# INSECTS ON THE SUNCOR DIKE,

# A SURVEY OF THE TYPES PRESENT AND AN EVALUATION OF THEIR EFFECTS ON DIKE VEGETATION

by

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## ABSTRACT

An insect survey of the Suncor dike showed that these animals were abundant. Representatives of 50 insect families were collected in sweep net samples, and additional families were observed to be present. Grasshoppers belonging to at least five different species were collected, as were herbivorous cicadellid and cercopid bugs, chloropid flies, and other herbivorous insects. The biomass ratio of carnivorous arthropods/potential prey insects (95% herbivores) in sweep samples was 0.11, indicating a heavy balance of herbivorous insects. Insect attacks were considered to be tolerable on most deciduous trees, but were more severe on conifer trees. Water stress appeared to be the greatest tree mortality factor.

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## 1. INTRODUCTION

Insects are the most prominent and diverse animals of terrestrial habitats in the Alberta Oil Sands Environmental Research Program (AOSERP) study area (Figure 1) (Ryan and Hilchie 1979). They form an essential food base for many species of vertebrates and other arthropods, and as well many insects prey on other insects (Ealey et al. 1979). They may be useful as biomonitors of environmental changes in the oil sands region (Hilchie and Ryan in prep.).

Small mammals were reported recently to be abundant on the Suncor tailings pond dike (Radvanyi 1978; Michielsen and Radvanyi 1979). These damaged the vegetation, girdling and killing many trees planted on the dike. This prompted efforts to control their populations using warfarin and biological control techniques (Green 1979). These are the main animal studies that have been carried out on the dike.

Insects, particularly large populations of grasshoppers and "flies" have been casually noted on the Suncor dike for several years. On 10 July 1979, the authors visited the dike and found young lodgepole pines heavily attacked by chermids (Homoptera) and pitch borer larvae (Lepidoptera), and many other signs of insect damage to the introduced vegetation.

Subsequently, this insect survey was approved. Except for the visit by the authors, and a cursory study by Jeff Green (pers. comm. 23 October 1979) presently in progress, no attempt had been made to determine what types of insects are present, and what effect they have on the dike vegetation. This study was commissioned to investigate the insects found on the dike and to assess problems caused by them.

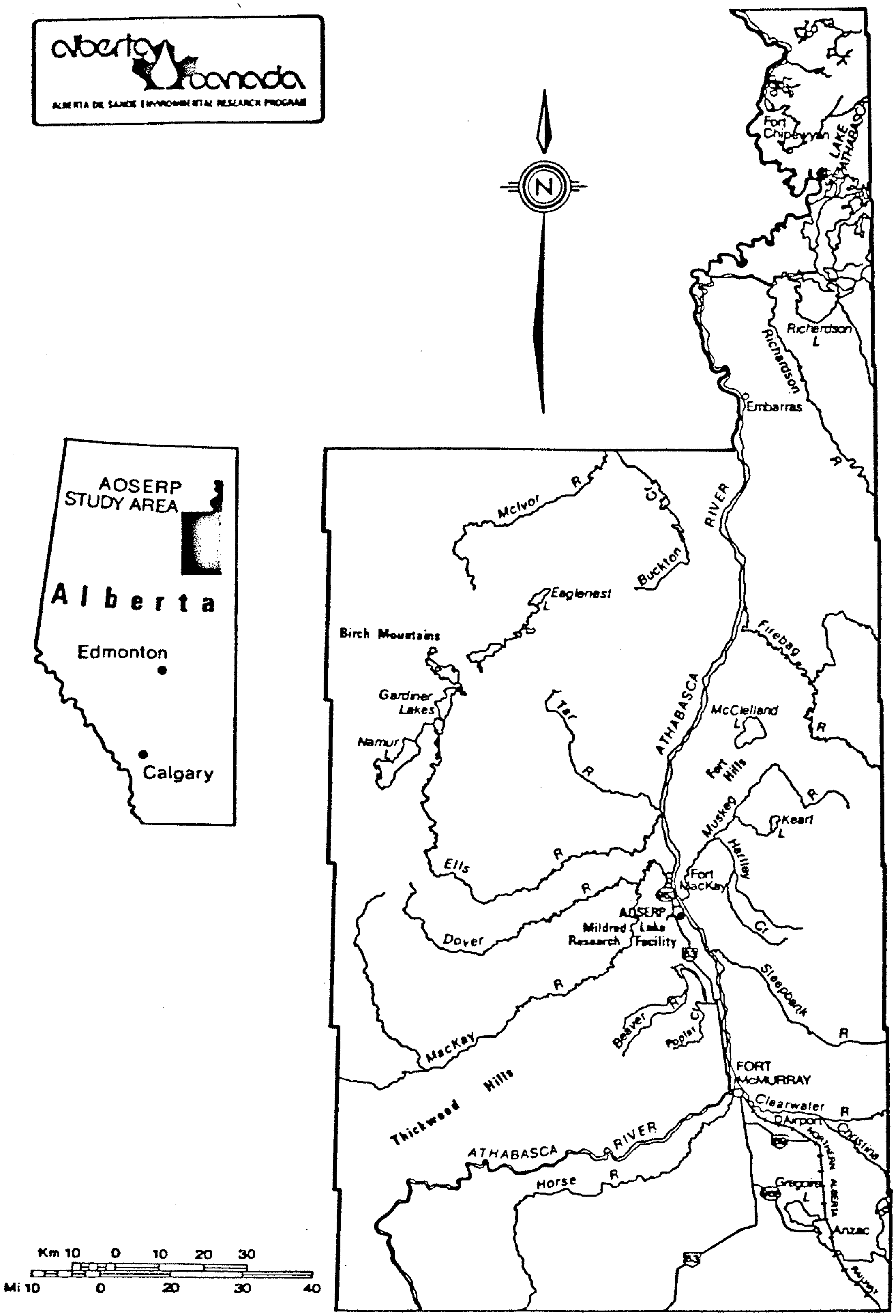


Figure 1. Location of the AOSERP study area.

## 2. MATERIALS AND METHODS

The dike was visited on seven separate occasions between 25 July and 28 August 1979 to collect data and specimens. Plants growing in lift 2 (see Sherstabetoff 1978), the oldest vegetated slope, were examined for insect damage and insects present. This survey included inspection of all the vegetation along 25 cm stem lengths of nine species of deciduous and two species of conifer trees, and entire plants of two grass species. Eight insect sweep net samples were collected on 25 July from the bottom and top of vegetated lifts at intervals from the south to the northwest end of the dike. Each sample consisted of twenty-five 180° net sweeps through the top of the vegetation. Insects collected by this method were sorted to family, counted, oven-dried, and weighed. Grasshoppers were specially collected and pinned, and sent to V.R. Vickery, of the Lyman Entomological Museum, McGill University, for species determination. Seeps on lift 1 were examined for insects, and seep water was collected and its pH measured at the AOSERP Mildred Lake Research Facility.

## 3. RESULTS

Results from the survey of vegetation damage incurred by insect activities are given in Tables 1 to 3. Nine species of deciduous trees are included in Table 1. Most of the damage to these trees was confined to the leaves, with three incidents of stem damage noted on specimens of *Acer negundo*, and two on *Betula papyrifera* and *Populus balsamifera*, and fruit damage noted on *Carragana arborenscens* and *B. papyrifera*. No scale insects were found on any stems. Leaf damage was frequently the result of chewing insects, including Lepidoptera larvae, grasshoppers, and leafcutter bees. Round holes or long strips were cut from leaves of all species by leafcutter bees. Aphids were sporadically abundant on leaves of several species, causing leaf curling or crinkling which is known as "blasting". On the carragana, aphid feeding in combination with lygaeid bug feeding and water stress led to the loss of large numbers of leaflets. These aphids were tended by ants, a situation also noted on *P. balsamifera*.

Conifer tree insects and damage (Table 2) differ distinctly from the situation on deciduous trees. Stems frequently had signs of insect damage, such as pitch borers on 16% and 80% of the *Pinus contorta* trunks inspected. A closed pitch borer gall is shown in Figure 2, and opened to expose the aegeriid moth larva within in Figure 3. Chermids, observed to be abundant during our initial inspection, were virtually absent from these lodgepole pine. Inspected trees of *Picea glauca* were so severely water stressed that many died. This voided any census of insect populations and damage on most trees. No signs of root collar weevils were found at the root-trunk area of any examined conifer trees.

Fifty specimens of two grass species were inspected (Table 3). Individual *Bromus inermis* plants were damaged more heavily than those of the smaller *Agropyron cristatum*. Only three *B. inermis* plants did not bear signs of insect damage. Stem boring occurred in one instance, presumably the larva of a chloropid fly, while three stem

Table 1. Survey of damage to dicotolydonous plants caused by insect activities on the Suncor tailings dike.

| Tree Species | Plot Location | | Number of Trees | Stems | | Shoots Damaged | | Damaged Leaves | | | | | Fruit Damaged | Arthropods on Steams or Leaves | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lift | Cell | | Number Surveyed[a] | Number Undamaged (Leaves & Shoots) | Number | Cause | Number per stem mean | Number per stem max. | Mean % area missing | Cause of Damage Insect | Cause of Damage Number of leaves | | Taxa | Number |
| Manitoba Maple *Acer negundo* L. | 2 | 5 | 15 | 75 | 53 | 3 | galls (3) | 3.6 | 11 | 25 | chewing insects | 60 | | lepidoptera larva | 1 |
| | | | | | | | | | | | leafcutter bees | 8 | | ants | 7 |
| | | | | | | | | | | | hemiptera feeding | 3 | | | |
| Willow *Salix fragilis* L. var. *basfordiana* | 2 | 5 | 15 | 75 | 14 | 0 | | 2.5 | 8 | 15 | chewing insects | 114 | | | |
| | | | | | | | | | | | skeletonizers | 24 | | | |
| | | | | | | | | | | | leafcutter bees | 3 | | | |
| | | | | | | | | | | | aphid blasting | 4 | | | |
| Carragana *Carragana arborescens* Lam. | 2 | 5 | 10 | 50 | 26 | 2 | | 35[b] | 79[b] | ND[c] | | | pods 2 (3 and 21 aphids) | lepidoptera larvae | 2 |
| | | | | | | | | | | | | | | lepidoptera egg mass | 1 |
| | | | | | | | | | | | | | | lygaeid bugs | many |
| | | | | | | | | | | | | | | aphids | many |
| | | | | | | | | | | | | | | spiders | 5 |
| Birch *Betula papyrifera* Marsh | 2 | 5 | 13 | 65 | 27 | 0 | | 2.1 | 8 | 21 | aphid blasting | 1 | fruiting bodys 2 | leaf hoppers | 2 |
| | | | | | | | | | | | hemipteran feeding | 3 | | ants | 3 |
| | | | | | | | | | | | leaf roller | 1 | | | |
| | | | | | | | | | | | leaf miner | 1 | | | |
| | | | | | | | | | | | skeletonizers | 4 | | | |
| | | | | | | | | | | | chewing insects | 52 | | | |
| Pin Cherry *Prunus pensylvanica* L.F. | 2 | 5 | 5 | 25 | 3 | 0 | | 6.7 | 19 | 24 | aphid blasting | 11 | none | | |
| | | | | | | | | | | | leafcutter bees | many | | | |
| Siberian Elm *Ulumus pumila* L. | 2 | 5 | 14 | 70 | 18 | 0 | | 3.4 | 14 | 3.5 | | | | ant | 2 |
| | | | | | | | | | | | | | | leafhopper | 1 |
| | | | | | | | | | | | | | | flies | 6 |
| | | | | | | | | | | | | | | spider | 1 |
| Alder *Alnus crispa* | 2 | 3 | 3 | 10 | 0 | 0 | | 3.7 | 7 | 4 | leafcutter bees | 4 | | | |
| Red Ash *Fraxinus pensylvanica* Marsh | 2 | 3 | 50 | 50 | 11 | 0 | | ND[c] | 38 | 80 | leafcutter bees | most | | | |
| Cottonwood *Populus balsamifera* hybrid | 2 | 6 | 10 | 50 | 16 | 2 | chewing (1) | 1.4 | 6 | 11 | leafroller | 1 | | aphids tended by ants | |
| | | | | | | | | | | | leaf miners | 4 | | spider | 1 |
| | | | | | | | | | | | chewing insects | many | | | |
| | | | | | | | | | | | leafcutter bee | many | | | |
| | | | | | | | | | | | skeletonizers | 1 | | | |

[a]Five stems per tree, each 25 cm in length

[b]Leaflets chewed or missing

[c]No data

Table 2. Survey of damage to conifer trees caused by insect activities on the Suncor tailings dike.

| Species | Plot Location | | Number of Trees | Stems[a] | | | Needles Damaged/Shoot | | Pitch Borers Per Tree - 3 Stems | | Root Collar Weevil | Other Arthropods | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lift | Cell | | Leaders | Branches | Damaged | Mean | Max. | Mean | Max. | | | |
| Lodgepole Pine (60-80 cm)<br>*Pinus contorta* Loudon | 2 | 6 | 19 | 19 | 38 | 1 | Trace | (5%) | 0.42 | 3 | 0 | ant<br>leafhopper<br>spiders | 1<br><br>5 |
| Lodgepole Pine (1.5-2 m)<br>*Pinus contorta* Loudon | 2 | 3 | 10 | 10 | 20 | 1 | Trace | (100%)[b] | 2.2 | 5 | 0 | cercopid spittles<br>many pitch borers below examined areas | 2 |
| White Spruce<br>*Picea glauca* (Moench) Voss | 2 | 4 | 22 | 22 | 44 | 47[b] | 48% | (100%)[b] | | | 0 | none | |

[a]Each stem surveyed 25 cm
[b]Major cause of damage: water stress

Table 3. Survey of damage to grasses caused by insect activities on the Suncor tailings dike.

| Species | Plot Location | | Number of Plants | Number of leaves examined per plant | Plants with no damage | Percent area missing per leaf | | Seed Head Damage | | | Arthropod Damage | Arthropods |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lift | Cell | | | | mean | max. | Plants | Chewing Scars mean | Chewing Scars max. | | |
| Smooth Brome (25-90 cm) *Bromus inermis* Leyss | 2 | 6 | 50 | 6 (4-8) | 3 | 8.5 | (16) | 43 | 3.2 | 7 | stem puncture wound (3)<br>stem mine (fly) (1) | moth larvae and pupae 18 (17 plants) |
| Crested Wheat Grass (15-45) *Agropyron cristatum* (L.) Gaertn | 2 | 6 | 50 | 4 (3-6) | 28 | 1.2 | (50) | 15 | 1.5 | 4 | stem puncture wound (3) | |

Figure 2. Pitch borer gall on trunk of sapling *Pinus contorta* in lift 2 cell 3 of the Suncor dike.

Figure 3. Above pitch borer gall opened to show *Vespamima* sp. (Lepidoptera, Aegeriidae) larva within feeding on the cambium layer of the sapling.

puncture scars were made by homopteran insects. Leaves commonly were chewed by grasshoppers and Lepidoptera larvae, and these chewed leaves suffered an average 8.5% leaf area loss. Eighteen small moth larvae and cocoons were collected from leaf blade folds but, since no adults emerged, they were not assigned to a family. Grasshoppers damaged the seed heads of 43 plants, feeding at an average 3.2 places on these heads. Of the 50 *A. cristatum* plants, 22 were damaged, 15 of which bore a mean 1.5 sites of seed head damage.

The kinds and numbers of insects and arachnids collected in the sweep net samples are given in Table 4. Altogether, representatives of 50 families of insects were collected. The undetermined Thysanoptera probably all belong to the family Thripidae, but require slide mounting for confirmation. The most consistently abundant insects included nabid, cercopid, and cicadellid bugs, chironomid and chloropid flies, and parasitoid wasps.

Sweep net samples showed that the insect population of lift 2 was 3.7 times greater than that of the upper lift. This difference is consistent, as the smallest bottom lift value is double the largest top lift value. Further, the biomass difference is 3.1 times greater in the bottom versus top lifts, and this is consistent sample for sample (Table 5). The sample size is too small for statistical confirmation of this trend.

The trophic level analysis revealed that the mean biomass of carnivores was 0.11 that of potential prey insects, while the range of these ratios for the eight samples was 0.026 to 0.282. Piercing-sucking insects and spiders dominated the biomass of carnivorous insects, while parasitoid wasps dominated in numbers of individuals. In only one sample did saprovore insect biomass (a category including insects which may consume plant or dead animal matter) exceed the biomass of herbivorous insects. Altogether the total biomass of herbivorous insects was 20 times that of the saprovore category; saprovores amounted to 4.3% of the total sweep sample biomass. The majority of herbivores were chewing insects;

Table 4. Kinds and numbers of insects and arachnids collected in twenty five 180° net sweeps on the Suncor tailings dike.

| Taxon | Cell 6 Lift 2 | Cell 6 Lift 6 | Cell 5 Lift 2 | Cell 5 Lift 6 | Cell 3 Lift 2 | Cell 3 Lift 6 | Cell 1 Lift 2 | Cell 1 Lift 6 |
|---|---|---|---|---|---|---|---|---|
| EPHEMEROPTERA | 1 | | | | | 2 | | |
| ODONATA | | | | | | | | |
| Coenagrionidae | 1 | | | | | | | |
| ORTHOPTERA | | | | | | | | |
| Acrididae | 4 | 5 | 3 | 4 | 1 | 1 | 5 | |
| PSOCOPTERA | | | | | | | | |
| Pseudocaeciliidae | | | 1 | | 2 | | 1 | |
| THYSANOPTERA | | | | | | | | |
| Phlaeothripidae | 4 | 1 | | | | 3 | | |
| Thripidae | | | 1 | | | | 1 | 2 |
| undet. | 1 | | | 1 | 1 | 5 | 5 | |
| HEMIPTERA | | | | | | | | |
| Lygaeidae | | | 1 | | | | | |
| Miridae | 9 | | 1 | 3 | | | | 1 |
| Nabidae | 2 | | 6 | 1 | | 10 | 10 | |
| Tingidae | 1 | | | | | | | |
| HOMOPTERA | | | | | | | | |
| Aphididae | | | 2 | 1 | | | | |
| Cercopidae | 2 | 3 | 16 | 2 | 11 | 2 | 75 | |
| Cicadellidae | 26 | 8 | 41[a] | 3 | 12[b] | 6 | 44 | 5 |
| COLEOPTERA | | | | | | | | |
| Carabidae | | | | | | 1 | | |
| Chrysomelidae | | | | | | | 2 | |
| Coccinellidae | | | 1 | | | | | |
| Lathridiidae | 2 | | 2 | 1 | | | 1 | |
| NEUROPTERA | | | | | | | | |
| Chrysopidae | | | | | | | 1 | |
| LEPIDOPTERA | | | | | | | | |
| Gelechioidea | | | | | 1 | | | |
| Geometridae | 1 | | | | | | | |
| Noctuidae | | | 2[c] | | | | | |
| Pyralidae | | | 2 | | | | | |
| undet. larvae | 2 | | 2 | 1 | | 1 | 3 | |
| DIPTERA | | | | | | | | |
| Agromyzidae | 5 | | 3 | | 3 | | | 3 |
| Anthomyiidae | | | 5 | 2 | 1 | 4 | | 1 |
| Cecidomyiidae | 1 | | 49 | 1 | 9 | 2 | | 4 |
| Ceratopogonidae | 2 | | | | | | | |
| Chamaemyiidae | 1 | | | | | | | |
| Chironomidae | 18 | 7 | 53 | 11 | 39 | 24 | 54 | 31 |
| Chloropidae | | 4 | 27 | 13 | 1 | 18 | 7 | 1 |
| Heleomyzidae | | | 1 | | | | 1 | |
| Lauxaniidae | 2 | | 1 | | | | | |
| Muscidae | 4 | 1 | | | 1 | | | |
| Phoridae | | | | | 2 | | | |
| Piophilidae | 1 | | | | | | | |
| Pipunculidae | | | | 3 | | | | |
| Stratiomyidae | | | | | | | 2 | |
| Syrphidae | 1 | | | | | | | |
| Tipulidae | 1 | | | | | | | |
| Trichoceridae | | | | | | | 1 | |
| HYMENOPTERA | | | | | | | | |
| Apidae | | 1 | | | | | | |
| Braconidae | | | | 1 | 1 | | 4 | |
| Diapriidae | | | | | | | 1 | |
| Encyrtidae | 61 | | 9 | | | | | |
| Eulophidae | | | 8 | | 1 | 2 | | |
| Formicidae | | | 3 | | 3 | | | |
| Mymaridae | 4 | | | | 3 | | 4 | |
| Platygasteridae | 1 | | | | | | | |
| Pteromalidae | 1 | 1 | 13 | 4 | 58 | | 25 | 3 |
| Scelionidae | | 1 | 1 | 3 | | 1 | | |
| Torymidae | 3 | | | | | | | |
| Trichogrammatidae | | | | | 1 | | | |
| Total Insects | 162 | 32 | 254 | 55 | 151 | 82 | 247 | 51 |
| ARANEIDA | 10 | 2 | 6 | 4 | 6 | 4 | 25 | 3 |
| OPILONIDA | | 1 | | | | | | |

[a] 2 with Hymenoptera Dryinidae parasites
[b] 1 with Hymenoptera Dryinidae parasite
[c] 1 with external Hymenoptera parasite

Table 5. Biomass (mg oven dry weight) and trophic level analysis of insects and arachnids collected in twenty five 180° insect net sweeps on the Suncor tailings dike.

| | Cell 6 Lift 2 | Cell 6 Lift 6 | Cell 5 Lift 2 | Cell 5 Lift 6 | Cell 3 Lift 2 | Cell 3 Lift 6 | Cell 1 Lift 2 | Cell 1 Lift 6 |
|---|---|---|---|---|---|---|---|---|
| Carnivore: | | | | | | | | |
| aerial | 7.6 | | | | | | | |
| parasitoid | 2.3 | | 2.0 | 1.5 | 3.5 | + | 5.1 | 0.1 |
| piercing-sucking | 7.3 | + | 18.4 | 1.7 | | + | 49.3 | |
| chewing | | | 2.6 | | | | 3.2 | |
| spiders | 3.9 | + | 17.9 | 1.7 | 17.9 | 2.8 | 64.4 | 5.0 |
| Total: | 21.1 | 16.5 | 40.9 | 4.9 | 21.4 | 6.6 | 122.0 | 5.1 |
| Saprovore: | 1.8 | 1.3 | 14.6 | 7.1 | 6.9 | 24.8 | 33.4 | 14.1 |
| Herbivore: | | | | | | | | |
| aquatic | 3.5 | | | | | 7.8 | | |
| pollenator | | 64.5 | | | | | | |
| piercing-sucking | 70.0 | 17.6 | 104.4 | 19.6 | 68.8 | 9.7 | 523.1 | 2.3 |
| chewing | 180.6 | 202.5 | 144.7 | 158.7 | 69.6 | 10.0 | 379.8 | |
| miner | 14.4 | 0.5 | 2.3 | 4.4 | 2.4 | 5.7 | 0.9 | 1.7 |
| Total Potential Prey: | 270.3 | 286.4 | 266.0 | 189.8 | 147.7 | 58.0 | 937.2 | 18.1 |
| Ratio of Biomass Carnivores / Prey: | 0.078 | 0.058 | 0.15 | 0.026 | 0.15 | 0.11 | 0.13 | 0.28 |
| Total sample Biomass: | 291.1 | 302.9 | 306.9 | 194.7 | 169.1 | 64.6 | 1059.2 | 23.2 |

Summary Totals:
Ratio of Biomass: Carnivores::Prey = 238.5/2173.5 = 0.110
Lift 2: Ratio of Biomass: Carnivores::Prey = 205.4/1621.2 = 0.127
Lift 6: Ratio of Biomass: Carnivores::Prey = 33.1/552.3 = 0.060

Biomass of Lift 2/Biomass of Lift 6 = 1826.6/585.4 = 3.12

i.e., grasshoppers, and piercing-sucking insects, particularly cicadellids (leafhoppers) and cercopids (spittlebugs).

Five species of grasshoppers were indentified from 17 specimens collected on the dike. These were: *Melanoplus bruneri* Scudder (8), *M. s. sanguinipes* (Fabr.) (2), *Camnula pellucida* (Scudder) (5), *Chorthippus c. curtipennis* (Harris) (1), and *Trimerotropis v. verruculatus* (Kirby) (1).

No insect adults or larvae were found in seeps along the bottom lift. Four water samples taken from different seeps had pH readings of 8.1, 8.1, 8.2, and 8.6. This seep water produced bright green algal growths within several weeks in all four storage jars.

Black flies (Simuliidae), no-see-ums (Ceratopogonidae), and horseflies (Tabanidae) commonly were encountered while working on the dike.

## 4. DISCUSSION

Trees growing on lift 2 of the Suncor dike represent established and growing survivors from plantings made several years ago. They are growing in well-drained sandy soil, so are regularly subject to water stress. Grasses, which dominate the dike vegetation, give the dike a prairie-like appearance. A thin litter layer has not yet developed into a significant humus layer. These conditions have shaped the development of the insect community on the dike.

Sandy, well-drained soils are the preferred nesting areas of many ground dwelling bees and wasps. Leafcutter bees cut holes and strips from all nine species of deciduous plants inspected in our survey. These insects were responsible for more leaf loss than all herbivorous insect feeding on the deciduous tree leaves. This vegetation is used as nest material for the brood maintained in the ground nests by the adult bees. Other ground dwelling wasps such as *Bembix americanum* (which hunts flies), *Tachysphex* sp. (which hunt grasshopper nymphs), and *Epicautu* sp. (which parasitize grasshopper egg pods) were noted among the dike inhabiting insects.

Insect damage to the nine deciduous tree species on the dike was not extensive. No trees were infested heavily with harmful insects. Carragana trees suffered the most insect damage, as aphid feeding in combination with water stress caused large numbers of leaflets to drop off. Water stress was the prime cause of this leaf loss, as well-watered trees in Edmonton can support large aphid populations yet keep their leaves and health. This severe water stress killed many aphids, and should produce a reduced aphid population early next year. Willows sustained more insect damage than the remaining tree species. This is a normal condition, as willows often support large populations of chrysomelid beetles, gall midges, and tenthredinid wasps as well as other insects. Less damage was found here than on willows growing along the Mackay River (cf. Ryan and Hilchie 1979). The examined birch leaves had only one insect leaf mine, which is well below the average for trees growing in Edmonton. Insect populations do not presently appear to be large enough to seriously harm these trees. However, water stress may be such a significant problem that additional insect feeding pressure could weaken trees and hasten their demise.

Insects appear to be exerting more pressure on the conifers. Sap-sucking insects like cercopid (spittle) bugs, which were abundant on the dike, often develop on conifers. Chermids may become extensively abundant on the dike conifers, as noted during the initial inspection. These insects drain large volumes of fluid from their hosts, straining proteins and other essential foods for themselves in the process. In doing so, they both decrease the vigor of the host plant and increase the severity of water stress. Some insect infestations develop when trees are injured or dying, the classic example being scolytid (bark) beetle invasions which eventually kill the dying tree. Infestations of the pitch borer *Vespamima* sp. are another example (Johnson and Lyon 1976). Populations of these insects on lodgepole pine trunks indicate that these trees are in a weakened state, as these insects are not normally found on healthy trees. Some lodgepole pines were so heavily infested that they were in danger of being girdled by these insects. The dead white spruce might have borne signs of insects that killed them had we performed autopsies. Water stress, however, appeared to us to be the key mortality factor.

Grass and grasshoppers, and leafhoppers, form a typical grassland association in the dike grasses. Chewing herbivorous insects, particularly grasshoppers, removed 8.5% of the leaf area of *Bromus inermis* and 1.2% of the leaf area of *Agropyron cristatum*. Grasshoppers can cause more than 30% leaf area loss on grasses in Saskatchewan prairies (Bailey and Riegert 1973). Grasshoppers chewed the seed heads of both grasses. This probably impaired seed formation, which was observed to be low. Leafhoppers were another grass-feeding insect abundant on the dike. Puncture holes counted in grass stems appeared to be feeding punctures which became infected. Chloropid flies were abundant in the sweep net samples.

Larvae of these flies mine grass stems, but only one *B. inermis* was found mined in our survey.

Sweep net samples revealed several aspects of the insect community structure. Saprovores comprised 4.3% of the total sweep sample biomass. Therefore this trophic level was poorly developed among the dike insects, a situation distinctly different from the surrounding forest ecosystems (cf. Ryan and Hilchie 1979). Most of the insect biomass was herbivorous. The ratio of arthropod carnivores to potential prey was 0.11, while for 12 habitat types around the dike this ratio was 0.65 (Ryan and Hilchie 1979). These values are not immediately comparable since the dike figures are from sweep net samples while the other figures are from absolute populations estimates; i.e., soil extractions and vegetation spraying. Furthermore, the sweep samples are mid-season values while the 12 habitat mean is from the end of the season, when predators are fully grown. The difference is great enough to postulate that the insect community structure of the dike differs from that of the surrounding forest, and is probably more comparable to an agricultural ecosystem. The dike has a herbivore-carnivore structure, dominated by herbivores.

The numerically most abundant carnivores were parasitoid wasps. These usually develop in the eggs of their hosts, or in their immature stages. A small biomass of parasitoid insects can have a significant impact on host insect populations. Other predatory and parasitic wasps were observed at the site, but were collected infrequently due to their ground nesting habits. Predatory nabid bugs are important enemies of leafhoppers and spittlebugs. Spiders feed on any insects they can capture. The diversity of these biological control agents was lower than that found in forest systems, which appears to be physically due to fewer niches to occupy in the comparatively thin and immature grassland habitat.

Two of the grasshopper species found on the dike, *Melanoplus sanguinipes* and *Camnula pellucida*, are recognized as pest species capable of causing economic losses to rangeland grasses (Smith and

Holmes 1977). J.M Hardmann, research scientist at the Lethbridge Agricultural Research Station, has communicated that roadside grasshopper populations of 13-24/yd.$^2$ may require controls, while populations of 25+ do require control efforts. Field crops require treatment at 13+/yd.$^2$. While grasshopper populations were not measured on a per square yard basis, the authors suspect that they were in the "may require control" population level.

Should insecticides be used to protect the dike vegetation from insect attack? This question requires several considerations. No economic crop yield comes from the dike, so this type of financial loss is not a factor. However, since manpower inputs were involved to establish and maintain the vegetation, a manpower loss value can be assigned to trees in particular and the vegetation in general. The impression of the authors was that most losses were due to water stress, with insect attacks often being a sign of poor plant health. These attacks probably have killed trees and grasses on the dike. Spraying water-stressed plants with toxic chemicals could cause them as much harm as their insect attackers. From the evidence gathered, it is felt that the conifers and carragana are the main trees that should be considered for insecticide treatment. A spray program will not necessarily save the conifers, and the carragana should rebound on their own.

No insects were found in the alkaline seeps at the base of the dike. This was not surprising as alkalai dissolves animal tissue, and prolonged exposure to even mildly alkaline water should be deleterious to insects. Algal blooms observed in the water collection jars show that this alkalai was degraded and utilized by biological systems.

## 5. SUMMARY

The insect fauna of the Suncor dike was surveyed briefly in late July to mid-August 1979. Nine species of deciduous trees were inspected for insect damage. Leafcutter bees cut holes in many leaves for their ground nests. Aphids contributed to water stress on carragana plants, which dropped many leaflets. No scale insects were noted on stems, and few mines and galls were noted. Observed insect population levels should not be destructive. Conifer trees were more heavily attacked, and trees may be stunted by insect girdling. Water stress appears to be the most significant factor harming these and the deciduous trees. Grasshoppers, leafhoppers, and chloropid flies were abundant herbivores which fed on grasses. Some of these grasshopper species are known to be destructive to rangeland. The authors are doubtful about the benefits of insecticidal treatment for most of the dike vegetation, although such treatment could prolong the life of conifer trees. No insects were found in alkaline seeps at the base of the dike.

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