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THE REDUVIIDS AND NABIDS ASSOCIATED WITH ARIZONA CROPS

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THE REDUVIIDS AND NABIDS ASSOCIATED WITH ARIZONA CROPS

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Two families, known commonly as the assassin and the damsel bugs, contain the bulk of the larger predatory Hemiptera found in Arizona agricultural areas. The only other abundant predaceous species in the one-third inch and larger size range is one of the stink bugs, *Podisus acutissimus*. This insect has the ordinary triangular shape of the familiar stink bugs and cannot be confused with the narrow assassin and damsel bugs. Among the stink bugs common on crops, it stands out in having a pair of very sharp and slender spines on the sides of the pronotum.

The samples reported here have been segregated from "sweepings" of crops in all of the major agricultural areas of the state, as detailed in the foreword to Ariz. Agric. Exp. Sta. Tech. Bul. 132 (Butler and Werner, 1957). Five hundred and twenty-two samples are represented in the present bulletin. See Table I. The 97 additional samples included here and not in the previous report are widely distributed by county and month. Three counties, Maricopa with 33 additional samples, Pima with 14 and Yuma with 12, are the best represented and the months of July with 37 additional samples, August with 24 and June with 11 are the best represented months.

REDUVIIDAE

Reduviidae can be distinguished from other terrestrial Hemiptera by the possession of the following characters: proboscis three-segmented, antennae four-segmented, head transversely grooved between the eyes, ocelli present, anterior femora tending to be thickened, pronotum divided into an anterior and a posterior lobe, and anterior wings (hemelytra) divided into a distinct corium and membrane, the corium without a cuneus. For field identification the two-lobed pronotum, moderately slender body form and noticeably elongate and two-lobed head distinguish the Reduviidae from others of the larger Hemiptera. Damsel bugs (family Nabidae) are similar in most ways but have the pronotum only inconspicuously lobed and have the head normal.

Little has been written on the taxonomy of the Reduviidae considered here. J. C. Elkins has revised the genus *Atrachelus* and delimited the North American species and subspecies in a very satisfactory manner. The genera *Sinea* and *Zelus* have not been studied in many years. In the absence of recent taxonomic treatment the identifications of Dr. R. I. Sailer, of the Insect Identification and Parasite Introduction Section, A. R. S., U. S. Department of Agriculture, have been used as a point of departure. The most useful publication in these genera is by Readio (1927), who has compiled the descriptions and references of the North American species and has devised and adapted keys for their identification. This publication was not intended to be a taxonomic revision.

TABLE I. The number of collections of the various species of Reduviidae and Nabidae in 522 samples from Arizona crops made in 1954-56.

County	Total Samples	*S. confusa*	*Z. renardii*	*Z. socius*	*A. cin. wyg.*	*S. complexa*	*S. rileyi*	*N. alternatus*	*N. ferus*
Yuma	76	33	12	4	23	5		22	43
Maricopa	187	100	51	40	43	13		100	81
Pinal	50	24	20	24	11	5		34	22
Pima	74	31	25	19	7	2	2	34	21
Santa Cruz	21	2		2	2	1		5	5
Cochise	43	3	3	6	3	1		33	17
Graham	27	4	6	3	2			19	8
Greenlee	6		1	1				5	1
Yavapai	12		2				1	6	1
Gila	4	1	2		1			1	
Mohave	7							3	
Coconino	5	1		1				3	1
Navajo	4								
Apache	6							1	1
Totals	522	199	122	100	92	27	3	266	201

The genera and species included in the present paper include all but a tiny fraction of the samples from crops in this family. Several specimens of *Pselliopus* were taken but this genus was so poorly represented that it is not likely that it is ever abundant enough to be of any great significance. It differs from the others in having very slender legs, which are conspicuously banded with black.

All of the species taken in crop sweepings are predaceous on insects. Two genera, *Triatoma* and *Rasahus*, are often seen at lights at night, even in agricultural areas. *Triatoma* feeds on mammalian blood, *Rasahus* reputedly on insects. The latter genus has not been taken in the crop samples, however.

The following key to the species taken in crop areas is original. It can be used for the identification of adults. Nymphs can usually be identified by a comparison of the anterior femora with those of the adults.

KEY TO SPECIES

1. Anterior femora spiny, tending to be knobby. (genus *Sinea*) 2
   Anterior femora straight-sided, not spiny 4

2. Posterior lobe of pronotum with sharp spines on the disc; anterior lobe with longer sharp spines; anterior femora with a sharp spine on the anterior surface between the dorsal spine and the antero-ventral series. *Sinea complexa*

   Posterior lobe of pronotum without spines on the disc, with at most blunt tubercles; anterior femora without the extra spine of *S. complexa* 3

3. Anterior femora, not counting spines, more slender, about 1/7 as thick as long, the dorsal spine moderate in length. Color usually tan. Very common. ..... *Sinea confusa*

   Anterior femora, not counting spines, thicker, about 1/5 as thick as long, the dorsal spine very long. Color usually dark brown to almost black. Scarce. ..... *Sinea rileyi*

4. Head with a pair of spines behind the antennae. A small, tan to brown insect, with conspicuous pubescence. Common. *Atrachelus cinereus wygodzinskyi*

   Head without a pair of spines behind the antennae. Slender, smooth-appearing species. (*Zelus*) 5

5. Posterior lobe of pronotum with the disc smooth, spineless. Color usually greenish, with the corium of the hemelytra rufous. Common. *Zelus renardii*

   Posterior lobe of pronotum with a pair of spines on the hind part of the disc. Color usually dark, with the dorsum of the abdomen rufous. Common. ..... *Zelus socius*

Genus *Atrachelus*

This genus has recently been revised (Elkins, 1954) and the revision should be consulted for a discussion of its relationships. The only member known from Arizona is the subspecies reported below. The characters given in the key and in the description should suffice for its identification.

Atrachelus cinereus wygodzinskyi Elkins. Small (adult 7-9 mm. long), moderately stout, brown, with conspicuous appressed brown pubescence. Dorsum of abdomen rufous except for the expanded lateral margins, which are banded dark and pale. The pronotum is about 0.28 as wide as the body is long. Legs dark, with obscure pale bands.

Head short, with a pair of spines just behind the bases of the antennae. Ground color dark, with a feeble median pale line behind the transverse suture. Pronotum conspicuously constricted at the transverse suture, the anterior lobe with the sides slightly swollen and the disc grooved medially; the sides of the posterior lobe converge anteriorly more rapidly than do those of the anterior lobe. Anterior lobe with the antero-lateral angles bluntly spined and the surface patterned with pubescence so that small areas are left glabrous; posterior lobe with the postero-lateral angles short-spined and the disc with a pair of spines that are slightly longer than the lateral spines, located just behind a line connecting the postero-lateral angles. The spines are often paler in color than the disc. Ridges run anteriorly from the discal spines. The corium is obscurely rufous in some specimens, brown in others, and the veins are just barely lighter in color than the rest of the surface. The membrane is dusky, with darker veins. Underside mostly dark, paler medially and along the margins of the abdomen.

The antennae have the base and apex of segment I and the base of segment III darker; segment III is thickened at the base in the male. The femora are distinctly annulate and the tibiae have an obscure pale ring near their

bases. The profemora are noticeably thicker than the metafemora and the mesofemora are intermediate. The profemora and protibiae have erect glandular setae. The abdominal segments have the postero-lateral margins short-spined. The abdominal dorsum is rufous where covered by the wings in repose; the exposed lateral margins of the segments have the anterior half pale, the posterior dark. In the male the last ventral segment bears a very short spine medially on the hind margin.

The subspecies *wygodzinskyi* ranges from the Rio Grande valley of Texas west to southern California. Elkins (1954) points out that it differs from the nominate subspecies, which range from east Texas to the Atlantic, north to North Carolina, in having the spines on the head and thorax short and the body a bit more robust. He further points out that the basal thickening of the third antennal segment of the male is less distinct and more variable in *wygodzinskyi* than in the other two subspecies he recognizes.

In Arizona this inspect is most abundant in Yuma county, where it was represented in 30% of the samples, almost as abundant in Maricopa and Pinal counties, but much less abundant in the other southern counties and not represented at all in the samples from the northern counties. It is best represented in the summer samples, followed by fall, winter and spring. We have no information on its biology.

Genus *Sinea*

Among our commoner genera of Reduviidae, *Sinea* stands out in having spiny anterior legs, the flexor surfaces of both profemora and protibiae being provided with double rows of recurved spines, which oppose each other to form an excellent grasping organ. The anterior legs also possess scattered long, erect setae that appear to be tactile in function. These are totally unlike the glandular setae of *Zelus* and *Atrachelus*. The legs and other parts of the body tend to have the surface granular and the granules on the head and pronotum may be modified into spines. A single spine is always present at the apical fifth of the extensor surface of the profemora in all our species. The clavus of the hemelytra is more translucent than the corium. The lateral margins of the abdomen are exposed and may appear "scalloped" in the female. The extent of the scalloping has been widely used in the delimitation of species.

The life history of *Sinea* has not been studied in detail. Readio (1927) states that all of those species that have been observed spend their entire life history on plants, feeding on small insects. *S. diadema* feeds on both injurious and beneficial insects, according to Smith (1942), with no observed preference for any types. Knowlton (1944a) observed *S. diadema* feeding on an adult syrphid fly, a pea aphid, an alfalfa weevil larva, and an alfalfa caterpillar. Balduf (1948) fed this same species fruit flies and house flies in the laboratory. Luginbill (1928) observed *S. sanguisuga* attacking a *Laphygma* larva and Caffrey and Barber (1919) reported that *S. spinipes* fed on nymphs of Say stink bug (*Chlorochroa sayi*).

Sinea complexa Caudell. This is a rather scarce species. It is small, 9-10 mm. long in the adult, stout and usually pale in color. The profemora are very stout and usually dark in color. The membrane of the hemelytra is pale, with brownish speckling and with the veins darker than the membrane; it appears darker than the rest of the body.

This species was poorly represented in our samples. It occurred in 10% of the Pinal county samples and in lesser numbers from Yuma to Cochise county. It was best represented in the summer and fall. It has been reported from Colorado, Utah, Arizona and California (Readio, 1927).

Sinea confusa Caudell. This is by far the most abundant species of the genus in Arizona and the one most likely to have its name changed when a modern revisionary study is undertaken. The Arizona populations appear to be quite uniform.

Adults 9-13 mm. long, moderately stout (pronotum about 0.23 as wide at base as body is long); tannish in color, sometimes with an olive or rufous cast, the membrane of the hemelytra noticeably darker. The lateral margins of the abdomen of the female are "scalloped," the margin of each segment bulging. In most specimens each "scallop" is dark anteriorly, pale behind.

Head spiny above; anterior to the transverse groove there are usually two rows of spines of three each, extending from behind the antennae to above the eyes, and an irregular median row; the lateral spines are usually the longer and scattered short spines or tubercles supplement the rows. Behind the transverse groove there is usually a pair of short spines above each ocellus, sometimes reduced to tubercles, and scattered very small spines. The region from the ocelli back to the base of the head may be darkened. The pronotum has short spines on the anterior lobe and scattered along the hind margin of the posterior lobe. The surface of the anterior lobe is smooth between the spines; the posterior lobe is coarsely reticulate, with a pair of bumps on the disc in line with the postero-lateral angles, which are usually spinose. A feeble ridge extends forward from each discal bump and a less distinct ridge lateral to each of these. The lateral margins of the pronotum are slightly angled toward the lateral notch of the transverse groove. The corium of the hemelytra is pale, with paler veins, the ground color usually darker apically. The membrane is partly dark, conspicuously so along the vein that reaches the apex and along a strip roughly parallel but lateral to it (actually toward the anterior margin of the wing). When the hemelytra are at rest, the dark stripe along the vein that touches the apex lines up with its mate on the other wing, this accentuating the contrast in color. The underside of the body is pale. In the male the last ventral segment of the abdomen is attenuated at about the apical third and bears a blunt spine on the apical margin, this often concealed by the clavate claspers.

This species is very closely related to *S. diadema* (Fab.) of the eastern United States and may not really be distinct. A thorough study of the genus throughout its range in North America would be needed to answer this question. It is represented in samples across the southern counties of Arizona, best represented from Maricopa, Pinal, Yuma and Pima counties, in that order. It is poorly represented or absent from the northern county samples. Seasonally, it is best represented in the fall months, followed by winter, summer and spring. It has been reported from Texas, Arizona, California, Mexico and Central America (Readio, 1927).

Sinea rileyi Montandon. This is a scarce species, usually dark, with the corium usually conspicuously paler where it is widest. Length of adult 8-10 mm.; body stout. The profemora are very stout and knobby, but not as extremely so as in *S. complexa*; they are usually no darker than the rest of the body.

The membrane of the hemelytra is marked almost as in *S. confusa.* The dorsum of the abdomen is rufous where covered by the hemelytra in repose.

Most of the specimens in the University of Arizona collection were collected from the southeastern mountain area of Arizona. Two crop samples from Pima county and one from Yavapai county contained single specimens. The species is included here because it might be confused with *S. complexa.* It has been reported from North Carolina, Florida, Texas, Arizona and California (Readio, 1927).

Genus *Zelus*

Slender species with the head and legs spineless and the abdomen not expanded laterally in either sex. The profemora, especially on the flexor surface, and the protibiae, have erect glandular setae that often have particles sticking to them. The appendages are all slender and long and the anterior legs are not noticeably thicker than the rest. Our two species are very distinct from each other.

Zelus renardii Kolenati. Adult 10.5-13.5 mm. long, moderately slender (pronotum about 0.22 as wide at base as body is long); ground color olive green or darker and the corium usually rufous but sometimes brownish. The upper surface has some scattered appressed pubescence.

Head slender, the dorsal surface with darker markings, especially behind the transverse suture. Paler specimens have several lateral dark spots behind the suture and dark specimens have the whole area behind the suture black except for a pale median mark. If the dark marking behind the suture is extensive, the region before the suture may also have dark markings. Antennae slender, with segment I about as long as an anterior femur, uniformly pale or with the terminal segments darker. Pronotum without spines, except that the antero- and postero-lateral angles are pointed in some specimens. The lateral margins of the anterior and posterior lobes form an almost straight line. In dark specimens the anterior lobe has a reticulate pattern of dark markings on a pale ground color and the posterior lobe is darker, with narrow pale lateral and posterior margins. The corium is rufous to darker, with pale veins; the membrane uniformly dark, with slightly darker veins.

The legs are uniformly colored, the femora pale and the tibiae and tarsi brownish. The underside is uniformly pale and the dorsum of the abdomen is rufous. In the male the last ventral abdominal segment has a slender, vertical, hooked median process apically.

This species was fairly well represented in samples from the southern counties, best represented in those from Pinal county, followed by Pima and Maricopa. It was best represented in fall and winter, followed by spring and summer, summer samples containing only one-third as great a percentage as those from fall and winter. It has been recorded from California, Kansas, Texas and Mexico (Readio, 1927).

The eggs of *Zelus renardii* have been described by Swezey (1936). They are cylindrical, a little more than 1 mm. in length, and are deposited in masses of 20 to 40 eggs on the surface of a leaf. The masses are brown in color and covered with a sticky substance. One female was observed to lay 269 eggs in five weeks of captivity. The eggs hatch in eight to ten days and the young become mature in four to five weeks, with five moults at five to nine day intervals.

The species is a general feeder, attacking both injurious and beneficial insects. Swezey (1936) and Nishida (1955) give lists of prey in the Hawaiian Islands, where the species has been introduced. Hymenoptera, Diptera, Coleoptera, Hemiptera and Homoptera are included in their lists. Ewing and Ivy (1943) record that three nymphs consumed 68 out of 80 bollworm eggs in eight days. Clancy (1946) found that the species would not feed on brown stink bug (*Euschistus*) eggs but that nymphs were taken. Moving first-instar nymphs were impaled on the proboscis and rapidly sucked dry. The assassin bugs ignored motionless stink bug nymphs. Morrill (1910) observed feeding on the nymphs of the conchuela (*Chlorochroa ligata*), another stink bug, in the laboratory.

Zelus socius Uhler. Adult 10-14.5 mm. long, slender (pronotum about 0.15 as wide at base as body is long); ground color usually dark, the dorsum of the abdomen rufous; legs paler and inconspicuously banded. Upper surface with scattered appressed pubescence.

Head slender, mostly dark above but midline narrowly pale behind the transverse suture and sometimes also pale on the midline and along the sides before the transverse suture. Pronotum mostly dark, the anterior lobe sometimes darker. The side margins of the anterior and posterior lobes form an almost straight line. All the margins of the pronotum are usually paler marked. The posterior lobe has the postero-lateral angles spined and, in addition, has a pair of spines on the disc just behind a line connecting the lateral spines. The spines are acute but blunt-tipped and are usually darker than the disc. A pair of irregular ridges may extend anteriorly from the discal pair, onto the anterior lobe. The anterior lobe often has a feeble pattern of paler markings, produced by denser pubescence. The corium of the hemelytra is dark, with a median vein pale and usually with a heavy vein just lateral to the membrane pale also. The membrane is uniformly dusky, with the veins conspicuously darker. The underside is partly dark in ground color, densely white-pubescent. In dark specimens the appendages have some banding. Dark markings occur as follows: dorsal and ventral surfaces of antennal segment I; base and apex of antennal segment II; apical half of profemora except apex and a pale band at the apical fourth; a similar marking on the mesofemora; and a dark marking on the apical fifth of the metafemora, usually excluding the very apex. The tibiae have a very small dark marking at the base in well-marked specimens. The male has a short, acute spine on the apex of the last ventral abdominal segment.

This species, like *Z. renardii*, was fairly well represented in samples from the southern counties of Arizona, occurring in 48% of the Pinal county samples, followed by Pima, Maricopa and Cochise counties. It was best represented in spring samples, followed by fall, summer and winter. Readio (1927) records it from thirteen states, from Illinois to Idaho and from Florida to California.

Readio (1927) states that practically nothing has been recorded on the biology of *Zelus socius*. The egg mass is elongate, with not more than three or four eggs placed side by side in a transverse row. Knowlton (1932) observed *Z. socius* to feed on the beet leafhopper (*Circulifer tenellus*) in the laboratory. Ewing and Ivy (1943) provided an adult with 40 bollworm eggs and it ate 23 in seven days.

NABIDAE

Nabidae are placed in the superfamily Reduvioidea and share many basic features with the Reduviidae. They can be distinguished from the latter by possessing a four-segmented proboscis and lacking a deep groove between the eyes. In general appearance they are much different, being gradually tapered anteriorly and more delicately formed in general.

In appearance our species are moderately slender, tannish to grayish in color, but sometimes brown, and not shiny. The adults range from 7 to 9 mm. in length. The Hemiptera most often confused with them are certain slender plant bugs (family Miridae), which have a cuneus on the hemelytra in the adult, this being a small apical zone of the corium, set off by a transverse suture.

The most recent revision of the family is by Harris (1928). He lists two subfamilies and 26 species in America north of Mexico, all but four of the species in the genus *Nabis*, to which our species belong.

Two species, *Nabis ferus* and *Nabis alternatus*, make up the great bulk of our samples. Two specimens from Kansas Settlement, Cochise Co., taken May 2, 1956 on alfalfa, are more slender than either of the abundant species, and have longer antennal segments and wings. These two specimens remain unidentified. Two specimens of *N. nigriventris* Stal, determined by H. G. Barber, are in the University of Arizona collection from Sta. Cruz Co., Nov. 11, 1928, A. A. Nichol collector. This species has also been recorded from the Huachuca Mts. and Mexico by Harris (1928), who cites literature records he could not check from Colorado, Texas, Guatemala and St. Vincent. The species has not been recovered from crop samples. All of the adults in our crop samples are of long-winged forms, though two in our collection from higher elevations in Arizona are brachypterous.

The following key to species found on Arizona crops does not include the specimens mentioned above. Only the unidentified species from Kansas Settlement was taken on a crop and it appears to be so rare that there is little chance of its being taken in any numbers in future samples. If it is, it can be distinguished from both *ferus* and *alternatus* by having the first antennal segment one and one-half times as long as the width of the head across the eyes, while this segment is equal to or less than this width in our common species.

KEY TO SPECIES

1. Pronotum with the anterior lobe dark in ground color, the posterior lobe contrastingly paler, with a darker midline and often four other subparallel longitudinal dark lines. Lateral margins of pronotum obtusely angled inward to the junction of the anterior and posterior lobes, because of the narrowness of the anterior lobe. Specimens taken during the winter months and those from higher elevations have the anterior femora conspicuously banded with dark brown and have scattered brown spots on the rest of the legs. ..... *Nabis alternatus*

   Pronotum with the anterior and posterior lobes similar in color, pale, with a darker midline running through the two lobes. The anterior lobe

may have marginal dark lines, particularly in specimens taken in the winter or at higher elevations. Lateral margins of the pronotum almost straight. Anterior femora uniformly pale, or marked with obscure brownish bands, particularly in specimens taken at higher elevations or in the winter. ..... *Nabis ferus*

Specimens of *N. alternatus* taken during the summer months may have the anterior lobe of the pronotum not as contrastingly marked as indicated and the profemora may have only obscure brownish bands or none. These specimens can usually be identified by the shape of the pronotum. As a check on the identification, the size of the blade of the male claspers at the tip of the abdomen is diagnostic. In *N. alternatus* its greatest width is distinctly less than the diameter of an eye and in *N. ferus* it is at least as wide as an eye.

Nabis alternatus Parshley. Adults of this species are generally smaller and more slender than those of *N. ferus*, though the difference is not great. Our specimens average about 7 mm. in length. In general appearance they are brownish, with small brownish spots on the hemelytra.

This species is fairly well represented in samples throughout the state. In the southern counties it was found in 77% of the samples from Cochise county, followed by decreasing percentages in Graham, Pinal, Maricopa, Pima, Yuma and Santa Cruz counties. It was consistently better represented than *N. ferus* in all the southern counties except Santa Cruz and Yuma. In Santa Cruz county it was equal and in Yuma county only half as well represented as *ferus*. Seasonally it was best represented in winter samples, followed by fall, spring and summer, the last containing approximately one-half as good a representation as winter.

Harris (1928) records the species from Iowa to British Columbia, south to Texas, California and Mexico. He describes a pale form (var. *uniformis* Harris) from roughly the same range. This form has not been segregated in our samples but the specimens taken in the summer, especially at lower elevations, might be referable to it. If so, the form probably has no biological significance but is only a seasonal variation rather than a biological isolate.

Taylor (1949b) has studied the life history of *N. alternatus* in northern Utah alfalfa fields. The following details are from his study. Caged females deposited from 90 to 200 eggs, with an average of 127 per female. "The eggs were deposited within alfalfa stems, being inserted to their full lengths, leaving only the egg caps visible. These caps rested slightly above the alfalfa stem surface. Eggs were deposited one at a time, usually four or six being laid in a row in the stem." Incubation took nine days at temperatures of 67 to 88°F. The nymphs pushed off the caps of the eggs in hatching and crawled out the end. There were five nymphal instars, averaging 3, 2.5, 3, 4.4 and 8.3 days per instar, from first to fifth. There were three generations in 1948 and Taylor believed the adult to be the overwintering stage in Utah.

Knowlton has reported numerous species of insects as prey, in a series of papers (1943, 1944b, 1945, 1950, 1953). The list of insects includes thrips, leafhoppers, psyllids, aphids and a small larva of the alfalfa caterpillar. *N. alternatus* is considered a common and economically important predator of the pea aphid in Utah alfalfa and pea fields (Knowlton, 1953). Taylor (1949b) has reared nymphs on pea aphids, nymphal and adult *Lygus* and thrips, and has found that the nymphs refuse to feed on alfalfa fluid. He

observed adults feeding on alfalfa weevil larvae, *Lygus*, pea aphids and first and second instar grasshopper nymphs in the field.

Taylor (1949b) found a tachinid fly parasite, *Leucostoma atra* Tns., to be the most important natural enemy of *N. alternatus* in northern Utah. This species is widely distributed in Arizona. The abdomens of parasitized *Nabis* were extremely distended laterally and ventrally by the tachinid larvae within. The parasite larvae emerged from the dorsum of the abdomen, pupated and emerged as adults in from seven to eight days. Taylor (1949a, b) reported also that *Apiomerus crassipes* (Fab.), a reduviid, and *Perillus bioculatus* Fab., a stink bug, were predaceous on *N. alternatus* in his area. Both genera occur in Arizona but have not been taken associated with crops.

Nabis ferus (Linnaeus). The general aspect of this species is of a tan to grayish insect, slightly stouter and larger than *N. alternatus*. Our specimens average about 8 mm. in length but some are as small as *N. alternatus*, especially some of the males. Dark markings are less pronounced than in that species but may be noticeable in specimens taken in cooler areas and during the winter.

Ferus was described from Europe but ranges widely over the United States, particularly in the north. Harris (1928) implies that it has been introduced into North America by man but we can find no evidence in the literature to support his assumption. It was fairly well represented in the samples from the southern counties of Arizona, very poorly or not at all from the northern counties. It was best represented in Yuma county, in 57% of the samples, followed by Pinal, Maricopa, Cochise, Graham, Pima and Santa Cruz counties. It was twice as well represented as *alternatus* in Yuma county, equally well in Santa Cruz county and less so in the rest. See Table I. Seasonally it was best represented in the winter months, followed by spring, fall and summer, the last slightly over one-half as well as the first.

Harris (1928) records it from 24 states, from Maine to Washington and from Mississippi to California, as well as from Quebec, Alberta and British Columbia, Canada. He discusses the life history briefly, from studies made in Iowa. He found that the species overwintered in the adult stage and that the females deposited eggs in the stems of grasses in the spring. The eggs incubated in about eight days and the nymphs underwent five moults, with the first four instars lasting about three days each and the last six. The young nymphs crawled about on the ground, the older nymphs and the adults on plants. Garman and Jewett (1914) made similar biological observations in Kentucky.

N. ferus has been reported to prey on quite a variety of insects. Smith (1942) reported that it fed on many beneficial insects on cotton in California, as well as on injurious insects such as cotton-dauber nymphs, aphids and leafhoppers. Webster and Phillips (1912) observed it attacking the green bug (*Toxoptera*), an aphid. Osborn (1912) states that it is one of the most efficient checks to leafhoppers on grasses but that it is not often seen feeding, because it kills and disposes of its prey quickly. Knowlton (1935, 1937) presents very detailed observations of its feeding on beet leafhopper and (1934) on potato psyllids. Flint (1918) found it to be one of the most common predators on chinch bugs, feeding on both nymphs and adults. The nabids ate an average of two chinch bugs a day over a two to three week observation period. Wildermuth (1917) observed both nymphs and adults feeding on adult flea beetles and Luginbill (1928) and Hofmaster and

Greenwood (1949) observed the species to feed on fall armyworm larvae. Garman and Jewett (1914) found it to be a useful check on the increase of the corn earworm. The identity of the species recorded, especially in some of the earlier papers, must be opened to question, since many entomologists confused *ferus* with *alternatus* and some other species.

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