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Shore Flies (Diptera: Ephydridae) of the Hanford Site, Washington

Abstract

Information is presented concerning the species composition, seasonal appearance, and habitat distribution of shore flies (Diptera: Ephydridae) at the Hanford Nuclear Site located in southcentral Washington State. The Hanford Site represents one of the largest undisturbed remnants of a shrub-steppe plant community in the western United States. Fifty-six species of shore flies in 32 genera were collected during the period 1994-1997. Aspects of the temporal distribution, relative abundance, and habitat selection of each species are discussed and compared to their appearance in the greater Pacific Northwest and with the results of a similar study conducted at Mount Rainier National Park which is located in the Cascade Mountain Range of central Washington. New distribution records for Washington are *Atissa litoralis*, *Hydrochasma faciale*, *Leptopsilopa varipes*, *Notiphila erythrocera*, *Philotelma alaskensis*, *Scatophila unicornis*, and *Trimerina nadizans*. Because the Hanford Site was removed from public access and therefore widespread development in 1943, this study provides an understanding of the shore fly fauna that might have been common throughout the semi-arid, shrub-steppe region of central Washington before the advent of large-scale agriculture and urbanization.

Introduction

Shore flies (Ephydridae) constitute one of the most species-rich families of acalyptrate Diptera in North America. They are one of the more biologically diverse groups of flies, occurring in almost every aquatic habitat including fresh and alkaline waters, hot and cold mineral springs, and pools of crude petroleum. The world fauna was cataloged by Mathis and Zatwarnicki (1995). Worldwide, the family comprises over 1750 species, approximately 440 of which occur in America north of Mexico. Zack (1979, 1983a) surveyed the shore flies of Mount Rainier National Park which is located in the Cascade Mountain Range of Washington, and found 59 species in 22 genera in the physiographically and ecologically diverse habitats of the Park. Although not as ecologically diverse, consisting of several small spring systems and a single alkaline pond, the Hanford Site nonetheless yielded 56 species in 32 genera. In general, the shore fly fauna of Hanford is like that found throughout the central basins of Washington and Oregon and may represent a species composition that was characteristic of a much more widespread shrub-steppe habitat before the advent of large-scale agriculture and urbanization.

Located in the Pasco Basin of the southeast corner of the Columbia Plateau, primarily in northern Benton County, Washington, the Hanford Site comprises 560 square miles of predominantly shrub-steppe habitat administered by the United States Department of Energy. The land was acquired in 1943 as a national security area for the production of plutonium used in nuclear weapons. Most of the Site has been closed to the public since 1943. Today, Hanford is less known as a site of nuclear weapons development than for its international reputation in nuclear waste management, environmental restoration, and research and development.

From an ecological standpoint, the placing of such a large tract of land virtually off limits to public access for over half a century has preserved a shrub-steppe ecosystem that has otherwise changed radically throughout the surrounding Columbia Plateau. Hanford serves as a refuge for many plants and animals, including insects, that probably were once common throughout the Plateau but today are confined to remaining small, undisturbed tracts of land.

Climate at Hanford is best characterized as semi-arid with hot and dry summers and cold winters. Precipitation ranges from 30-35 cm at the crest of Rattlesnake Mountain (1150m) to less than 12 cm in central Hanford and along the Columbia River (150m). Temperature ranges from an average of 3°C in January to 33°C in July; temperatures of 32°C or above occur an average of 56 days per year (ERDA 1975).

In addition to general surveys (ERDA 1975, Rogers 1979), specific groups of insects studied at the Hanford Site include darkling beetles

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(Rickard et al. 1974, Rickard and Haverfield 1965, Rogers et al. 1978), ground dwelling beetles (Rickard 1970), grasshoppers (Sheldon and Rogers 1978), torymid wasps (Grissell and Zack 1996), and weevils (O'Brien and Zack 1997). The vascular plants of Hanford, including details of the riparian flora, are found in Sackschewsky et al. (1992). Aspects of both flora and fauna are treated in Downes et al. (1993).

Materials and Methods

Shore flies were sampled using a standard 15 inch diameter fine-mesh, aerial insect net. In open, vegetation-free riparian and non-riparian areas, sweeping was conducted as close to the surface of the ground as possible. When disturbed, some groups of shore flies (e.g., *Atissa*, *Mosillus*, and *Parydra*) do not fly far in a vertical plane but will skim the surface in a horizontal direction. They can be difficult to collect if the net does not virtually touch the surface. In riparian areas with sparse vegetation along the shoreline or with low, emergent vegetation such as watercress, sweeping again took place as close to the surface of the water or ground as possible. When larger emergent plants such as cattail or sedges were present I tried to sweep through the vegetation. Species of *Notiphila*, especially, often perch on vegetation while other taxa such as *Ilythea* and certain *Parydra* are found at the ground surface between such plants. In any riparian area it is essential to completely sample all available microhabitats.

Sampling was not quantitative in design. In each habitat, flies were collected differentially from each of the microhabitats. Open riparian areas (e.g., the crust surrounding the alkaline pond) could be easily sampled in a minimal number of sweeps while heavily vegetated areas sometimes required the sight identification of flies on specific pieces of vegetation before they could be captured. In non-riparian grasses, shore flies usually were taken while sweeping for non-shore fly taxa, especially leafhoppers. The amount of time spent at each site during a given collecting period also varied depending on the availability of shore fly habitat due to events such as flooding and the presence or absence of seasonal vegetation.

After netting, flies were aspirated and placed into killing jars. Flies were eventually sorted, counted, and a representative sample prepared and deposited into the M. T. James Entomological Collection at Washington State University.

Table 1 indicates the general habitat type in which each species was encountered. I have defined the following broad habitat types at Hanford: 1. non-riparian vegetation; 2. alkaline pond; 3. spring/vegetation; and 4. spring/non-vegetation. Non-riparian vegetation consisted of areas, primarily with grasses, removed from surface waters by at least 500 m, that supported populations of shore flies. Within this habitat are species such as *Philygria debilis* Loew and *P. nigrescens* Cresson, the larvae of which probably feed on soil microorganisms, plant detritus, and possibly plant rootlets. Alkaline pond species are those found on the water surface of the pond or on the alkaline crust and vegetation-free or sparsely vegetated margins of the pond. The larvae of these species (e.g., *Mosillus bidentatus* (Cresson) and *Haloscatella muria* Mathis) probably feed on microorganisms including primarily algae and some decaying, wrack vegetation. Spring/vegetation species are most commonly associated with vegetation (e.g., sedges, cattails, and watercress) emerging from the water or immediately adjacent to it. Larvae of these taxa (e.g., *Notiphila* and *Hydrellia*, see Deonier 1971) are primarily phytophagous feeding on the roots and stems of those plants. Spring/non-vegetation species are found in vegetation free or sparsely vegetated outflow areas surrounding the springs themselves. At Hanford, the largest of these systems was Rattlesnake Spring. Taxa found in this habitat include certain *Scatella*, *Parydra*, *Atissa*, and *Discocerina*. Larvae of these species feed on microorganisms, primarily algae, and possibly some decaying vegetation. In this habitat, the presence and abundance of a given species may fluctuate dramatically based on the amount of available habitat which is subject to changes due primarily to periodic flooding.

As in previous studies (Scheiring and Foote 1973, Zack 1979, 1983a), the relative abundance of each species is calculated based on its percentage of the total number of specimens taken within each of the four designated habitats. In all situations where only a single specimen was taken, the species is listed as rare (Table 1). Abundance figures were designated as follows:

rare (r)	0-3 percent of the total catch/habitat
occasional (occ)	3-9 percent
common (c)	9-15 percent
abundant (a)	15-26 percent
very abundant (va)	26 percent and greater

TABLE 1. Species inventory, habitats, relative abundance, and months during which individual species were collected.

Species	Habitat Type and Relative Abundance	Months Species was Collected
Subfamily Discomyzinae		
Leptopsilopa varipes (Coquillett)*	spring/vegetation (occ)**	Mar, Sep
Psilopa compta (Meigen)	spring/vegetation (occ)	Mar, Apr, May, Jun, Jul, Aug, Oct
P. girschneri von Röder	spring/vegetation (occ) non-riparian vegetation (r)	Apr, Jun, Aug, Oct
Trimerina madizans (Fallén)*	spring/vegetation (r)	Jun
Subfamily Hydrellinae		
Atissa litoralis (Cole)*	spring/non-vegetation (r)	May, Jun, Oct
Hydrellia griseola (Fallén)	spring/vegetation (a) non-riparian vegetation (c)	Mar, Apr, May, Jun, Jul, Aug, Sep, Oct
H. proclinata Cresson	spring/vegetation (a)	May, Jun, Jul, Aug
H. sp. 1	spring/vegetation (r)	Mar, May, Jun, Aug, Oct
H. sp. 2	spring/vegetation (r)	Aug, Oct
H. sp. 3	spring/vegetation (r)	May
Notiphila aenegma Cresson	spring/vegetation (occ)	May, Jun, Aug
N. decoris Williston	spring/vegetation (r)	Jun, Jul, Aug, Oct
N. erythrocera Loew*	spring/vegetation (r)	Jun, Aug, Oct
N. macrochaeta Loew	spring/vegetation (r)	May, Jun, Jul, Aug, Oct
N. olivacea Cresson	spring/vegetation (occ)	May, Jun, Aug
N. quadrisetosa Thomson	spring/vegetation (r)	May, Jun, Jul, Aug, Oct
Ptilomyia alkalinella (Cresson)	alkaline pond (occ)	Jun
Typopsilopa arnaudi Wirth*	spring/vegetation (occ)	Mar, Jun, Jul, Aug, Oct
Subfamily Gymnomyzinae		
Allotrichoma sp.	spring/non-vegetation (occ) non-riparian vegetation (r)	Mar, Apr, May, Jun, Jul, Aug, Oct
Diclasiopa lacteipennis (Loew)	spring/non-vegetation (r)	Jul
Discocerina obscurella (Fallén)	spring/non-vegetation (occ)	May, Jul, Aug
Gymnoclasiopa argyrostoma (Cresson)	spring/non-vegetation (occ) non-riparian vegetation (r) alkaline pond (r)	Mar, Apr, May, Jun, Jul, Aug
Hydrochasma faciale (Williston)	spring/non-vegetation (r)	Jul
Mosillus bidentatus (Cresson)	spring/non-vegetation (occ) alkaline pond (occ)	Apr, Jun
M. tibialis Cresson	spring/non-vegetation (c)	May, Jun, Jul, Sep
Ochthera anatolikos Clausen	spring/non-vegetation (r)	Jun
O. occidentalis Clausen	spring/non-vegetation (r) spring/vegetation (r)	Jun, Jul, Aug
Polytrichophora setigera (Cresson)	spring/non-vegetation (r)	May
Subfamily Ilytheinae		
Hyadina binotata (Cresson)	spring/non-vegetation (r) spring/vegetation (r)	Mar, May, Jun, Jul
Ilythea caniceps Cresson	spring/vegetation (r)	Mar, May, Jul, Sep
Lytogaster gravida Loew	spring/non-vegetation (r) spring/vegetation (r)	Mar, May, Jun, Jul, Aug, Sep, Oct
Nostima picta picta (Fallén)	spring/vegetation (r)	Apr, Aug
Philygria debilis Loew	spring/vegetation (occ) non-riparian vegetation (a)	Mar, Apr, May, Jun, Jul, Aug, Sep, Oct
P. nigrescens (Cresson)	spring/vegetation (r) non-riparian vegetation (occ)	May, Jun, Jul, Aug, Sep
Pelina prospinosa Clausen	spring/vegetation (r)	Mar, Jul, Oct

Table 1 Continued, next page

TABLE 1. Continued

Species	Habitat Type and Relative Abundance	Months Species was Collected
Subfamily Ephydrinae		
Calocoenia platypelta (Cresson)	spring/vegetation (r)	Oct
Ephydra packardi Wirth	spring/non-vegetation (r)	Aug
Haloscatella arichaeta (Mathis)	spring/non-vegetation (occ) alkaline pond (occ)	May, Jun, Jul
H. muria (Mathis)	spring/non-vegetation (occ) alkaline pond (r)	May, Jun, Jul, Aug
Lamproscatella occidentalis Mathis	spring/non-vegetation (a) non-riparian vegetation (occ)	Mar, Apr, May, Jun, Oct
Limnellia turneri Mathis	spring/vegetation (occ) non-riparian vegetation (r)	Mar, May, Jun, Sep, Oct
Paracoenia bisetosa (Coquillett)	spring/non-vegetation (occ) alkaline pond (va)	Mar, Jun, Jul
Parydra aquila (Fallén)	spring/non-vegetation (r)	May, Jun, Jul
P. aurata Jones	spring/non-vegetation (r)	Mar, Jun, Jul, Aug
P. fossarum (Haliday)	spring/non-vegetation (a)	Mar, May, Jun, Jul, Aug, Oct
Philotelma alaskensis Cresson*	spring/non-vegetation (r)	May
Scatella marinensis (Cresson)	spring/vegetation (r)	Mar, Apr, May, Jun, Aug
S. paludum (Meigen)	spring/vegetation (occ) spring/non-vegetation (va)	May, Jun, Jul, Aug, Oct
S. stagnalis (Fallén)	spring/vegetation (a) spring/non-vegetation (va)	Mar, Apr, May, Jun, Jul, Aug, Sep, Oct
S. triseta Coquillett	spring/vegetation (r)	Mar, May, Jun, Jul
Scatophila despecta (Haliday)	spring/vegetation (occ) spring/non-vegetation (a)	Mar, Apr, May, Jun, Jul, Aug, Sep, Oct
S. exilis Cresson	spring/vegetation (r) spring/non-vegetation (r)	Mar, Apr, May, Jun, Jul, Oct
S. unicornis Czerny	spring/vegetation (r)	May
S. sp. 1	spring/vegetation (r)	Apr
S. sp. 2	spring/vegetation (r)	Mar
S. sp. 3	spring/vegetation (r) spring/non-vegetation (r)	Mar, Apr, May
S. sp. 4	spring/vegetation (r)	May
Setacera aldrichi Cresson	spring/vegetation (r)	Oct
S. needhami Johannsen	spring/non-vegetation (r)	Oct
S. pacifica (Cresson)	spring/non-vegetation (r)	Mar

*indicates a new distribution record for Washington State (Mathis and Zatwarnicki 1995)
**Letters indicate relative abundance: va=very abundant, a=abundant, c=common, occ=occasional, r=rare (see text for explanation)

Temporal differences are not taken into account in these abundance designations but presence during seasonal periods can be obtained from the discussion of each species found in the Results section of this paper. Shore flies were sampled at the Hanford Site 36 times during the four year period. However, not all sites were sampled during each visit and the apparent absence of a species during seasonal periods should not be taken as an indication that the species was not present. Based on numerous systematic and distributional studies (see for example, Zack 1979, 1983a, Deonier 1965, Scheiring and Foote 1973, as well as revisional studies cited in this paper) most shore fly species are multivoltine with no seasonal breaks in occurrence given the availability of appropriate habitat. Since many aquatic habitats, especially small spring systems and alkaline ponds which made up the majority of habitats on the Hanford Site, are subject to dramatic changes throughout the year, one would expect shore fly populations and species composition to fluctuate depending

on the frequency and severity of environmental factors such as precipitation. Observationally, this was the situation at Hanford.

Survey Sites

Administratively, Hanford is divided into several subunits. Two of these subunits were surveyed during this study. The first is often referred to as central Hanford. This area is bordered by the Columbia River to the north and east, Route 24 to the northwest, and the Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE) to the west. The Arid Lands Ecology Reserve was the second subunit surveyed. ALE is an area of approximately 75,000 acres that lies to the south and west of central Hanford. ALE runs north and east from the summit of Rattlesnake Ridge (1150 m) to the Cold Creek Valley (150 m). Fourteen intermittent and permanent springs occur on ALE; these are the only lotic habitats, aside from the Columbia River, that occur at Hanford.

Three sites on central Hanford yielded shore flies. While the Hanford Site contains a long stretch of free-flowing Columbia River, only one site along the River was surveyed and this was on just two occasions. The Columbia River pumping station site lies along the River near the Washington Public Power Supply System nuclear energy generating plants approximately 20 km north of Richland. Rocky areas along the River and small pools adjacent to it were swept for flies. The site along the River was generally unproductive for shore flies.

The only naturally occurring pond on the Hanford Site is West Lake. This alkaline pond is situated at the west end of Gable Mountain. West Lake is surrounded by an alkaline crust with no emergent macrovegetation along the shoreline. However, large areas of bulrush (*Scirpus* spp.) and various grasses and other vegetation occur in the area surrounding the pond. The size of the pond is a direct function of groundwater elevation and fluctuates throughout long and short term periods depending on climate and seasonal weather conditions. On average, the pond encompasses ten acres. Because the pond is not referred to as "West Lake" on any topographic maps, I chose to label the insects as collected at an "alkaline pond." This is the designation that appears in the Results section of this paper and on specimen labels.

A large area of sand dunes exists along the western margin of the Columbia River and several kilometers inland. The dunes were sampled extensively for various taxa. Shore flies were not a target of these surveys but were collected on two occasions by sweeping sand dune vegetation. Only *Psilopa girschneri* von Röder, *Philygria debilis* Loew, and *Allotrichoma* sp. were taken at this site. These species may have been collecting plant nectar as a food source.

Shore flies were collected from nine sites on ALE, although three of these sites were not riparian. The radio telescope site is located at the southeast corner of Rattlesnake Ridge and primarily consists of a big sagebrush (*Artemisia tridentata* Nutt.)/bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scrib. & Smith) plant community. Other equivalent, non riparian survey sites along the Ridge are listed as Rattlesnake Ridge in discussions of species. The third non-riparian site is recorded as the 1200 Foot Road. This was a dirt access road, with abundant adventitious vegetation, located at approximately 360 m (1200 ft) in elevation at the southeast base of Rattlesnake Ridge. Collecting at all of these sites involved general sweeping of vegetation as shore flies were not expected to be common.

Fourteen intermittent and permanent springs have been mapped on ALE; four of these systems were sampled during this study. The site designated Rattlesnake Ridge/spring is an unnamed spring that occurs just below the summit of the Ridge on the northeast facing slope. This spring consisted of a small pool approximately one meter in diameter and a cascading flow that traveled 10-15 meters before it disappeared into the soil. Several small, shrubby willows (*Salix* spp.) grow along the margins of the spring and stream providing some shade while sedge (*Carex* spp.) and cattail (*Typha latifolia* L.) grew sparingly.

The Rattlesnake Spring system is situated in the northwest corner of ALE on the flat of Cold Creek Valley. This is the most prominent, permanent spring on the Hanford Site and flows for about 3 km, beginning from ground seepage and being fed by a number of smaller springs along its course. Eventually it disappears into the ground. The bottom of the stream is composed of sand and gravel. The system is subject to periodic flash floods, especially in the winter and spring, that may completely scour sections of the stream form-

ing areas of vegetation-free shoreline. Over 90 species of algae and diatoms have been recorded from the system (ERDA 1975) but the dominant macrophyte is watercress (*Rorippa nasturium-aquatica* (L.) Schinz & Thell.) which seasonally occupies as much as 85% of the stream area (ERDA 1975). Cattail and sedges are common along the stream margin. Peachleaf willow (*Salix amygdaloides* Anders.) is the dominant tree throughout the Rattlesnake Spring corridor.

Lower Snively Spring (including the sites designated below Lower Snively Spring and Snively Ranch) is another large spring system occurring in Snively Canyon which lies south of Rattlesnake Spring. This system runs approximately 2 km down Snively Canyon. In addition to vegetation discussed for Rattlesnake Spring, shrubby willows, mockorange (*Philadelphus lewisii* Pursh), and black cottonwood (*Populus trichocarpa* T. & G.) dominate the spring corridor.

Bobcat Spring lies in lower Bobcat Canyon which is located at the base of Rattlesnake Ridge in central ALE. This is a spring system consisting of a small pool 5-6 meters in diameter with a short-lived outflow which eventually disappears into the ground. Although a thick margin of shrubs surround the spring, there is no extensive canopy and the spring and stream are usually choked with watercress.

Distributional information is taken primarily from Mathis and Zatwarnicki (1995). Species indicated as new for Washington are not recorded in their catalog as occurring in the state. Dates listed for a species collection should not be interpreted as inclusive or an indication that the species was not at a survey site at other time periods. Not all sites were collected on a systematic basis; some more remote sites were sampled only 4-5 times during the survey while other more accessible sites were sampled as many as 20 times. The following arrangement follows that in Mathis and Zatwarnicki (1995) except that species are arranged alphabetically within subfamilies. When available, I have included biological information.

Results

Subfamily Discomyzinae

Leptopsilopa varipes (Coquillett). New WA record: 28 Mar, 15 Sep. Rattlesnake Ridge/spring, Bobcat Canyon. *Leptopsilopa varipes* is a western species previously recorded from British Columbia, California, and Idaho. The fact that the species was collected only in the early spring and late summer probably does not indicate that it is a spring/fall species.

Psilopa compta (Meigen). 22 Mar, 29 Mar, 11 Apr, 24 Apr, 3 May, 1 Jun, 21 Jun, 20 Jul, 5 Aug, 11 Oct. Rattlesnake Spring, Lower Snively Spring, Snively Ranch, Bobcat Canyon. Found throughout the Afrotropical, and Holarctic Regions, this is a common species throughout the Pacific Northwest, especially in habitats with extensive shoreline vegetation. At Mount Rainier (Zack 1979, 1983a), it was the most abundant species in the sedge meadow habitat. Throughout eastern Washington, *P. compta* is extremely common in both the sedge meadow and cattail marsh habitats. Zack (1983a) presented information on the biology of this fly.

Psilopa girschneri von Röder. 20 Apr, 10 Jun, 21 Jun, 5 Aug, 29 Aug, 11 Oct. Rattlesnake Spring, Lower Snively Spring, Rattlesnake Ridge/spring, sand dunes. *Psilopa girschneri* is found throughout much of the world. One specimen was taken at Mount Rainier in the sedge meadow habitat (as *Psilopa olga* Cresson). At Hanford, it was found to be sympatric with *P. compta* at most sites on most dates. Throughout eastern Washington, it can be found with *P. compta*, often abundantly.

Trimerina madizans (Fallén). New WA record; 21 Jun. Rattlesnake Spring. This Holarctic species was previously reported from several northeastern states and Quebec and as far west as Iowa and Ohio. Only one specimen was collected on the Hanford Site. I have collected the species from southern (Hart Mountain Wildlife Refuge, Lake County) and northcentral Oregon (McNary Wildlife Area, Umatilla County) as well as at three locations in eastern and central Washington. The species has never been found in abundance, and no more than two specimens have been taken at any location. All specimens were taken while sweeping thick vegetation surrounding springs or small pools.

Subfamily Hydrelliinae

Atissa litoralis (Cole). New WA record:16 May, 21 Jun, 11 Oct. Rattlesnake Spring, Lower Snively Spring. Previously reported from California and Oregon in the west and Ohio and Iowa in the midwest. Only four specimens were collected. I

have collected this species at several sites throughout eastern Washington, primarily on vegetation-free shorelines of small pools.

Hydrellia griseola (Fallén). 29 Mar, 19 Apr, 20 Apr, 3 May, 15 May, 16 May, 1 Jun, 10 Jun, 21 Jun, 7 Jul, 12 Jul, 20 Jul, 31 Jul, 5 Aug, 19 Aug, 29 Aug, 1 Sep, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Bobcat Canyon, Rattlesnake Ridge/spring, radio telescope, Columbia River pumping station.

H. griseola was collected in numerous aquatic and nonaquatic habitats throughout the Hanford Site. The species was abundant throughout the field season. *H. griseola* is nearly cosmopolitan and is occasionally considered a pest of rice; Mathis and Zatwarnicki (1995) presented an extensive list of host plants. Although abundant in and around riparian situations where the larvae bore stems of aquatic vegetation, adults are also found considerable distances from water where they visit flowers and feed on plant nectar. At Hanford, most specimens were taken by sweeping riparian vegetation. However, the species was not uncommon in meadow and grassy areas far removed from water. Although nectaring sources often were not identified, several specimens were taken from the flowers of meadow goldenrod, *Senecio canadensis* L.

This is one of the most commonly collected northwestern shore flies; it is certainly the most common in areas with substantial riparian vegetation, but it also occurs on shorelines with extensive non-vegetated areas where adults probably feed on algae and other microorganisms. At Mount Rainier, *H. griseola* was collected in seven of 10 habitat types sampled and was very abundant on flower heads of pearly-everlasting [*Anaphalis margaritacea* (L.) B&H] (Zack 1979, 1983a). While shore fly/flowering plant associations are reported elsewhere in the literature (Deonier 1971; Scheiring and Foote 1973; Judd 1977) they are, nonetheless, rare.

Hydrellia proclinata Cresson. 3 May, 1 Jun, 7 Jul, 12 Aug, 29 Aug. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Rattlesnake Ridge/spring. This common species is found throughout most of the western United States and western Canada. It is often taken in conjunction with *H. griseola*. At Mount Rainier, the species was found in several habitat types, but was most common in vegetation of roadside ditches (Zack 1979, 1983a). At both Mount Rainier and Hanford it was not found in meadows or visiting flowers as was *H. griseola*.

Hydrellia is a species-rich taxon last revised by Deonier (1971). Species are sometimes difficult to identify and numerous new species, especially in the Pacific Northwest fauna, have been recognized but not yet described. I chose not to apply names to the following three species at this time. Although they appear related to described species with northwestern distributions, differences in morphology and genitalia indicate that some species may be more variable than previously defined or that these are new species. Continuing faunistic and systematic studies should help to clarify these situations. Intensive collecting of often host-plant specific and therefore habitat-specific *Hydrellia* is needed.

Hydrellia sp. 1. 29 Mar, 16 May, 21 Jun, 19 Aug, 11 Oct. Rattlesnake Spring, Lower Snively Spring.

Hydrellia sp. 2. 29 Aug, 11 Oct. Rattlesnake Spring.

Hydrellia sp. 3. 16 May. Rattlesnake Spring.

Notiphila aenigma Cresson. 3 May, 16 May, 1 Jun, 21 Jun, 5 Aug, 19 Aug, 29 Aug. Rattlesnake Spring, Lower Snively Spring, Rattlesnake Ridge/spring. This species occurs throughout the western United States and southwestern Canada. It was the second most abundant *Notiphila* (next to *N. quadrisetosa*) collected on the Hanford Site and is one of the most commonly collected species in the central basin of Washington. Mathis (1979) and Busacca and Foote (1978) discussed the biology of this species. The latter paper also contains descriptions of the immature stages. Two specimens of *N. aenigma* were collected at Mount Rainier, one each in the sand shore and sedge meadow habitats (Zack 1979, 1983a).

Notiphila decoris Williston. 21 Jun, 20 Jul, 19 Aug, 29 Aug, 11 Oct. Rattlesnake Spring. Like all other species of *Notiphila*, *N. decoris* was swept from emergent vegetation around the margin of a permanent spring. This is a common species throughout eastern Washington and eastern Oregon and is often found sympatrically with *N. macrochaeta*.

Notiphila erythrocera Loew. New WA record. 10 Jun, 21 Jun, 5 Aug, 19 Aug, 29 Aug, 11 Oct. Rattlesnake Spring. This species is Neotropical and Nearctic in distribution; it occurs throughout

most of the United States. It appears, however, to reach its northern limit in Washington where it is here recorded for the first time. Although it was collected throughout the season, I never found more than one or two individuals at any site during a day's collecting activities. It was always taken in conjunction with other species of *Notiphila*. During intensive collecting throughout Washington, this is the only known location where *N. erythrocera* occurs.

Notiphila macrochaeta Loew. 3 May, 1 Jun, 7 Jul, 5 Aug, 19 Aug, 29 Aug, 11 Oct. Rattlesnake Spring. Mathis (1979) states that *N. macrochaeta* is often taken with specimens of *N. olivacea* and *N. decoris*. This was certainly the case at Hanford where the three species were taken together in almost all collections.

Notiphila olivacea Cresson. 3 May, 16 May, 1 Jun, 21 Jun, 5 Aug. Rattlesnake Spring. This is one of the most commonly collected *Notiphila* in the Pacific Northwest. I have collected it throughout the central basin of Washington in vegetation, especially sedges, around the margins of both fresh and slightly alkaline ponds.

Notiphila quadrisetosa Thomson. 3 May, 16 May, 1 Jun, 10 Jun, 21 Jun, 7 Jul, 5 Aug, 19 Aug, 29 Aug, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring. *Notiphila quadrisetosa* is widely distributed and commonly collected in Washington; the Hanford Site is no exception.

Ptilomyia alkalinella (Cresson). 27 Jun. Alkaline pond. This western species is a common component of the fauna occurring on the vegetation free margins of alkaline ponds throughout central Washington. At Hanford, specimens were taken only at the alkaline pond.

Typopsilopa arnaudi Wirth. New WA record; 22 Mar, 1 Jun, 7 Jul, 5 Aug, 19 Aug, 29 Aug, 11 Oct. Rattlesnake Spring and Bobcat Canyon. This species is known from throughout the western United States and south to Baja California Norte in Mexico. I have collected it at several other locations in southcentral Washington, but not in northern Washington or in southern British Columbia. The basin area of southcentral Washington may represent its northernmost occurrence.

Subfamily Gymnomyzinae

Allotrichoma sp. 29 Mar, 11 Apr, 20 Apr, 24 Apr, 16 May, 1 Jun, 10 Jun, 21 Jun, 7 Jul, 20 Jul, 29 Aug, 11 Oct, Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Snively Ranch, Rattlesnake Ridge/spring, sand dunes. *Allotrichoma* and related genera have a long and complicated taxonomic history. Species are difficult to define and numerous undescribed species certainly exist. *Allotrichoma* is a common component of the northwestern shore fly fauna and is especially abundant in the central basins of Washington and Oregon. The genus is in need of revision.

Diclasiopa lacteipennis (Loew). 12 Jul. Rattlesnake Spring. Only one specimen of this species was collected at Rattlesnake Spring. *Diclasiopa lacteipennis* occurs in the Afrotropical, and Holarctic Regions and is found along vegetation free shorelines of most central Washington streams and small pools.

Discocerina obscurella (Fallén). 3 May, 16 May, 31 Jul, 19 Aug. Rattlesnake Ridge/spring, Rattlesnake Spring, Lower Snively Spring. This is one of the most widespread species of shore fly occurring in the Afrotropical, Neotropical, and Holarctic Regions. It is a very common component of mud and sand shore habitats throughout the Pacific Northwest. Zack (1979, 1983a) found *D. obscurella* in the moist meadow and mud and sand shore habitats at Mount Rainier National Park. The biology and immature stages of this species were treated by Foote and Eastin (1974).

Gymnoclasiopa argyrostoma (Cresson). 29 Mar, 11 Apr, 15 May, 16 May, 9 Jun, 10 Jun, 27 Jun, 7 Jul, 8 Jul, 12 Aug, 19 Aug. Rattlesnake Spring, Lower Snively Spring, Snively Ranch, Rattlesnake Ridge/spring, alkaline pond, radio telescope, Rattlesnake ridge. This was one of the most commonly encountered species on the Hanford Site, being collected in both aquatic and nonaquatic situations. It is one of the few species of shore fly that is found in grasslands and meadows, often a considerable distance from water. It is not known if larvae live and feed in the soil of these habitats or if adult flies travel from more normal shore fly aquatic and semi-aquatic breeding and larval sites. In aquatic situations, adults are common on open mud and sand shores.

The species has a sporadic distribution in the western United States and Saskatchewan, Canada. It is one of the most commonly encountered species in Washington and the Pacific Northwest; it was found in seven of 10 habitat types surveyed

at Mount Rainier (Zack 1979, 1983a) and was very common in the wet woodland and sand shore habitats. It was also very abundant on the flowers of *Anaphalis margaritacea* (L.) B&H and travels from aquatic habitats in search of plant nectar (see discussion of *Hydrellia griseola*).

Hydrochasma faciale (Williston). New WA record. 12 Jul, 20 Jul, 31 Jul. Rattlesnake Spring. This species is primarily Neotropical in distribution with previous Nearctic records from California, Arizona, and Texas. The species probably occurs throughout much of the more arid central basin of western North America. Southcentral Washington may represent its northern limit. Collected only in July, the species may have a limited temporal distribution.

Mosillus bidentatus (Cresson). 11 Apr, 20 Jun, 28 Jun. Rattlesnake Spring, Lower Snively Spring, alkaline pond. This species is known from throughout the western and central United States where it can be abundant along vegetation-free shore margins of ponds and streams. It is especially prevalent along the margins of alkaline ponds, as it is at Hanford. Mathis et al. (1993) revised *Mosillus* and present short discussions of this and the following species.

Mosillus tibialis Cresson. 16 May, 1 Jun, 10 Jun, 21 Jun, 7 Jul, 8 Jul, 20 Jul, 1 Sep. Rattlesnake Spring, below Lower Snively Spring, Rattlesnake Ridge/spring. This widely distributed species is found throughout the United States and southern British Columbia to sites in Central and South America. Like *M. bidentatus*, this species is more commonly found along vegetation-free margins of ponds and springs. In extensive collecting throughout the central basin of Washington, it appears that *M. tibialis* is more prevalent in fresh to slightly alkaline situations while *M. bidentaus* is more common in moderately to highly alkaline situations. Both species, however, are most often associated with wrack vegetation and this may be where eggs are deposited and larvae feed. Mating is often observed on this wrack debris.

Ochthera anatolikos Clausen. 1 Jun. Lower Snively Spring. One male specimen of this species was collected on the Hanford Site. This is one of the most widespread species of *Ochthera*, occurring throughout most of the United States and Canada, and being especially common in the northeast. It has been found throughout Washington.

Ochthera occidentalis Clausen. 1 Jun, 7 Jul, 5 Aug. Lower Snively Spring. *Ochthera occidentalis* is found primarily in the western United States and western Canada. This species also occurs throughout Washington, and one specimen was collected at Mount Rainier (Zack 1979, 1983a). *Ochthera occidentalis* is the most commonly collected *Ochthera* in central Washington.

Ochthera females. Several species of *Ochthera* often occur sympatrically at single locations, and females are difficult if not impossible to separate. While specimens included in this category probably include the two species thus far identified from the Hanford Site, it is possible that other species, including *O. collina* Clausen which also occurs in the central basin of Washington, occur at Hanford. All *Ochthera* are predaceous as both adults and immatures and can be found in almost all aquatic habitats where they prowl both open riparian areas as well as shore line vegetation searching for prey. The genus was revised by Clausen (1977).

Polytrichophora setigera (Cresson). 16 May. Lower Snively Spring. Only two specimens were taken at the Hanford Site. *Polytrichophora setigera*, however, is a common inhabitant of pond and slow moving stream margins throughout the central basin of Oregon and Washington. It occurs mainly in riparian areas devoid of vegetation.

Subfamily Ilytheinae

Hyadina binotata (Cresson). 29 Mar, 16 May, 1 Jun, 21 Jun, 7 Jul. Rattlesnake Spring, Lower Snively Spring. The species appears to have a widespread but spotty distribution with records from Alaska in the west to Georgia and Ohio in the East, to Mexico in the south. Additional studies will probably fill many of these distributional gaps. Zack (1979, 1983a) found the species to be a rare inhabitant in the moist meadow, mud shore, and sand shore habitats. Clausen (1983), in his revision of the genus, records *H. binotata* as a common northwestern species.

Ilythea caniceps Cresson. 22 Mar, 28 Mar, 29 Mar, 16 May, 7 Jul, 27 Sep. Lower Snively Spring, Snively Ranch, Bobcat Canyon, Rattlesnake Ridge/spring. *Ilythea spilota* is an uncommon inhabitant of spring habitats throughout the northwest. On Mount Rainier, it was collected only in the sedge meadow habitat (Zack 1979, 1983a). At Hanford, specimens were collected by sweeping

vegetation along the margins of several springs. The species appears to occur primarily on the substrate rather than on the vegetation.

Lytogaster gravida Loew. 29 Mar, 3 May, 16 May, 1 Jun, 21 Jun, 7 Jul, 5 Aug, 19 Aug, 15 Sep, 27 Sep, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Bobcat Canyon, Rattlesnake Ridge Spring. This is a geographically widespread species that can be found in most aquatic habitats with at least some partially vegetation-free areas. At Mount Rainier, it was found rarely in four of the habitat types sampled (Zack 1979, 1983a). It is most often collected close to the water's edge or in vegetation over the water. This was the case at Hanford where it was collected only along the margins of several springs.

Nostima picta picta (Fallén). 11 Apr, 24 Apr, 5 Aug, 12 Aug, 19 Aug, Lower Snively Spring, Snively Ranch, Rattlesnake Ridge/spring. This extremely handsome species is found throughout much of the Neotropical and Holarctic Regions. In Washington, it is not commonly collected but it is found in vegetation around the margins of small pools and springs.

Philygria debilis Loew. 28 Mar, 29 Mar, 19 Apr, 20 Apr, 24 Apr, 3 May, 6 May, 15 May, 16 May, 1 Jun, 13 Jun, 12 Jul, 23 Aug, 29 Aug, 27 Sep, 11 Oct. Rattlesnake Spring, Lower Snively Spring, Snively Ranch, Rattlesnake Ridge/spring, radio telescope, Rattlesnake Ridge, sand dunes. This is a common species throughout all of the northwest and much of North America. It is one of the most common shore flies found in nonaquatic habitats such as grass fields and meadows. Larvae may eventually be found in the soil of such areas, especially where moisture levels are high or consistent. I have collected adults on several golf courses in eastern Washington along the edges of fairways. At Hanford, adults were often taken sweeping flowering plants unassociated with water. At Mount Rainier, the species was abundant on the flowers of *Anaphalis margaritacea* (Zack 1979, 1983a).

Philygria nigrescens (Cresson). 15 May, 9 Jun, 10 Jun, 7 Jul, 12 Aug, 19 Aug, 29 Aug, 27 Sep. Snively Ranch, Rattlesnake Ridge/spring, radio telescope Rattlesnake Ridge. This species is found in the same habitats as *P. debilis*, but it was never as abundant as the latter species.

Pelina prospinosa Clausen. 30 Mar, 12 Jul, 20 Jul, 1 Oct. Rattlesnake Spring, Lower Snively Spring. The species is common throughout most of the western United States and south into Mexico.

The genus *Pelina* was revised by Clausen (1973) who designated several new species that, based on studies throughout Washington, occur sympatrically in many habitat types. Unfortunately, females are difficult if not impossible to identify and there may be more than one species of *Pelina* that occurs at the Hanford Site.

Subfamily Ephydrinae

Calocoenia platypelta (Cresson). 11 Oct. Rattlesnake Spring. Only one specimen of *P. platypelta* was taken by sweeping vegetation along the margin of the spring. The species is found sporadically throughout the western United States.

Ephydra packardi Wirth. 5 Aug. Rattlesnake Spring. This is a commonly encountered shore fly being found throughout much of central and western North America including British Columbia and western Mexico. *Ephydra packardi* can be very abundant along the margins of moderately alkaline ponds throughout the central basin of western North America, especially Washington. It is interesting that this species was not found at the alkaline pond habitat at the Hanford Site; in fact, no *Ephydra* spp. were found at the pond. Several other species of *Ephydra* are found throughout central Washington and could eventually be found at the Hanford Site.

Haloscatella arichaeta (Mathis). 16 May, 1 Jun, 21 Jun, 7 Jul. Rattlesnake Spring, alkaline pond. This species occurs throughout the northwestern and midwestern states. In the Pacific Northwest, it is often found in abundance along the margins of alkaline ponds and lakes. At Hanford, it was almost always taken with collections of *H. muria* (Mathis), as is common throughout central Washington. It is, however, rarely as abudnant as *H. muria*.

Haloscatella muria (Mathis). 16 May, 21 Jun, 27 Jun, 7 Jul, 5 Aug. Rattlesnake Spring, Lower Snively Spring, alkaline pond. *Haloscatella muria* is found throughout much of the United States. It is a common inhabitant of vegetation-free spring and pond margins of both fresh and alkaline waters.

Lamproscatella occidentalis Mathis. 22 Mar, 29 Mar, 11 Apr, 19 Apr, 24 Apr, 3 May, 4 May, 16 May, 1 Jun, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Snively Ranch, Bobcat Canyon, radio telescope, Rattlesnake Ridge. This was one of the more abundant species of shore fly taken on the Hanford Site. As are other *Lamproscatella* and *Haloscatella,* it is common around the vegetation-free margins of Washington central basin ponds and springs. However, *L. occidentalis* appears to prefer fresh or only slightly alkaline water. The species was not collected at the alkaline pond on the Hanford Site or at other alkaline ponds throughout the Washington central basin. The species occurs throughout most of western North America and western Canada.

Limnellia turneri Mathis. 22 Mar, 29 Mar, 30 Mar, 15 May, 16 May, 1 Jun, 9 Jun, 27 Sep, 11 Oct. Rattlesnake Spring, Lower Snively Spring, Bobcat Spring, Rattlesnake Ridge/spring, radio telescope, Rattlesnake Ridge, 1200 Foot Road. Although several species of *Limnellia* are found in Washington, *L. turneri* is the most commonly encountered. It was found in three different habitat types at Mount Rainier (Zack 1979, 1983a). At Hanford, it was found in both aquatic and non-aquatic habitats as well as on the flowers of chokecherry (*Prunus virginiana* L.) A few specimens of *L. turneri* were also taken while sweeping unidentified, non-flowering vegetation in areas substantially removed from water of any type.

Paracoenia bisetosa (Coquillett). 22 Mar, 20 Jun, 12 Jul. Rattlesnake Spring, Bobcat Canyon, alkaline pond. *Paracoenia bisetosa* is one of the most common inhabitants of alkaline pond margins, where larvae feed in algal mats. Aspects of life history and descriptions of immatures can be found in Zack (1983b). The species is more common in riparian areas of slightly to moderately alkaline ponds, but it is replaced by species of *Ephydra* in highly alkaline ponds. *Paracoenia bisetosa* is also found along the margins of freshwater pools and springs but never in as prodigious numbers as adjacent to alkaline pools.

Parydra aquila (Fallén). 16 May, 1 Jun, 10 Jun, 7 Jul, 12 Jul, 20 Jul. Rattlesnake Spring, Lower Snively Spring, Bobcat Canyon, Rattlesnake Ridge/spring. Species of *Parydra* are common in open riparian areas where they appear to feed primarily on diatoms. *Parydra aquila* occurs throughout the Holarctic Region and is often one of the more abundant members of the open shore, riparian shore fly community. At Mount Rainier, the species was collected in the sand shore and roadside ditch habitats (Zack 1979, 1983a). At Hanford, the species was rare, and the collection of single specimens was not unusual. This may be a result of little vegetation-free riparian area, the unstable nature of most of the Hanford spring shore lines, and a lack of substantial growth of diatoms along shorelines. The primarily open spring systems with little if any vegetational canopy may not be conducive to the diatom composition that supports *P. aquila* (but see discussion of other *Parydra* spp.).

Parydra aurata Jones. 28 Mar, 1 Jun, 7 Jul, 5 Aug. Lower Snively Spring, below Lower Snively Spring, Bobcat Canyon. *Parydra aurata* is widespread in western North America, occurring from British Columbia south to Mexico. At Hanford, the species was collected in the same habitat types as *P. aquila* but not as often. In Washington, the species is not common but appears to be fairly widespread throughout the central and eastern sections of the state. This species was very abundant around the margins of several hot springs in Harney County, Oregon, but collections from numerous other hot springs throughout Oregon and Washington do not indicate that the species is a major component of the hot spring fauna.

Parydra fossarum (Haliday). 29 Mar, 3 May, 16 May, 1 Jun, 10 Jun, 21 Jun, 7 Jul, 5 Aug, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Bobcat Canyon, Rattlesnake Ridge/spring. This was the most common species of *Parydra* collected at the Hanford Site. While it was not found at Mt. Rainier, it is among the most abundant and widespread of the basin species and appears to prefer warmer, open shoreline waters that are common in the central basin of Washington.

Philotelma alaskensis Cresson. New WA record. 16 May. Lower Snively Spring. Only a single specimen of *P. alaskensis* was taken at the Hanford Site while sweeping a vegetation free margin of the spring. This species has been collected from throughout central and eastern Washington, but always in small numbers. It is taken in both alkaline and fresh water situations. Additionally, new distribution records in my collection for *P.*

alaskensis include British Columbia and along the margin of the Great Salt Lake in Utah.

Scatella marinensis (Cresson). 29 Mar, 24 Apr, 16 May, 1 Jun, 5 Aug. Lower Snively Spring, Snively Ranch. This species is found throughout the western United States and southern British Columbia south to Mexico. *Scatella marinensis* was taken while sweeping emergent vegetation around each of the springs. Only one specimen was taken on each occasion. The species has been collected throughout Washington, often by sweeping emergent vegetation. I have never encountered more than three or four specimens at any collecting site.

Scatella paludum (Meigen). 3 May, 16 May, 1 Jun, 10 Jun, 21 Jun, 7 Jul, 12 Jul, 5 Aug, 16 Aug, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Rattlesnake Ridge/spring, Columbia River pumping station. This is one of the most common species collected at the Hanford Site and throughout the Pacific Northwest. At Hanford, the fly was found along the margins of almost all aquatic situations including the Columbia River. *Scatella paludum* was also one of the more abundant species collected at Mount Rainier, especially in the sand shore and wet woodland habitats (Zack 1979, 1983a).

Scatella stagnalis (Fallén). 22 Mar, 29 Mar, 11 Apr, 24, Apr, 3 May, 16 May, 1 Jun, 21 Jun, 7 Jul, 20 Jul, 5 Aug, 19 Aug, 29 Aug, 27 Sep, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Snively Ranch, Rattlesnake Ridge/spring, Columbia River pumping station. This is perhaps the most widespread and one of the most commonly encountered species of shore fly in the world. *Scatella stagnalis* occurs in all faunal regions except the New World tropics. Not only does this species have a wide geographic distribution, but it also occurs in a variety of habitat types. At Mount Rainier, it was encountered in seven of 10 habitat types sampled and was, in most of those habitats, the most abundant species (Zack 1979, 1983a). It can be taken by sweeping all riparian areas regardless of the presence of vegetation. I have not found the species around alkaline ponds or lakes.

Scatella triseta Coquillett. 22 Mar, 29 Mar, 3 May, 16 May, 1 Jun, 7 Jul. Rattlesnake Spring, Lower Snively Spring, Bobcat Canyon. A sister species of *S. marinensis*, *S. tristis* is often sympatric with the former species. At Hanford, *S. tristis* is certainly the more common species. Five or six specimens were collected for every specimen of *S. marinesis*. In collecting throughout the Pacific Northwest, I have never encountered either species in abundance. Mathis and Shewell (1978) present distributional and some natural history information on both *Scatella tristis* and *S. marinensis*.

Scatophila. The genus *Scatophila*, especially the western fauna, is in need of study. While numerous species are known to occur in the Pacific Northwest, and in Washington in particular, it is difficult to identify species based on presently available descriptions. Additionally, many new species occur in the region which serves to complicate maters. When the genus was last revised by Sturtevant and Wheeler (1954) they had few specimens from which to evaluate species differences. While they described many new species, it is sometimes difficult to place collected material into currently described taxa.

These studies suggest that certain species of *Scatophila* might be confined or better adapted to environmental conditions in the early to middle spring. Of the five species of *Scatophila* collected at Hanford, only *S. despecta* and *S. exilis* were taken after 16 May. Conditions of the spring habitats in which all *Scatophila* were collected change significantly throughout the year. These changes may affect the microorganismal fauna on which these flies feed. Zack (1983b, 1983c) found that minor habitat changes such as degree of canopy and therefore shade, could be correlated with differences in occurrence of species of *Parydra*.

Scatophila despecta (Haliday). 22 Mar, 29 Mar, 11 Apr, 24 Apr, 3 May, 16 May, 1 Jun, 10 Jun, 7 Jul, 8 Jul, 5 Aug, 12 Aug, 19 Aug, 29 Aug, 15 Sep, 27 Sep, 11 Oct. Rattlesnake Spring, Lower Snively Spring, below Lower Snively Spring, Snively Ranch, Bobcat Canyon, Rattlesnake Ridge/spring, Columbia River pumping station. One of the more abundant species of shore fly found on the Site, *S. despecta* was found to be an occasional inhabitant of the stream rocks habitat at Mount Rainier (Zack 1983a). The species has an extensive Holarctic distribution. *Scatophila despecta* from Hanford were compared with specimens from Ohio, and their genitalia appear to be identical.

One large collection of *S. despecta* was made at Lower Snively Spring on 16 May. The flies

were exceedingly abundant in the vegetation over and around this small spring. On two other occasions in the fall, at Rattlesnake Spring and Rattlesnake Ridge/spring, the flies were also the most abundant ephydrid encountered. In extensive collecting throughout the Pacific Northwest, I have never found species of *Scatophila* to be a major component of the fauna. Perhaps weather or some other environmental condition leads to the build-up of a suitable food source that allows populations to expand. All of these spring systems are subject to fluctuations, especially in the spring and fall.

Scatophila exilis Cresson. 29 Mar, 11 Apr, 16 May, 1 Jun, 10 Jun, 7 Jul, 11 Oct. Rattlesnake Spring, Lower Snively Spring, Rattlesnake Ridge/spring. *Scatophila exilis* was taken in conjunction with *S. despecta* but never in abundance. During the May 16 collection, however, six specimens were collected instead of the usual one or two. This may substantiate the hypothesis of some environmental change that favored species of *Scatophila* (see discussion of *S. despecta*).

Scatophila unicornis Czerny. New WA record. 16 May. Bobcat Canyon. Only a single specimen of *S. unicornis* was taken sweeping the margin of a vegetation choked Bobcat Spring. The species has an Holarctic distribution but was previously known only from California in the western United States.

Scatophila sp. 1. 24 Apr. Snively Ranch. One specimen of an unidentified *Scatophila* was taken by sweeping vegetation around this small spring site. The specimen appears to be very close to *S. carinata* Sturtevant and Wheeler (Sturtevant and Wheeler 1954) but does not have a black abdomen as described for that species.

Scatophila sp. 2. 22 Mar. Bobcat Canyon. One specimen of an unidentified species was taken by sweeping dense vegetation at the margin of this small spring. The specimen has the overall markings of *S. despecta* but the facial setation is markedly different.

Scatophila sp. 3. 29 Mar, 24 Apr, 16 May. Lower Snively Spring. Seven specimens of this unidentified species were taken only at Lower Snively Spring in the spring of the year. This species may have a spring or spring/fall seasonal pattern, but that would be rare for a shore fly.

Scatophila sp. 4. 29 Mar, 16 May. Lower Snively Spring, Bobcat Canyon. As with the above species, this one was taken only in the spring of the year. Five specimens of this unidentified species were collected.

Setacera aldrichi Cresson. 11 Oct. Rattlesnake Spring. This species occurs throughout much of the western United States as far south as central California. As with the following *Setacera*, only one specimen was collected at the Hanford Site from emergent vegetation at the margin of a spring.

Setacera needhami Johannsen. 11 Oct. Rattlesnake Spring. This species is commonly encountered throughout much of the more arid regions of the western United States and as far east as Nebraska. It is a common inhabitant of algal mats found around the margins of basin ponds, especially slightly alkaline ponds, throughout central Washington. Eggs are deposited into and larvae can be found feeding in algal mats. Zack (1983c) presents information on life history aspects and describes the immature stages.

Setacera pacifica (Cresson). 22 Mar. Bobcat Canyon. This is the most widespread species of *Setacera* in North America occurring throughout the western United States as far east as Michigan and along the southern border in Canada. With *S. needhami*, it can be found around the margins of many central Washington basin ponds, where it also appears to be associated primarily with algal mats. Although *S. pacifica* occurs sympatrically with *S. needhami* around the margins of alkaline ponds, I have never found it as common as *S. needhami* in these habitats.

Discussion

From the standpoint of diversity of habitats, the Hanford Site is relatively depauperate. However, the spring systems that form the aquatic ecosystems on the Site proved to have a diverse and rich fauna. Fifty-six species of shore flies in 32 genera were taken on the Hanford Site. The only comprehensive study of shore flies conducted in the Pacific Northwest was undertaken by Zack (1979, 1983a) in which I studied the fauna of Mount Rainier National Park. Of the 59 species collected at Mount Rainier only 16 were also taken at Hanford. This is probably a result of habitat types available for colonization with accompanying

differences in trophic resources. For example, Mount Rainier supported a rich fauna of *Parydra* with 11 species; only 4 species were collected at Hanford. This may be a result of available shade, water temperatures, and subsequent colonization by diatoms that appear to be a preferred food of *Parydra* spp. While not as significant, we also see differences in *Scatella*. Two widely distributed species, *S. stagnalis* and S. *paludum*, that were commonly found both at Hanford and at Mount Rainier, occupy a wide variety of habitat types, and have wide geographic distributions. Species such as *S. laxa* Cresson, *S. pentastigma* (Thomson), and *S. picea* (Walker), which were collected at Mount Rainier, represent species of boreal distribution and do not occur in the more arid regions of the Columbia Plateau and the Great Basin including the Hanford Site.

In contrast to Mount Rainier, the shore fly fauna of Hanford is consistent with that found throughout the remainder of central and eastern Washington and the Columbia Plateau in general. Examples include the rich diversity of *Lamproscatella* spp. and alkaline and warm water pond species such as *Mosillus* spp., several *Notiphila*, *Ephydra packardi*, and *Ptilomyia alkalinella*.

Of the species newly recorded for Washington in this study, I have taken most at various locales throughout central Washington. An exception is *Scatophila unicornis* which, while Holarctic in distribution, was previously known only from California and east of the Mississippi River. In extensive collecting throughout the Pacific Northwest, this is the only specimen that I have encountered. Future survey work may yield new species of shore flies and range extension records. Several other species found in central Washington and Oregon and perhaps even as far south as Utah and Nevada may eventually be found on the Hanford Site as further studies are conducted.

The Hanford Site presents us with one of the largest remaining, relatively undisturbed tracts of shrub-steppe habitat in the Pacific Northwest. The fauna and flora of the Site, including shore flies, may present us with a view of the animal and plant assemblages that more common throughout the Columbia Plateau before the advent of large-scale, especially irrigated, agriculture and urbanization.

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