.

**Protonymph:** Gnathosoma dorsally (Figs. 13, 24) and ventrally (Figs. 14, 32) as in female protonymph, $g$ reduced in size, with $g$ and $a$ appearing anterolaterally.

Idiosomal shape (Fig. 13) similar to that of male larva, and strikingly different from that of female protonymph (cf. Fig. 5). Idiosoma ventrally (Fig. 14) with single unstriated area, $s$ added as in female protonymph. Legs I and II lacking basal lobe. Leg III better formed than in female, two segments visible and setae longer and stouter. Leg IV a stumpy, with basal segment barely visible. Posterior idiosomal setae (k) and lateral pore as in male larva.

**Dentognath:** Gnathosoma dorsally (Figs. 15, 25) and ventrally (Figs. 16, 33) similar to that of preceding stages.

Idiosomal shape (Fig. 15) as in male protonymph, dorsal shield with tendency toward posterolateral widening and anterior and posterior concavity. Body setation as in male protonymph, with all idiosomal setae well developed. All legs well developed in comparison with female deutonymph (cf. Fig. 7); $l$ I not lobed basally, similar to leg II; legs III and IV with strongly developed complement of setae, usually with six setae on leg III and four on leg IV; setae of leg III often better developed than those of leg IV (although not in specimen illustrated).

Ventrally (Fig. 16) setation as in protonymph, with single unstriated area. Posterior idiosomal setae (k) and lateral pore as in protonymph.

Adult: Gnathosoma dorsally (Figs. 18, 20) with slight relative shortening and rounding of movable palpal segment, modified palpal setae $g$, and especially $a$, considerably hypertrophied over condition in deutonymph.
Idiosoma dorsally (Fig. 18) almost covered by dorsal shield, considerably broadened posteriorly and posteriorly incised.

Genital opening located in dorsal shield at about level of base of leg II. Aedeagus eversible, tubular, and whiplike. Genital opening flanked by inverted V-shaped spurs and three pairs of minute setae. One pair of anterior p-series (probably p₁) reduced to microsetae and situated on dorsal shield near anterior margin; other idiosomal setae somewhat enlarged relative to their condition in male deutonymph.

Ventrally (Fig. 17), idiosomal setation as in deutonymph, but ventral unirradiated area lacking. Legs similar to those of deutonymph, but somewhat better developed. Legs I and II with three or six segments plus terminal segment (pretarsus); increase in segmentation apparently brought about by partial or complete subdivision of basal segment. Leg III may have two or three segments; leg IV two-segmented. Terminal setae of legs III and IV more strongly developed than their counterparts in deutonymph.

Lateral pore and posterior idiosomal setae (k) lacking.

Adult male allotype illustrated in Figures 18 and 19 somewhat reduced in size from male deutonymph of Figures 16 and 17; this reduction normal, or perhaps host-influenced, as allotype taken from different host than remainder of type series (see below under "Allotype" in Taxonomic Data section).

**TAXONOMIC DATA**

**Type host**

**Holotype**
Adult ♂, Hopland Field Station, Mendocino Co., California, 29 March 1953 (B. C. Nelson; Host No. BCN 550). No. 3246 in the USNM Collection, Washington, D. C.

**Allotype**
Adult ♀, 11 mi SE of Nebraska City, Nebraska, 25 January 1900 (N. Braasch; Host No. 600125-1), from cardinal, *Richmondena cardinalis* L., AOU p. 540 (Aves: Passeriformes: Fringillidae);
posted under the same accession number as the holotype in the USNM.

Note: Two male deutonymphs in the process of molting into adults were present in the series from the brown creeper, but no fully molted adult males were available from this host; rather than designate an incompletely formed, tenent specimen as an allotype, a well-sclerotized adult male from the cardinal was chosen.

Paratypes
These include 3 ♀ larvae, 4 ♂ protonymphs, 5 ♂ deutonymphs, 6 ♀ adults, 1♂ larva, 3♂ protonymphs, and 7 ♂ deutonymphs, all from the same locality and host species as the holotype. In addition, four adult ♀ paratypes, Laurel, Maryland, 20 March 1981. (W. W. Moss; Host No. WM-1), from cardinal.

Material is deposited in the collections of the Academy of Natural Sciences of Philadelphia (1♀); the Borden F. Bishop Museum, Hawaii (1♂); the Canadian National Collection, Ottawa (1♀; No. 9356); the Institute of Acanthology, Columbus, Ohio (1♀); the Snow Entomological Museum, Lawrence, Kansas (1♂ larva, 1♂ protonymph, 1♂ deutonymph, 1♂ adult, 1♂ protonymph, 1♂ deutonymph); the Zoological Institute of the Academy of Sciences, Leningrad, USSR (1♀). Remaining material is in the collections of the authors.

The type series is mounted in Hoyer's medium and the cover slips are rings with Zut lacquer.

Remarks
Of the species of Harpyrhynchus described to date, H. novophanaria sp. n. is most similar...
morphologically to H. pluriama Fritsch, a European form, but differs from the latter in having one of the modified palpal setae (g₄) of the female thickened and distinctly shorter than the other two modified setae (all three are long, unthickened and similar to each other in H. pluriama). In addition, the lobes at the bases of legs I and II of the female are more prominent in H. nococoplumaris, and the male aedeagus is closer to the anterior margin of the dorsal shield. According to Fritsch's 1954 descriptions and illustrations, legs I and II of female H. pluriama lack the empyodium, a structure that is present in H. nococoplumaris; however, due to the poor preservation of the specimen of H. pluriama examined, the absence of an empyodium in this species cannot be confirmed at this time.

The type host of H. nococoplumaris (the brown creeper, Certhia familiaris) also occurs in Europe, in the range of birds parasitized by the Palearctic H. pluriama. Accordingly, it would be of interest to sample European creeper populations to determine which (if either) of these two closely similar mites is present on this host in Europe.

**BIOLGIO OF HARPYRHYCHUS NOCOCOPLUMARIS**

Virtually nothing is known of the biology of harpyrhynchids, aside from their host records and the tendency of a few species to induce the formation of host cysts (Mégnin, 1877; Morley and Shillinger, 1937). The first complete description of the developmental cycle of a harpyrhynchid is given above for H. nococoplumaris; no data are yet available on the duration of each stage for this or any other harpyrhynchid.

The following observations, although incomplete, are a first contribution toward our understanding of the natural history of these mites.

**Chromosome complement**

No animal or plant has been reported to possess a smaller number of chromosomes than that found in the type species Harpyrhynchus nococoplumaris n.sp., and not many species have been reported to have as few. Oliver and Nelson (1967) found Harpyrhynchus brevis Evering to have the same number, and listed several taxa that share this number in at least some cells during some part of the individual's development. For example, certain species of insects (coccids of the tribe Iceryai) display a haploid number of two chromosomes, with unfertilized haploid eggs developing parthenogenetically into males; fertilized eggs develop into females (Hughes-Schröder, 1948). Two species of water mites, Euplotes rhizopus Friesig and E. setosa Koenig, were found to have n = 2, but were not arthroktosus (Sokolov, 1954).

The presence of haploid and diplodiplo eggs suggests that arhenobyo may be present in Harpyrhynchus nococoplumaris and in other species of the family (e.g., H. brevis Evering, a similar situation exists (Oliver and Nelson, 1967). Obviously, the mere coexistence of haploid and diploid embryos is not definitive proof of arhenobyo. In the diaspidean scale Pseudolacacampa pentagona (Targ.), male embryos begin as diploids, but the paternal chromosomes are eliminated during later cleavage stages, the male embryos developing thereafter as true haploids (Brown and Bennett, 1957). Nevertheless, this type of chromosome behavior is rare and the finding of haploid and diplodiplo eggs is the fact that arhenobyo is common in many trematobiform mites (Oliver, 1962), argues strongly in favor of arhenobyo in this species.

**Location on host and oviposition**

Mites such as H. nococoplumaris remain in close contact with the host throughout their developmental cycle and, accordingly, belong to the host-dwelling ecological category of Audy (1948, 1958) and Cannin (1963, 1965). Most cheyletid mites in this category scatter their eggs or young loosely over or within the body or feathers of the host (e.g., Cheyletidae; Sminthuridiidae; Proenigmidae; Ophiidiidae; Fain, 1964), or lay their eggs singly on stalks (e.g., some Myobioiidae; Grant, 1942). In the case of H. nococoplumaris (and in H. pluriama and H. pilocrocas Brelere and Trosserrat), the eggs are laid in a string, and the female herself serves as the site of attachment (see fig. 11a of Fritsch, 1954).

The slightly mobile female deutonymph of H. nococoplumaris can be found at the base of the calamus of a feather, oriented parallel to the length of the shaft, with mouthparts at the surface of the host's integument. In this position the subsequent molt to the adult stage occurs, when copulation presumably takes place (as in a closely similar species of Harpyrhynchus from the cowbird; Moss, unpublished.). The female attaches to the calamus of the feather by means of a small feather sheath that eventually comes to envelop both her and her eggs. The latter are arranged serially, and remain attached to each other. The eggs will separate from each other, however, if placed in water and agitated. Eggs laid most recently are white, situated closest to the female, and contain early stage embryos suitable for chironomus study. Older eggs are yellow, further from the female, and contain advanced embryos. Finally, the oldest eggs are followed by the collapsed, empty chironomus from which lar- vrae have hatched. Females apparently die in situ after the completion of oviposition.

Adult females of H. nococoplumaris occur chiefly on the contour feathers of the head, neck, and upper breast. Mites may be found on the auricular, gular, and malar feathers, as well as on those of the lores and occiput (feather sheath is that of Pettingill, 1950). Females are restricted to the ventral surface of the auricular feathers. On feathers other than the auriculars, the ventral surface is usually utilized, but some females attach to the dorsal surface. Attachment sites are normally in areas that cannot be pressed effectively, and it is possible that ventral attachment is an additional adaptation to prevent dislodgment of the mite by the host.

An exhaustive count was made of the number of attached females and their eggs on a brown creeper (BCN 552). Of 85 attached females, five had no eggs, and one female and her eggs were covered with a fungus so that an accurate count could not be made. Egg production of the 84 females for which counts could be made is presented in Table III. The presence of white eggs suggested that a female was still ovipositing. Obviously, as counts were made before all females had completed oviposition, the numbers of Table III do not represent the actual biotic potential of the species, but only the reproductive picture at one point in time.

Seventy-one females had one to three white eggs. Seventy-four females had yellow eggs with advanced embryos; the maximum number of advanced embryos per female was 12. The maximum number of eggs laid by one female was 48 (two white eggs, 10 yellow eggs, and 38 empty chironomuses). The maximum number of eggs laid per mite varied considerably among eight females presumed to have ceased oviposition: five females with only empty chironomus had laid 15, 24, 28, 34, and 40 eggs, while three females with only advanced embryos and empty chironomus had laid 13, 19, and 26 eggs. Further counts must be made in order to determine if this variation was geographical, or perhaps the result of mite mortality due to the death of the host. The latter alternative is possible, although some mites remained alive up to 10 days subsequent to their removal from the host under the conditions mentioned above. Loss of empty chironomuses from the egg strings would be a source of counting error. However, although the empty chironomuses are easily broken by direct contact with forceps, the choriones remain intact when the feathers are removed and mounted on slides; further, a study skin of a brown creeper collected in 1863 and deposited in the University of California Museum of Vertebrate Zoology (No. 6420) still has many H. nococoplumaris females with relatively long strings of empty chironomuses. Unfortunately, accurate counts of the eggs could not be made without damaging the skin.

**Discrimination of developmental stages**

The developmental stages of H. nococoplumaris may be distinguished from each other by a few easily observed characters. The larva may be identified by its three pairs of legs,
one pair of hypostomal setae (h₁), only two pairs of ventral hypostomal setae (v₁ and v₂), and by its modified palpal seta g₂ which extend back almost to the base of the gnatho-
soma. Protontynphs may be recognized by their possession of a stublike leg IV that lacks setae, by the presence of a second pair of hypostomal setae (h₂), and the third ventral hypostomal setae (v₃), as well as the addition of two palpal setae (g₃ and g₄) accompanied by a reduction in length of g₂. Dentontynphs possess setae on leg IV, but lack a reproductive apertur.

Adult males lose their posterior hypostomal setae (k) and ventral uncereolated area, and possess an acellicere that opens via the dorsal shield. Adult females exhibit a dorsal migration of leg IV, with a considerable hypertrophy of the setae of legs III and IV, and possess a ventral genital opening situated posteriad of setae k₁. Males and females of all stages prior to the adult may be distinguished from each other on the basis of the number of posterior hypostomal setae (k): two pairs are present in males, one pair in females.

Relatively few species of acarines are known from all developmental stages and few, if any, exhibit sexual dimorphism in all instars subse-
quently to the egg (see Moss and Funk, 1965, for a description of a halacoptid that exhibits such dimorphism in all stages subsequent to the larva). It is, unfortunately, an extremely difficult task to maintain harparynychid mites in colonies. If this difficulty could be over-
come, the mite described in the present paper, H. nocomplani, would be an ideal organism for use in population studies of the dynamics and possible causes of shifts in sex ratio.

Apparent seasonality of reproduction

Although harparynychids may be collected at almost any time of the year, actively ov-
posing females of H. nocomplani have been found by us so far only during the months of March through June, a period corresponding roughly to the breeding seasons of its hosts. Year-round-year collections of H. nocomplani are needed to confirm this observa-
tion. It would seem reasonable that a synchronization of the reproductive seasons of the mite and its hosts would be of advantage to the mite, in assuring transfer from host to host. In addition, it would be disadvantageous for ovipositing female mites to attach to feather-

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Atyes of The University of Nebraska enabled the collection of additional specimens of H. nocomplani from western North America. Mite material was loaned to us by Willbur B. Ems of The University of Missouri, and Wil-
helm Fritsch provided specimens of H. phur-

synus (Buchholz) (Ichthyogamasidae): Chipping Sparrow (Fringilla c. tullipectus), AOU p. 10.13 (CALIFORNIA: Mendocino Co., Hopland Field Sta-
tion, 18 May 1965; B. C. Nelson, BCN 593 and 594; same locality and collector, 16 June 1960, BCN 768; Wisconsin: 15 mi of Sturgeon, 2 Sep-
tember 1962, W. W. Moss, M-190).

A congenерic association

On two occasions, harparynychid eggs were found attached singly by a tiny stalk to the skin of the occiput and neck (i.e., the cervical uropygium) of chipping sparrows, Spizella pas-
serrina (BCN 593 and 594) positive for H. nocomplani. A female harparynychid ob-
erved in the process of laying a stalked egg was subsequently identified as Harparynychus brevis Ewing, a species that also occurs in a wide variety of hosts (at least 25 species of North American passeriforms; Moss, unpubl.) Visually, females of H. brevis retain their locomotor ability and wander freely over the surface of the host, this mite was implicated in cyst formation by Morley and Shillingar (1937).

It is interesting that two species of Harp-
arynychus, H. nocomplani and H. brevis, were found together twice on two separate hosts. The presence on the same host of two species of the same parasite genus is not rare among homoeothelyous ectoparasites, and may be of common occurrence among species of the related cheyletid family Cheyletidae (e.g., at least three species of Cheyletus Cann et al. have been found on the house fly, Tanytarsus araneus (Agassiz): Cann, pers. comm.). We have no data on possible competition for food and living space between these two harpar-
rynychid, although competition for oviposi-
tional sites is obviously avoided as described above.

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