

Insects with Incomplete (Paurometabolous) Metamorphosis

Insects and People
Insect Taxonomy

Orders with Complete Metamorphosis

Hemiptera (true bugs, scale insects, etc.) 121,000 194

Orthoptera (grasshoppers, crickets) 37,000 24

Psocoptera (bark lice) 10,000 18

Odonata (dragonflies; damselflies) 9,000 11

Blattodea (roaches) 8,000 ?

Ephemeroptera (mayflies) 4,000 1

Plecoptera (stoneflies) 4,000 0

Mantodea (mantids) 3,000 ?

Dermoptera (earwigs) 2,000 4

Pthiraptera (lice) 2,000 2

Isoptera (termites) 1,000 4

Order Ephemeroptera mayflies

- Incomplete metamorphosis
- Immatures are aquatic (naiads)
- Chewing mouthparts in immatures, adults do not feed
- Adults are short-lived, ephemeral
- Important in aquatic environments as food and water quality indicators

*Aquatic immatures
are termed naiads*



*Naiads serve as a food
resource and water
quality indicators*



*Naiads
leave water
for final
molt to
adult*



Insects and People Insect Taxonomy

*Adults are delicate appearing insects
Some live as little as 24 hours - ephemeral!*



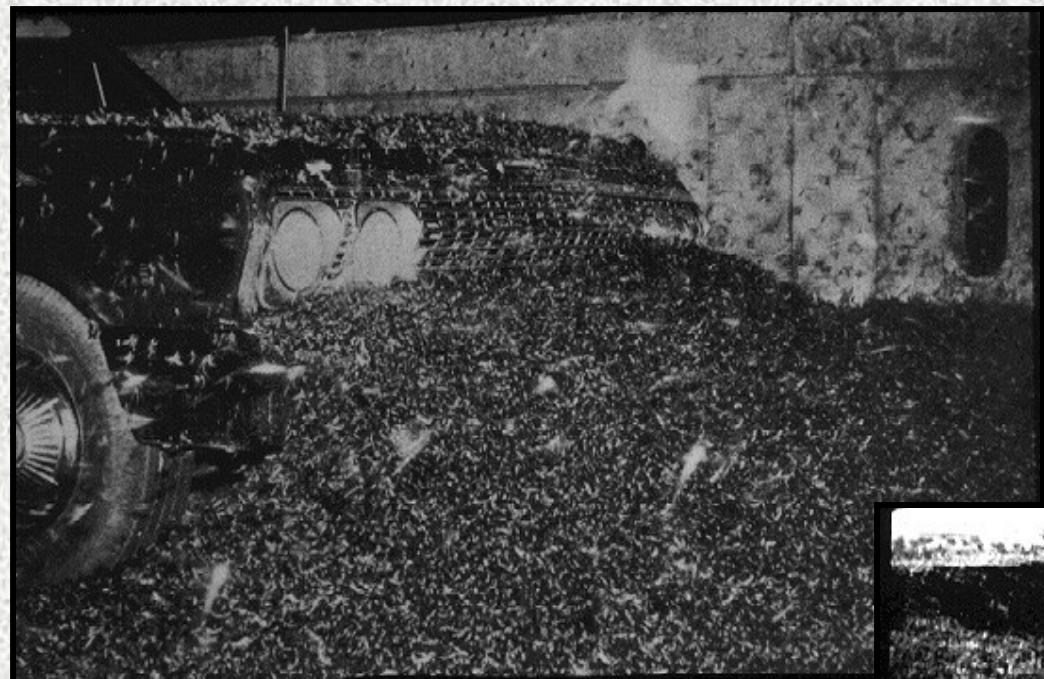
*Common
At
Lights*

Mayfly Emergences

*A Great Food
Resource!*



Insects and People
Insect Taxonomy



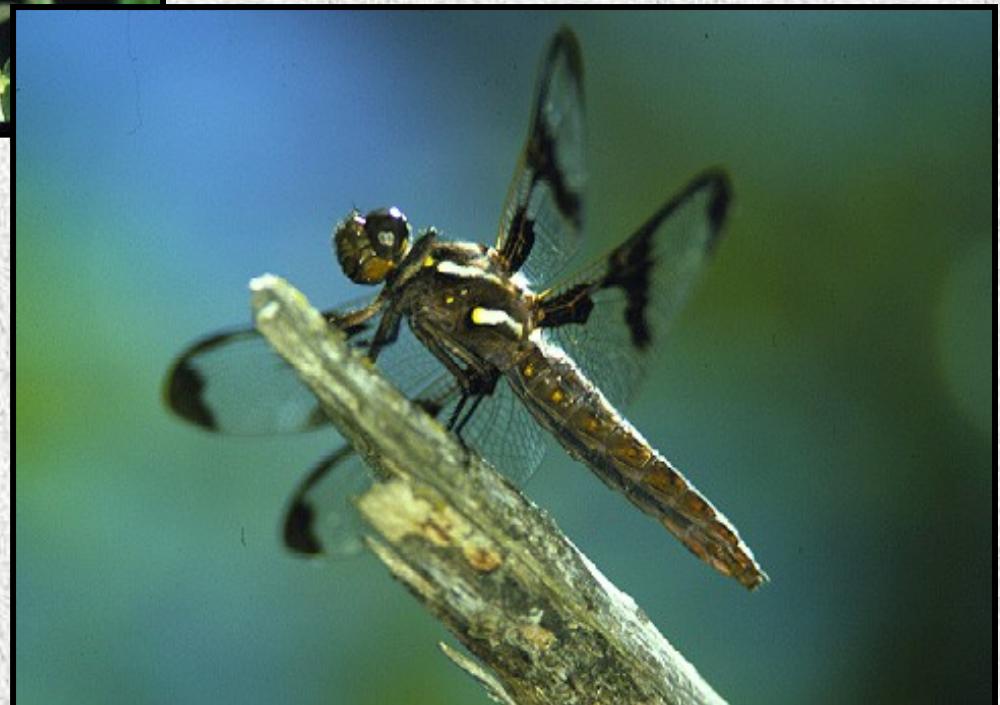
Order Odonata dragonflies and damselflies

- Incomplete metamorphosis
- Immatures are aquatic (naiads)
- Immatures and adults with chewing mouthparts - both are predators
- Some with an unusual means of sperm transfer
- Green darner dragonfly - WA state insect



*Dragonflies are
large predatory
insects*

*Dragonflies cannot
fold their wings
over the abdomen*



Damselflies are usually smaller, more "delicate" appearing, and capable of folding their wings over the abdomen



Van Waters & Rogers
1983 division of Univar

Insects and People
Insect Taxonomy

Naiads leave the water for their final molt to the adult stage





*Newly eclosed
dragonfly
expanding its
wings and
“drying”*

Insects and People
Insect Taxonomy

Eyes of Odonata are large with many facets -they have excellent eyesight



Insects and People
Insect Taxonomy

Immatures (naiads) are also voracious predators



*Note
Wing
Pads*

Insects and People
Insect Taxonomy

The wheel configuration is an unusual mating position



Insects and People
Insect Taxonomy

Order Orthoptera

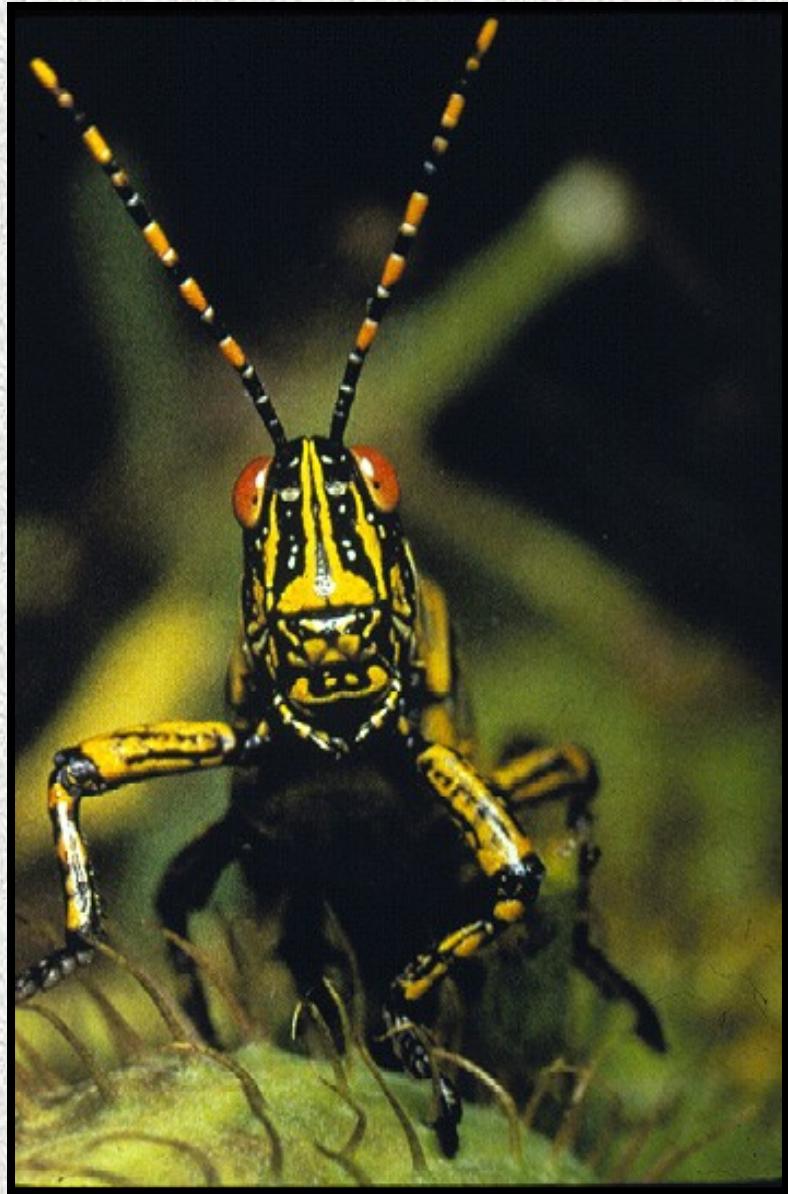
grasshoppers, locusts, crickets, katydids

- Incomplete metamorphosis
- Chewing mouthparts in both adults and immatures
- Most are phytophagous, some are omnivorous
- Some are serious pests
- Some produce sound

Jiminy Cricket!



Insects and People
Insect Taxonomy



*Most grasshoppers are
Phytophagous*

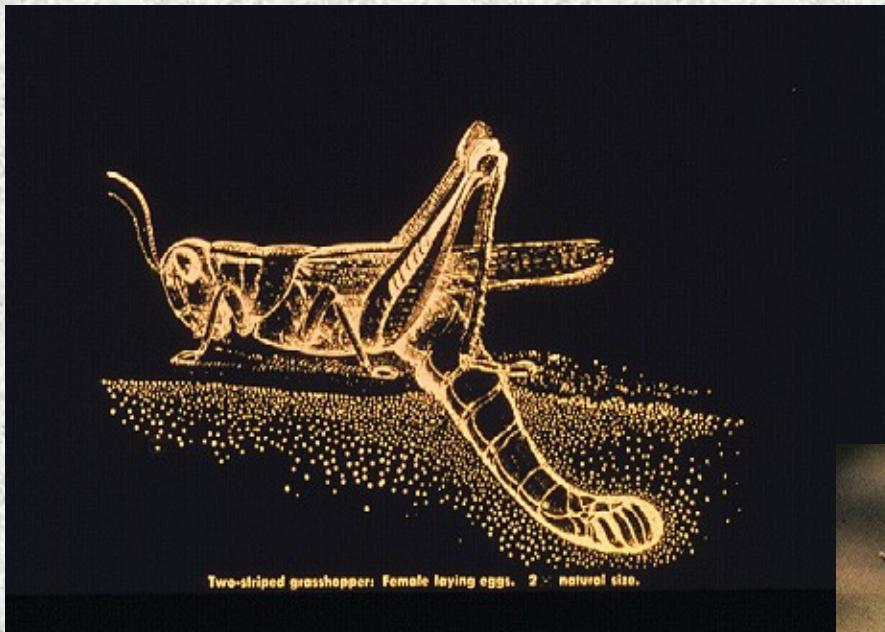
*Among the most
pestiferous
of insects*

A typical grasshopper



Insects and People
Insect Taxonomy

*Most grasshoppers
oviposit an egg mass
into the soil*

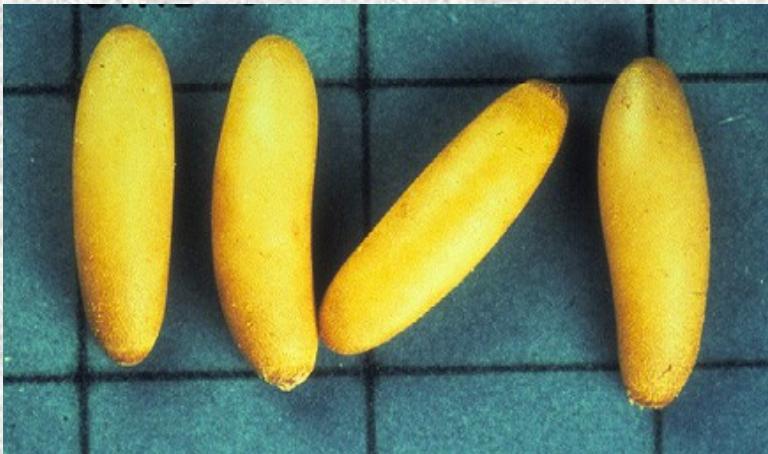
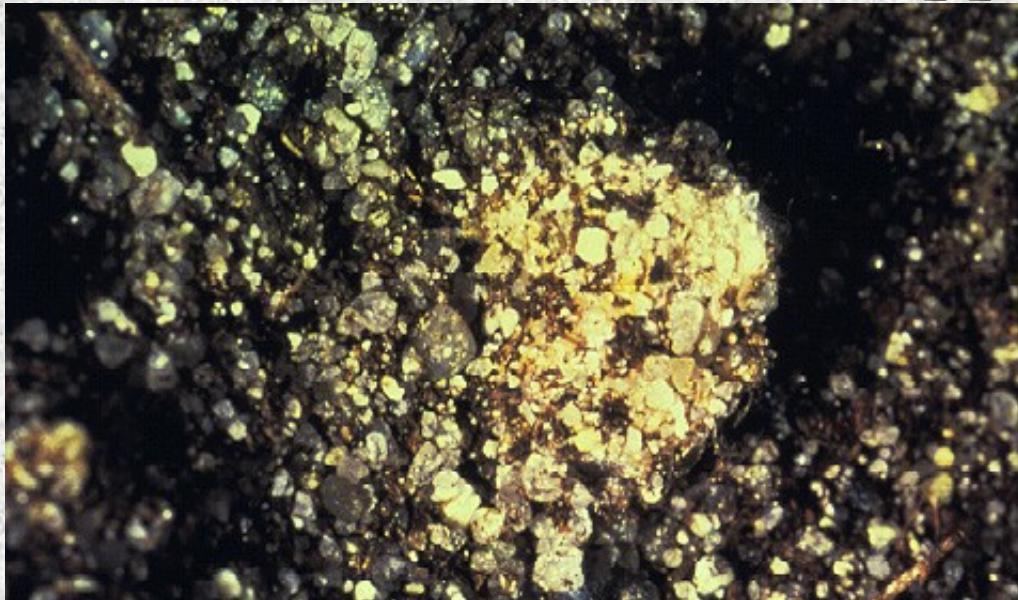


*Eggs usually
over-winter*



Insects and People
Insect Taxonomy

Grasshopper egg pods



Insects and People
Insect Taxonomy



Van Waters & Rogers Inc.
1980 © Van Waters & Rogers

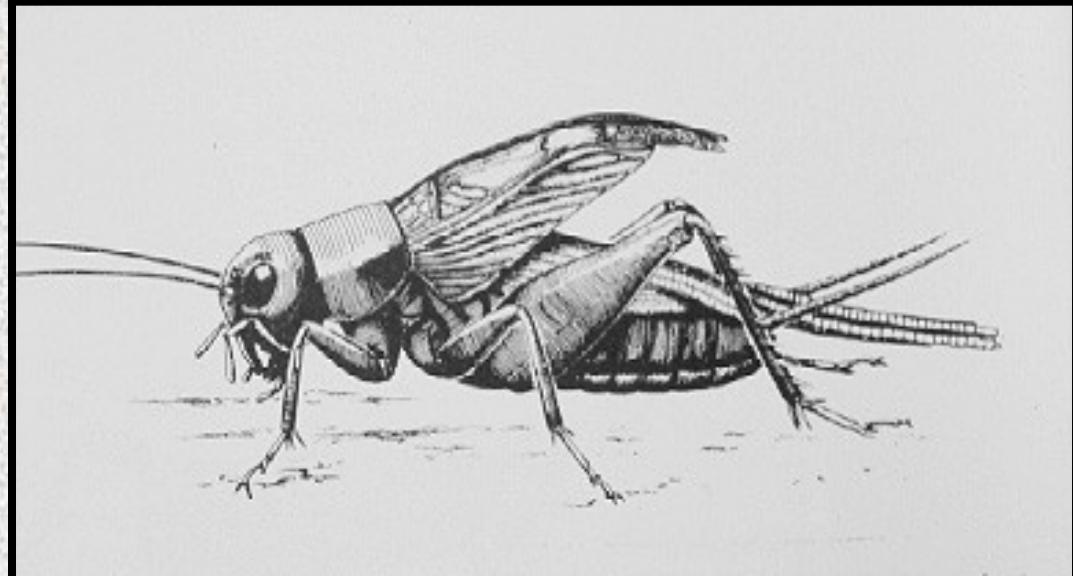
Common field cricket



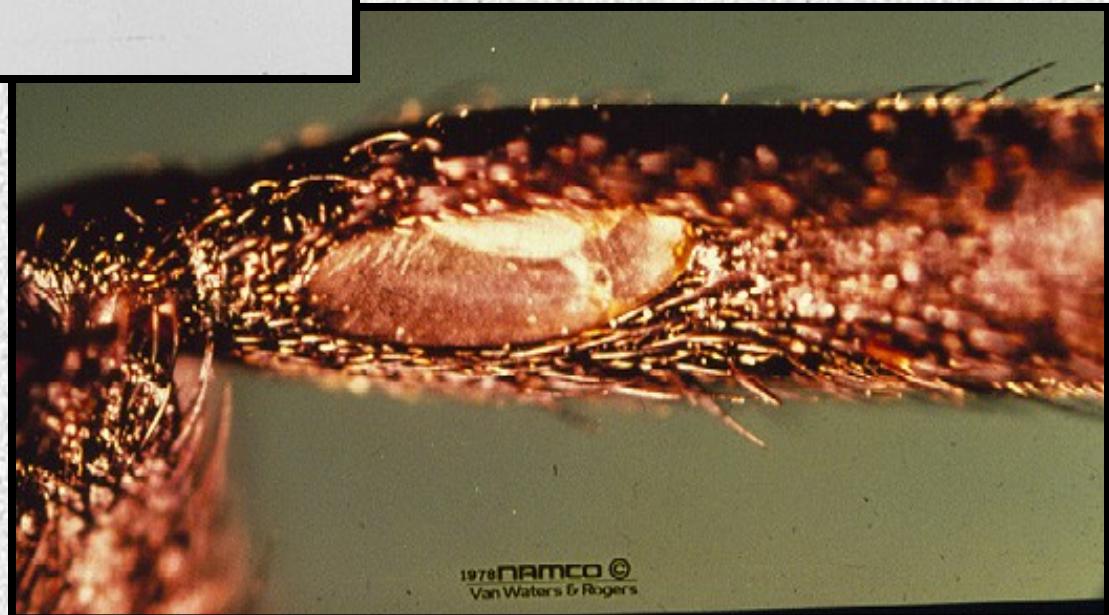
1978 NAMCO ©

Insects and People
Insect Taxonomy

Crickets "sing" and hear songs



*The "ear" is
found on the leg -
A tympanum*



1978 NAMCO ©
Van Waters & Rogers

Insects and People
Insect Taxonomy



*Adults!
They are secondarily
wingless*

*Some interesting
looking crickets*



Insects and People
Insect Taxonomy

Katydid



*"Leaf"
insects*



Insects and People
Insect Taxonomy



Camouflage



Insects and People
Insect Taxonomy



Camouflage
“Blending-in”



Insects and People
Insect Taxonomy

Order Mantodea praying mantids

- Incomplete metamorphosis
- Immatures and adults with chewing mouthparts - both are predators
- Eggs deposited in cases called oötheca

Praying mantids

*voracious predators, capable of turning the head
as if on a “neck”*



Insects and People
Insect Taxonomy

Mantids use their raptorial fore legs to capture prey



Van Waters &
1982 division c

Insects and People
Insect Taxonomy

Mantid nymphs are also predators



**Van Waters & Rogers
1983, division of Univar**

Insects and People
Insect Taxonomy

Males are smaller than females



Insects and People
Insect Taxonomy

Mantid eggs are deposited in cases called oötheca that are formed by the accessory glands



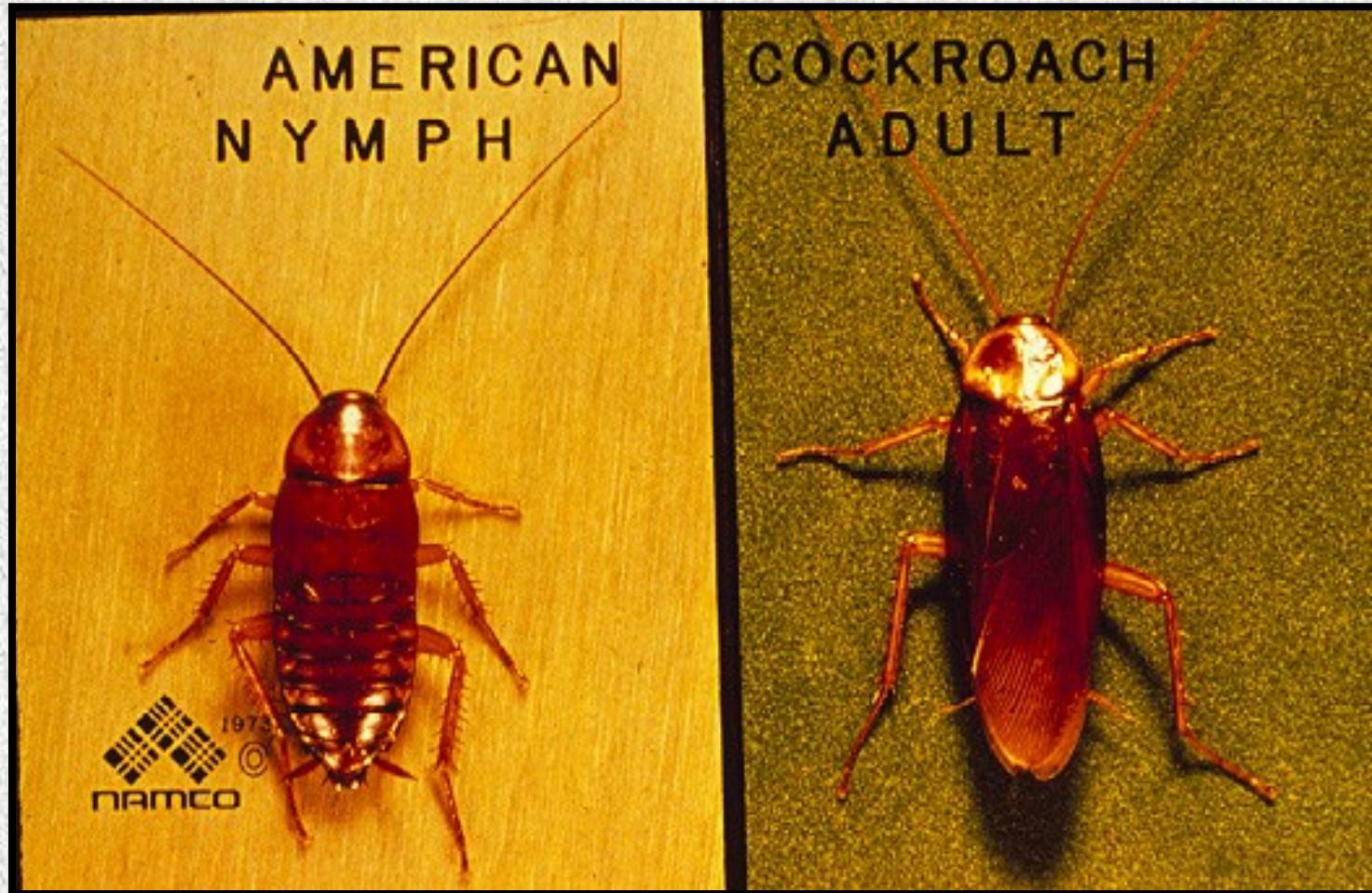
Van Waters & Rogers Inc.
1989 subsidiary of Univar

Insects and People
Insect Taxonomy

Order Blattaria cockroaches

- Incomplete metamorphosis
- Chewing mouthparts in both adults and immatures - omnivorous in feeding habits
- Some are serious pests
- More tropical than temperate in distribution
- Eggs usually deposited in an oöthecum

Cockroaches are pestiferous/nuisance insects when in contact with humans



The forewing of a roach is called a tegmina

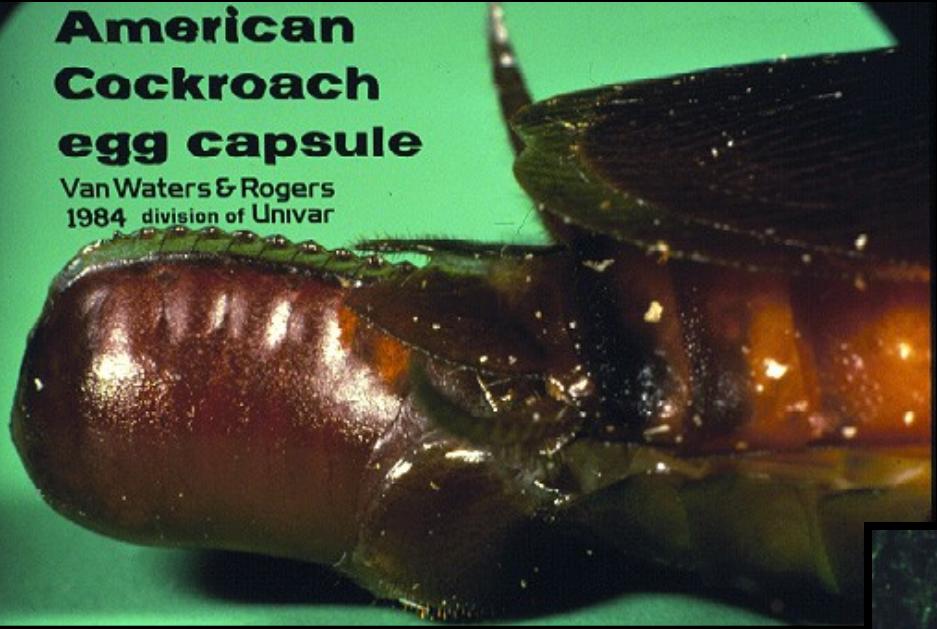


Roaches are omnivorous feeders

Roaches can stink! - fat takes on food odors

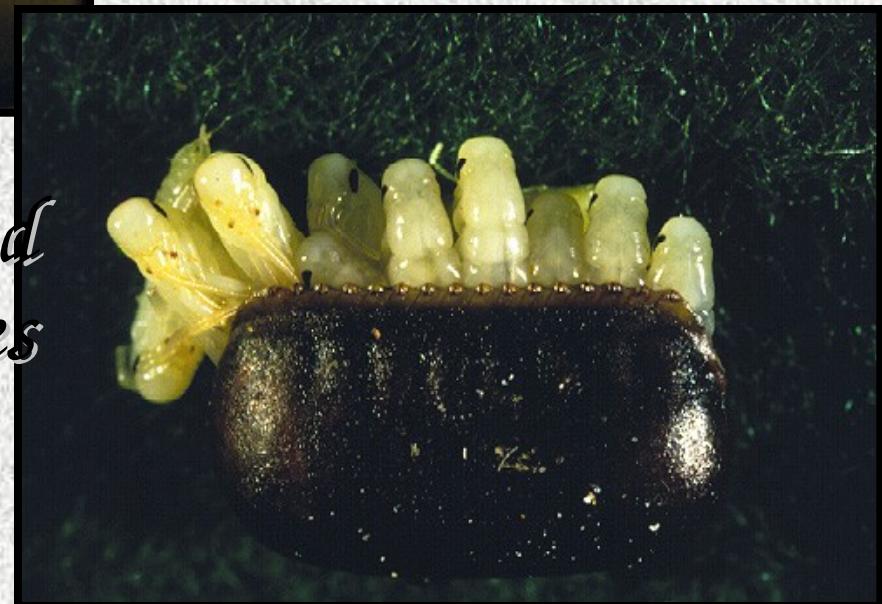
**American
Cockroach
egg capsule**

Van Waters & Rogers
1984 division of Univar

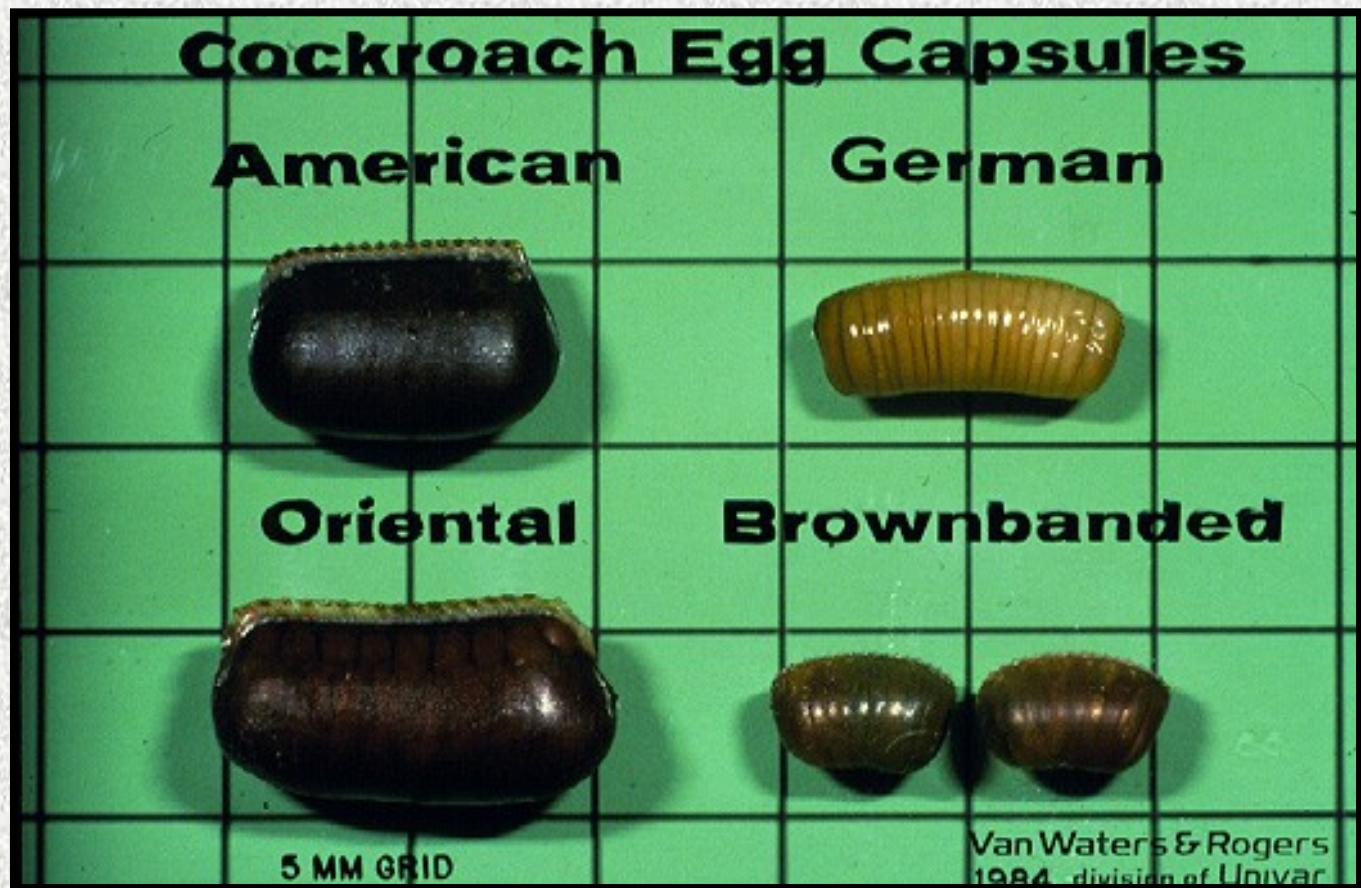


Oötheca are deposited throughout structures

Many roaches deposit eggs in an oöthecum



A good PCO (Pest Control Operator) can tell the infesting species by the oothecum

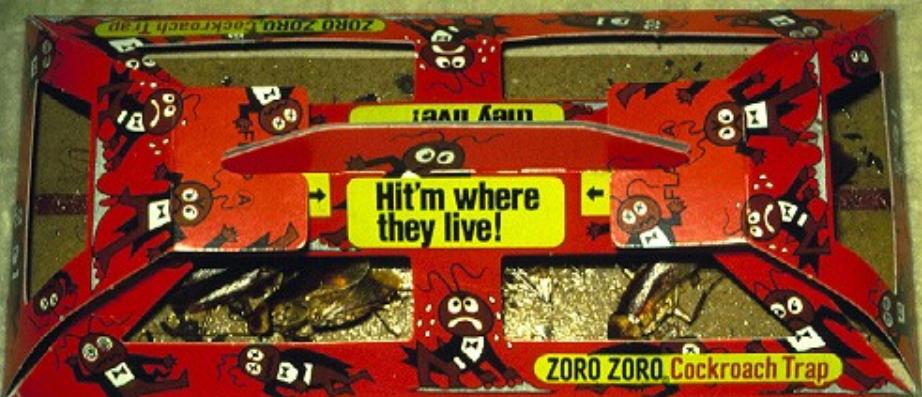




Molting



Cockroach Sticky Trap



Heard of a "roach" motel?

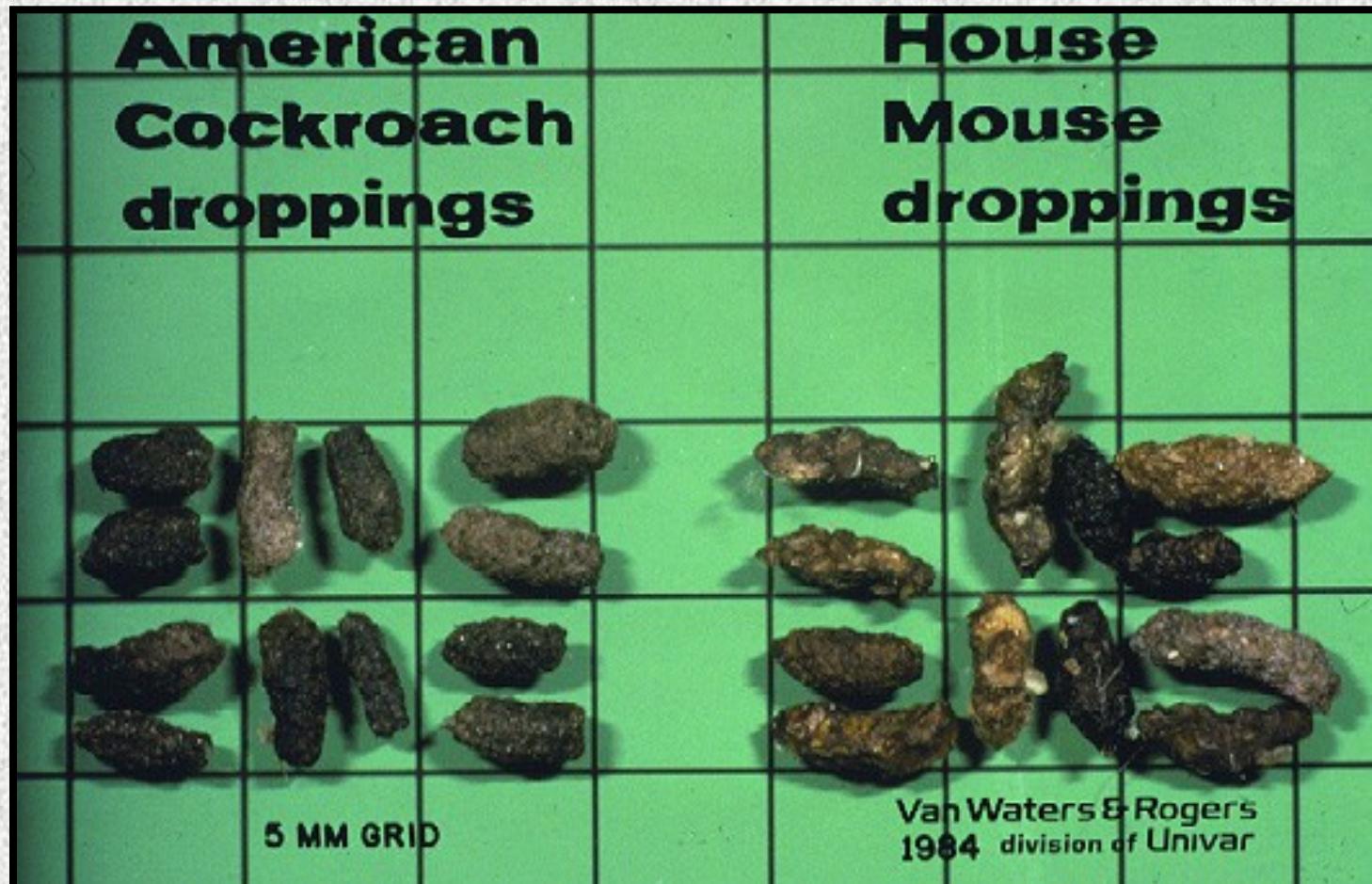
Take
advantage of
roach behavior

American Cockroaches in Sticky Trap



Insects and People
Insect Taxonomy

Could you tell the difference between roach and mouse droppings?



Insects and People
Insect Taxonomy

There are some beautiful roaches in the tropics



There are some big roaches out there!



Most roaches are tropical in distribution

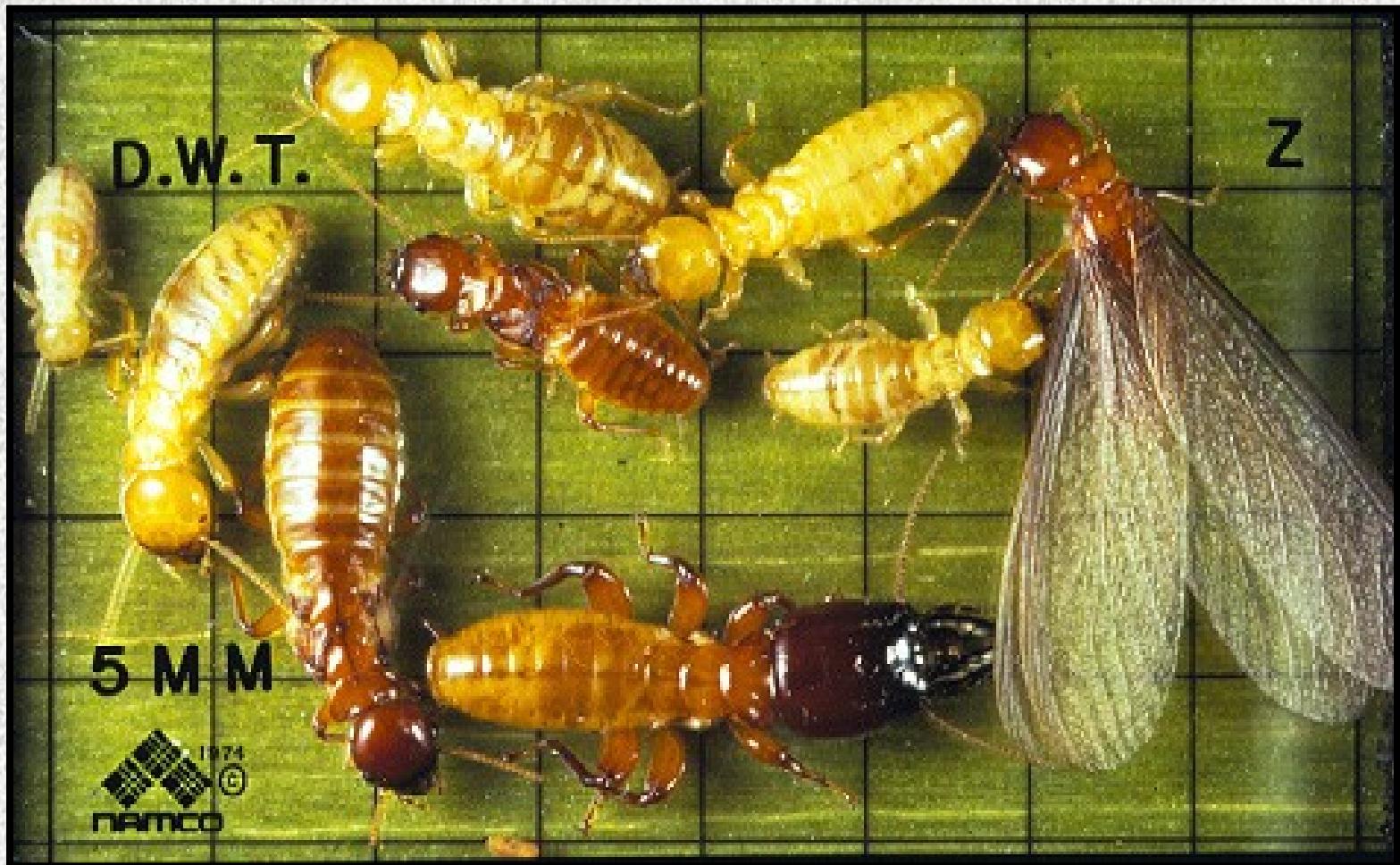


Insects and People
Insect Taxonomy

Order Isoptera termites

- Incomplete metamorphosis
- Chewing mouthparts - feed on cellulose with aid of gut symbionts
- Social insects
- Usually associated with the soil (moisture)
- Important in natural decomposition
- Can become very serious pests

Termites are social insects - they live in colonies



Insects and People
Insect Taxonomy

Termites and ants are very different insects!

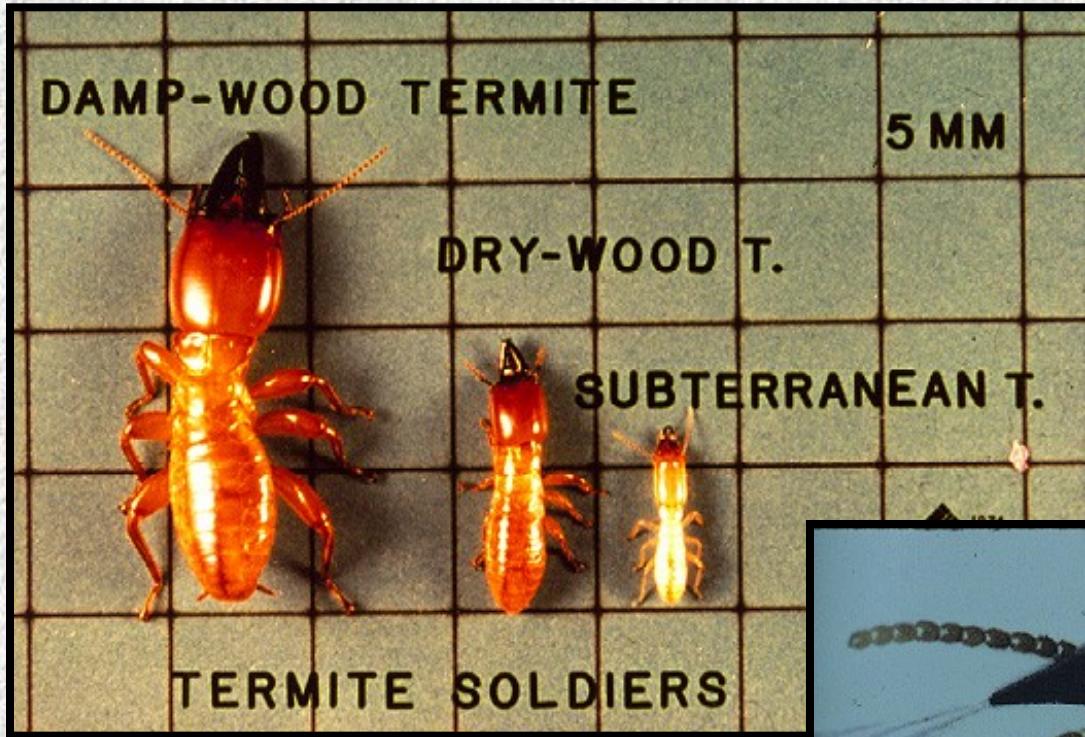


Insects and People
Insect Taxonomy

This queen may produce 10 million young during her life!

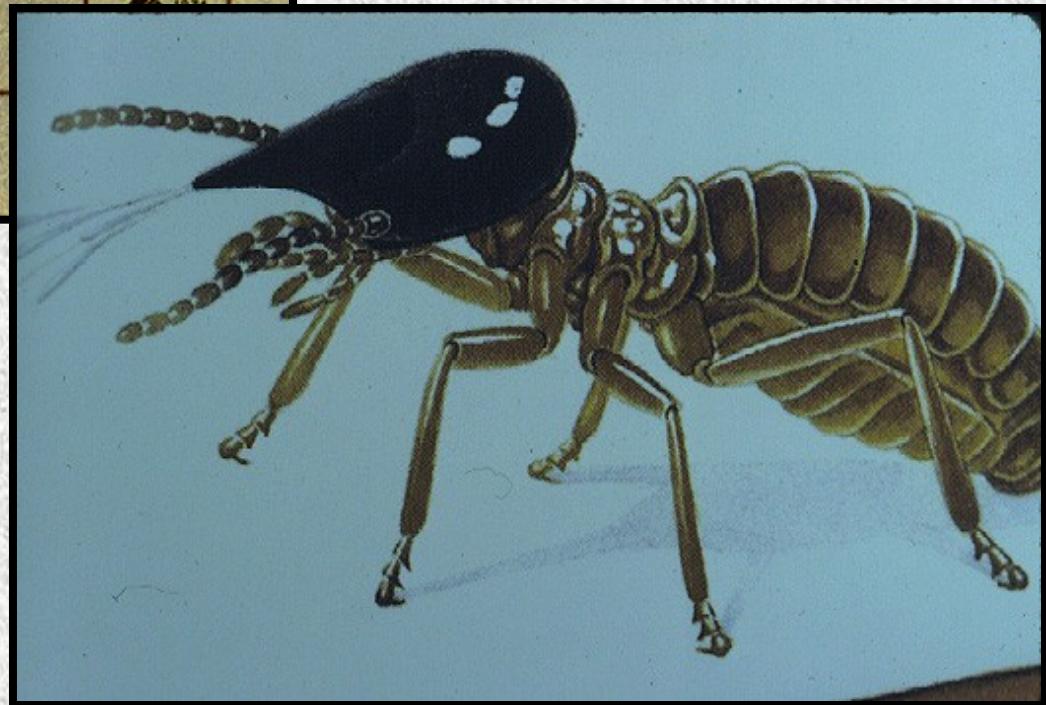


Insects and People
Insect Taxonomy

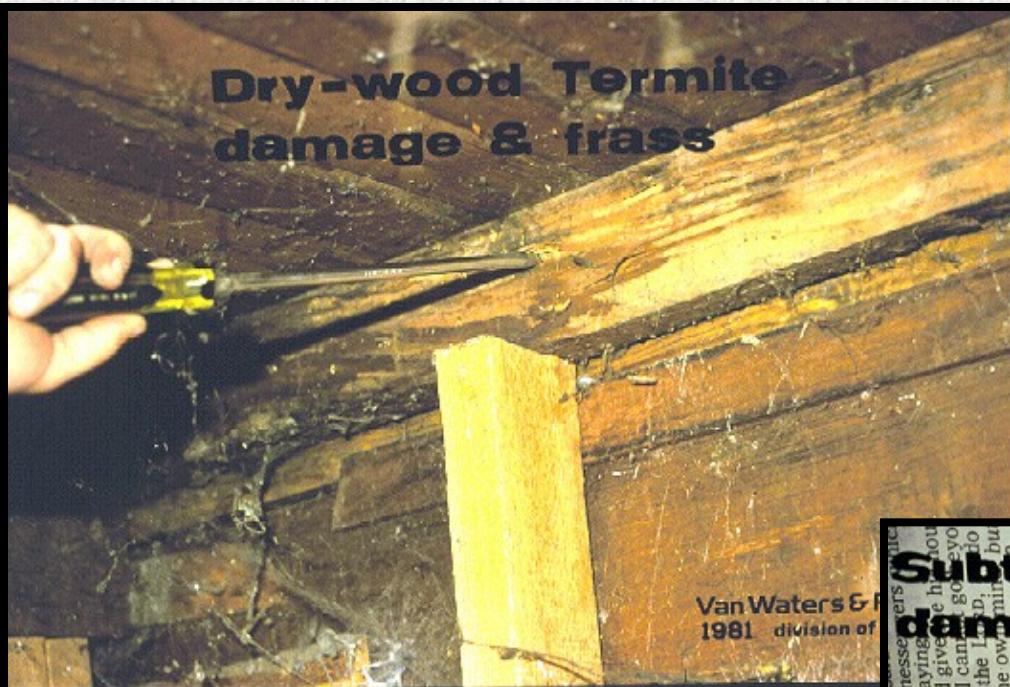


*Protective caste -
soldier*

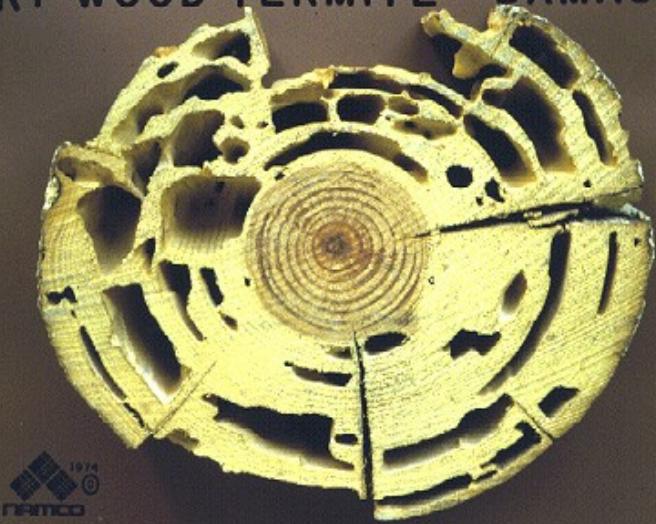
Anasute



Insects and People
Insect Taxonomy



DRY-WOOD TERMITES - DAMAGE



Subterranean Termites damage to Holy Bible

22 And Balalaam said unto them, If I tell you also to thy messenger, that I have seen what thou sayest unto me, saying, There is no silver and gold in the land, and there is no commandment of mine own or of the Lord saith, that will give me good or bad of mine own self, then I will tell you. 13 If Balalaam could see unto another man's eyes, he would tell him all that he saw. 14 And now, behold, a people come therefore, a people that see unto another man's eyes, and they say, Come unto another man, and say unto him, Please God that I may see unto another man from thence. 15 And he took up his staff, and went into Balak's camp, and said unto Balak, Build me here ten rams, and ten rams, and I will go unto the people toward Jesus. 16 Balalaam had said, Bring a ram on every side of the camp. 17 I shall see him, but behold him not; not might I look upon his eyes. 18 Star out of Israel, and star out of Moab, and star out of Sheba. 19 Out of Jacob shall come a star, and he shall be a Prince, and he shall be a King, and he shall be a King of kings. 20 And Balalaam said, Woe is me that I have seen what thou sayest unto me, saying, There is no silver and gold in the land, and there is no commandment of mine own or of the Lord saith, that will give me good or bad of mine own self, then I will tell you. 21 And now, behold, a people come therefore, a people that see unto another man's eyes, and they say, Come unto another man, and say unto him, Please God that I may see unto another man from thence. 22 And he took up his staff, and went into Balak's camp, and said unto Balak, Build me here ten rams, and ten rams, and I will go unto the people toward Jesus. 23 Balalaam had said, Bring a ram on every side of the camp. 24 And Balalaam said, Woe is me that I have seen what thou sayest unto me, saying, There is no silver and gold in the land, and there is no commandment of mine own or of the Lord saith, that will give me good or bad of mine own self, then I will tell you. 25 And now, behold, a people come therefore, a people that see unto another man's eyes, and they say, Come unto another man, and say unto him, Please God that I may see unto another man from thence. 26 And he took up his staff, and went into Balak's camp, and said unto Balak, Build me here ten rams, and ten rams, and I will go unto the people toward Jesus. 27 Balalaam had said, Bring a ram on every side of the camp.

...and a bulkhead and a ram

CHAPTER 24

in Ba'laam saw that it pleased

to bless Israel, he went not
times to seek for enchant-

one set his face toward the wil-

Jam lifted up his eyes, and he

abiding in his tents according

es; and the spirit of God came

took up his parable, and said

son of be or shall say, and gives a "open bath said:

which heard the words

which saw the Vision of the
Trance, but having

Environ Biol Fish (2007) 80:1–12
DOI 10.1007/s10641-006-9999-0

odly are thy tents, O Israel!

vermacles, & ~~the~~ spread forth, &
alleys are they ~~the~~ trees of

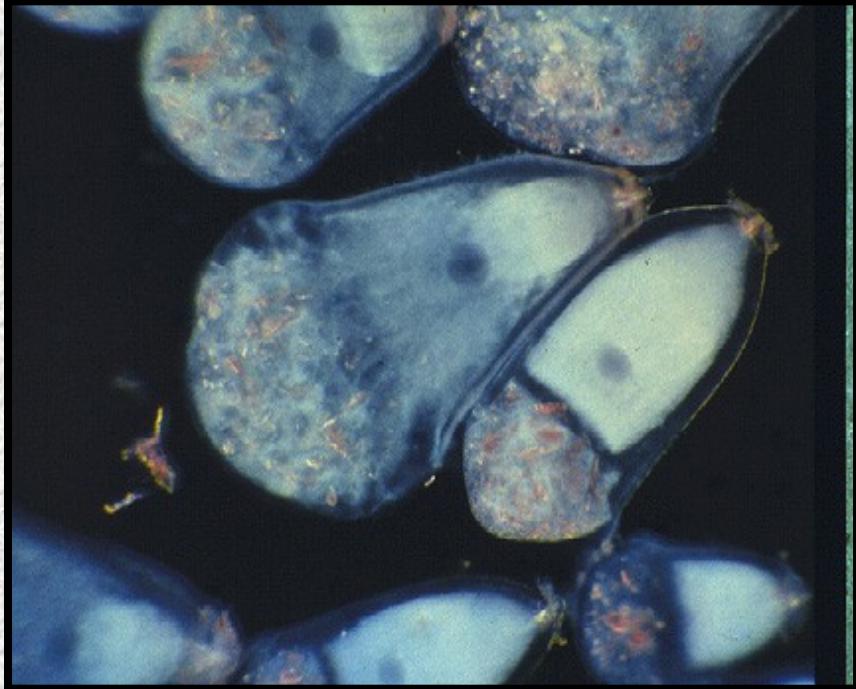
Yan
Waters & Rogers
Division of Universal

Nevertheless the Kentish
wasted, until Asshur shall
have captive.
23 And he took up his parable,
Alas, who shall live when God
24 And ships shall come from the
of Chittim, and shall

Insects and People

Insect Taxonomy

*Termites cannot
digest wood!*



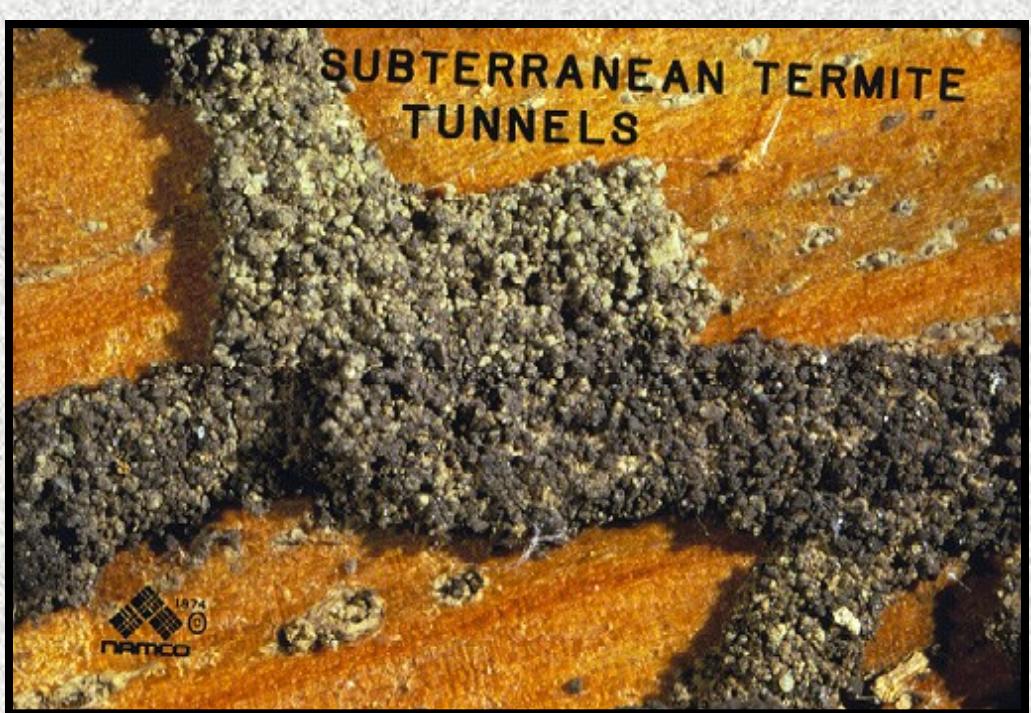
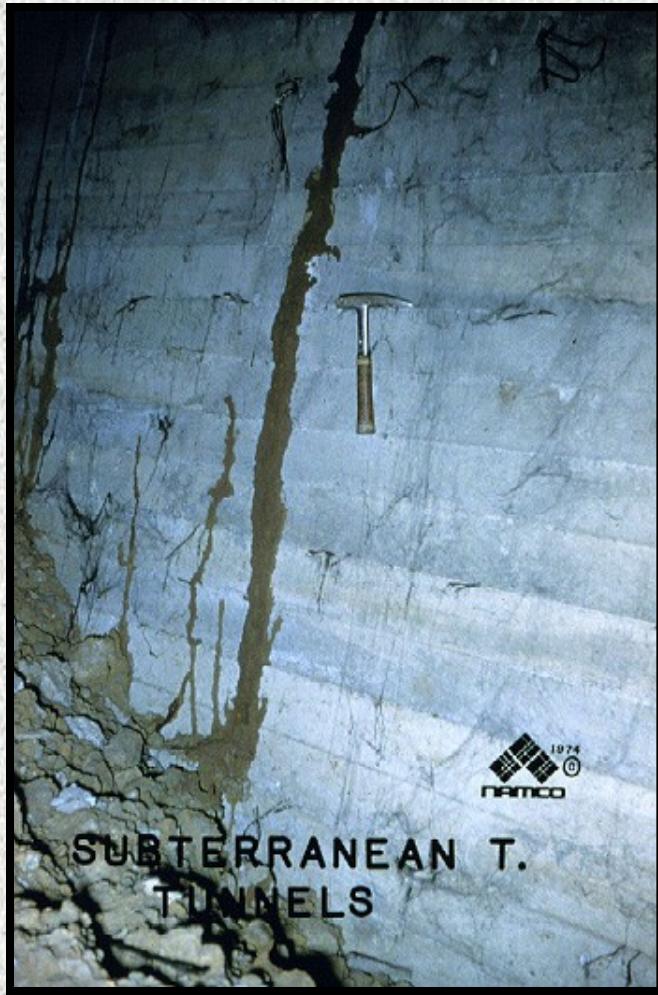
*They rely on
internal gut
symbionts*

*Subterranean termites are common in eastern
WA*



Insects and People
Insect Taxonomy

Subterranean termites maintain contact with the soil



Insects and People
Insect Taxonomy

A swarm of termite reproductives in East Africa



Food

Insects and People
Insect Taxonomy



*Termite mounds
in Africa*

*Mounds are like
High-rise
Air-conditioned
buildings*

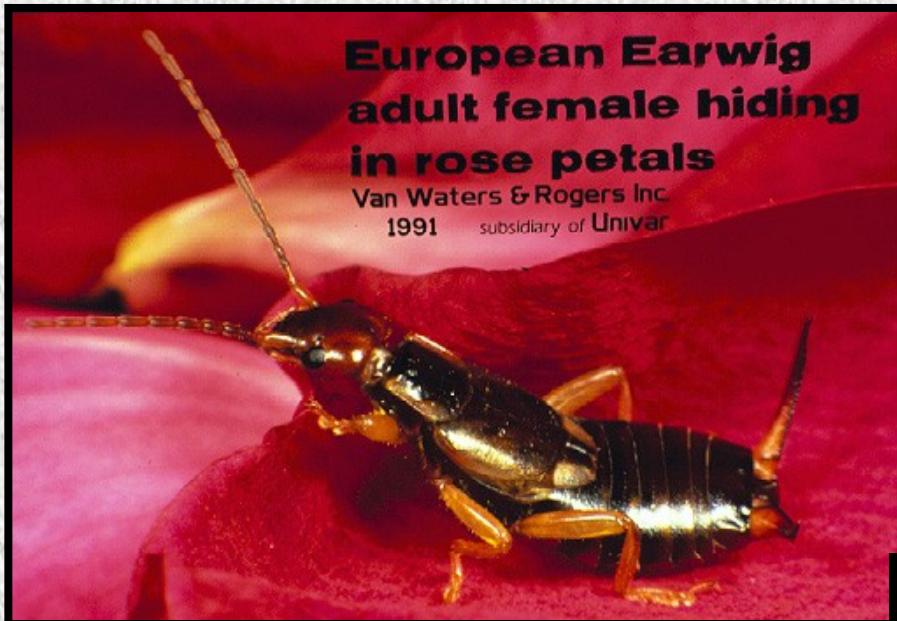


Insects and People
Insect Taxonomy

Order Dermaptera

earwigs

- Chewing mouthparts
- Hindwings are ear-shaped
- Distinctive cerci
- Do not enter ear to feed on brain
- Can be a nuisance

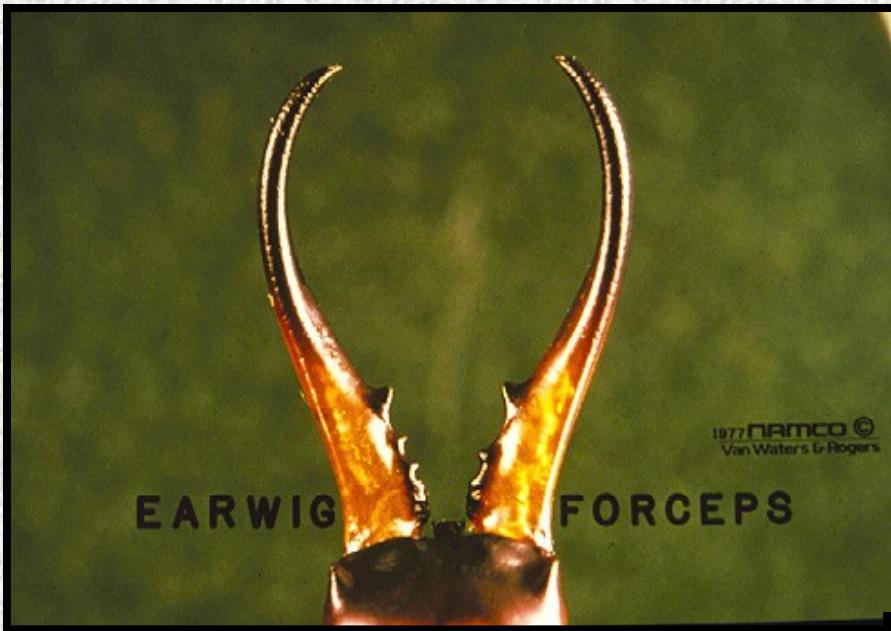


*Earwigs are
omnivorous feeders*

*Earwigs are very
distinctive*



Insects and People
Insect Taxonomy

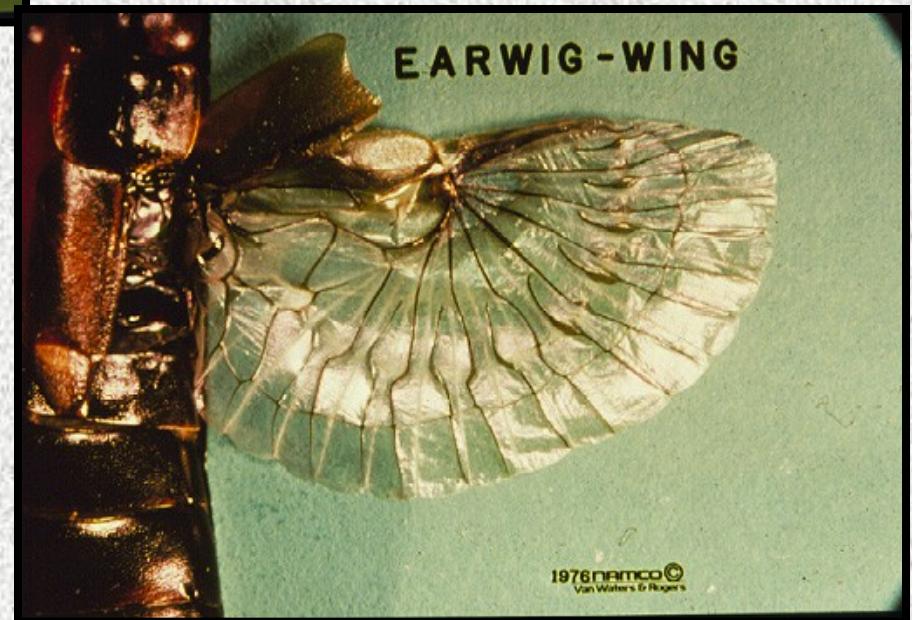


EARWIG
FORCEPS

1977 NAMCO ©
Van Waters & Rogers

*The hindwing is
“ear” shaped*

Very distinctive cerci



1976 NAMCO ©
Van Waters & Rogers

Insects and People
Insect Taxonomy

Earwig nymphs receive some parental care



Insects and People
Insect Taxonomy

Order Plecoptera stoneflies

- Incomplete metamorphosis
- Immature is aquatic (naiad)
- Chewing mouthparts in immatures and adults (adults may not feed)
- Important aquatic food source
- May be important in water quality studies

Stonefly naiads are usually found in fast-moving, cool waters.

They are an important part of the aquatic food chain

*Water
Quality
Indicators*



Insects and People
Insect Taxonomy

*Stonefly adults rarely move far from the stream
Often copied by fly fisherpersons*



*Some adults
emerge in
winter*

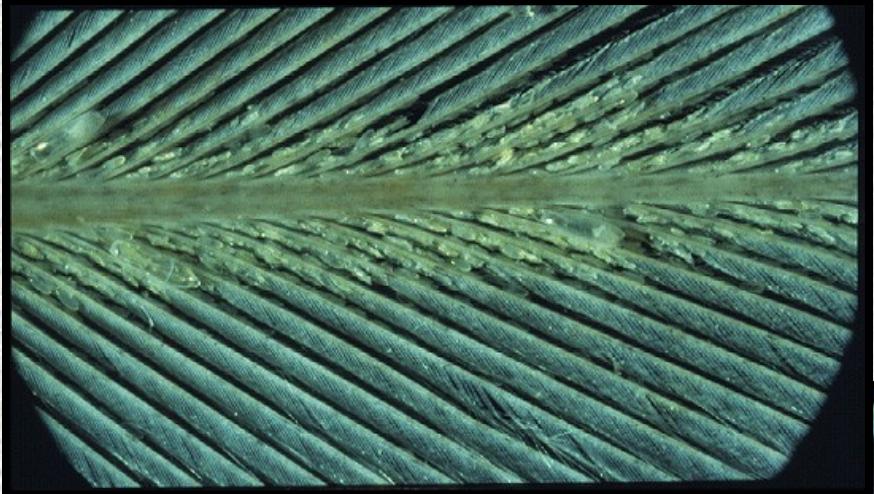
Order Pthiraptera chewing and sucking lice

- Incomplete metamorphosis
- Chewing lice (Mallophaga) feed mainly on birds - feathers, skin, hair, debris
- Sucking lice (Anoplura) feed mainly on mammals - blood
- Lice are secondarily wingless
- Eggs called nits when glued to hairs
- Can be serious pests

*Chewing lice (Mallophaga) have chewing mouthparts
The head is as wide as the thorax*

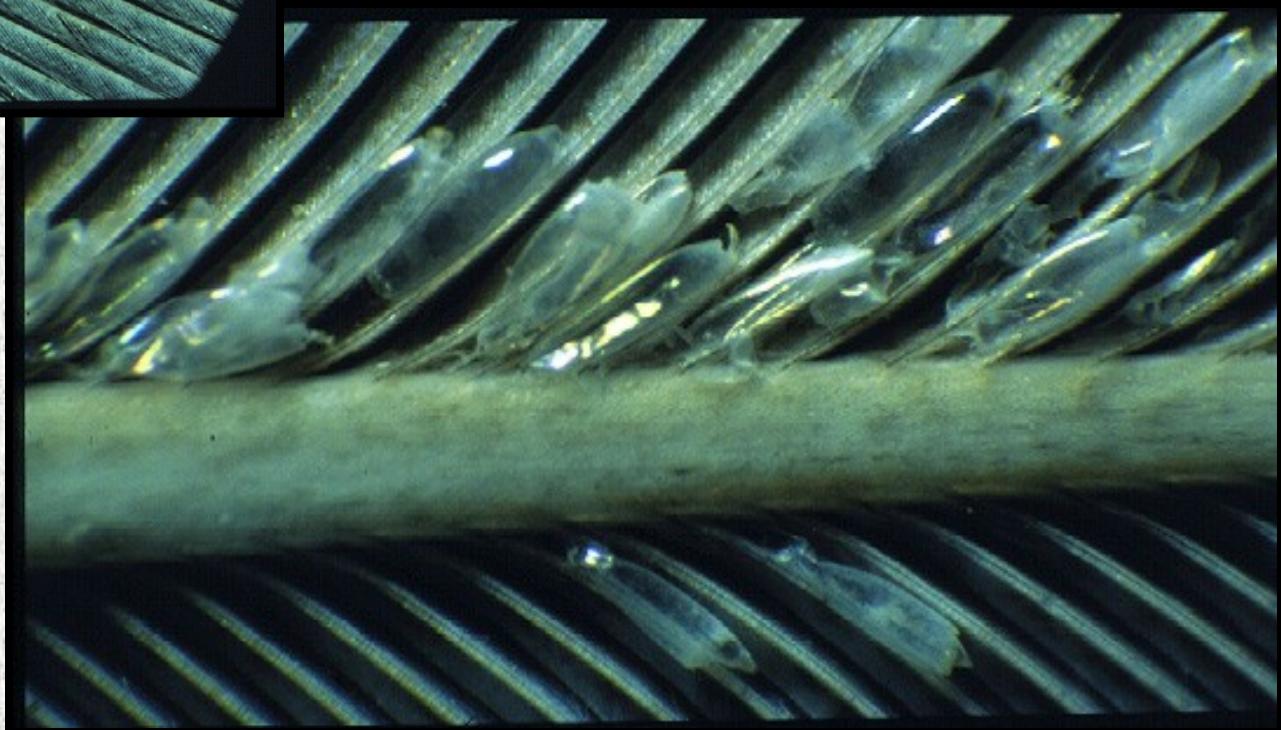


*Most feed
on birds*



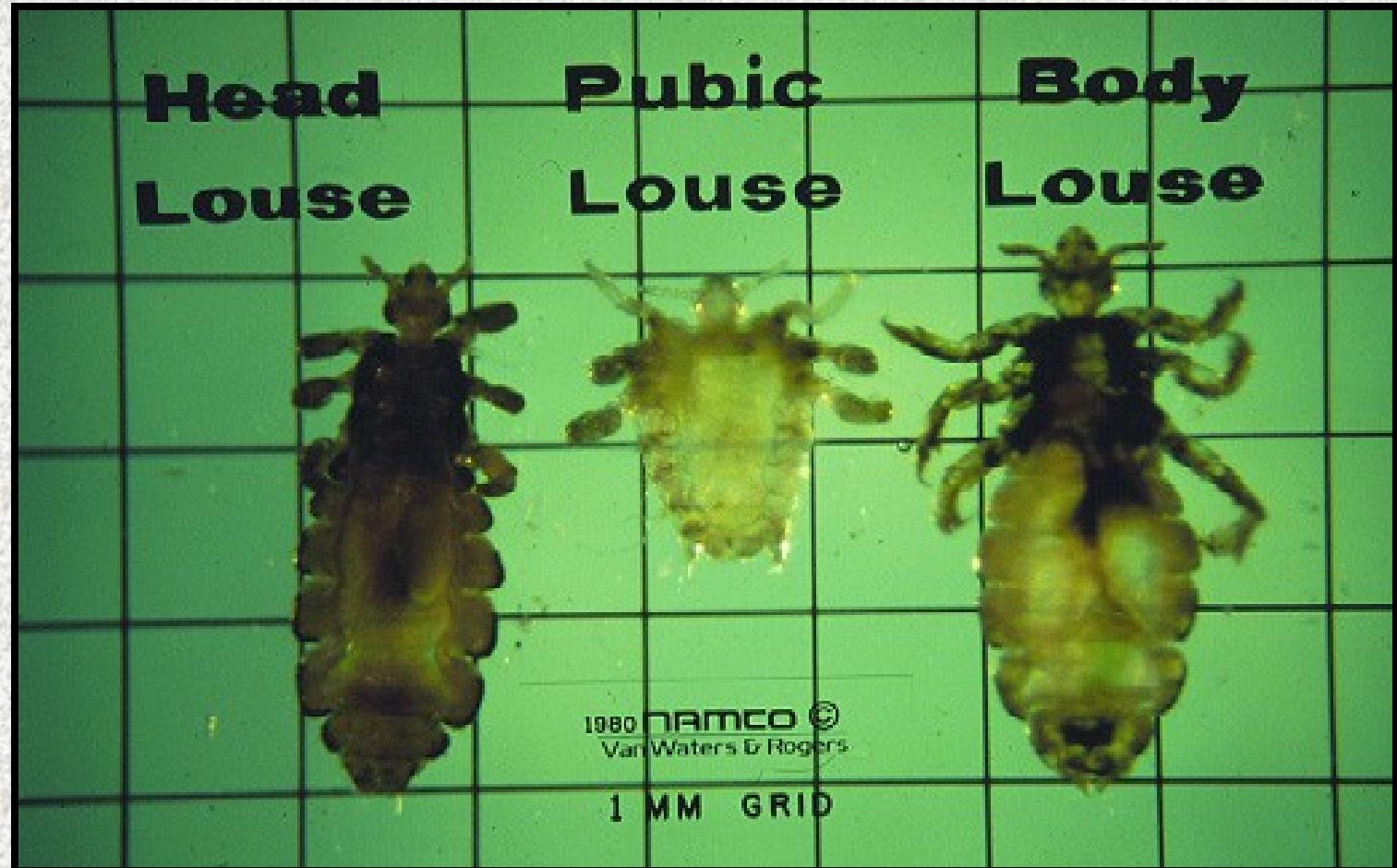
*Feed on feathers,
skin, blood, debris*

*Eggs are
laid on the
shafts of
feathers*



There are three types of sucking lice found on humans.

*All
feed on
blood*



Head lice remain on the body when not feeding

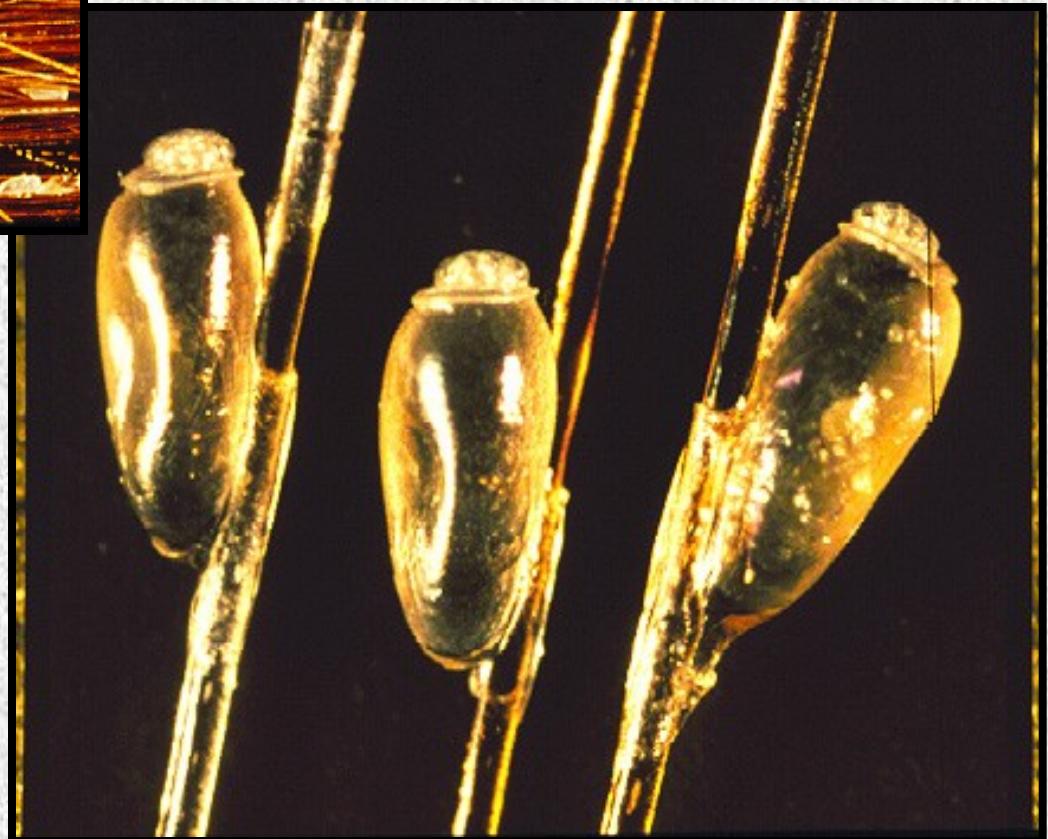


Insects and People
Insect Taxonomy



*Head lice glue their eggs
to hair shafts*

*Eggs glued to
hairs are called
“nits”*



Insects and People
Insect Taxonomy

Body lice leave the body after feeding



Insects and People
Insect Taxonomy

- ⌚ Eggs are laid on clothing and in bedding
- ⌚ Easy to contact



*Seam
squirrels*



Insects and People
Insect Taxonomy

*The crab or pubic louse
Found on coarse body hairs*

*Eggs laid
on body
“nits”*

*Cause
severe
itching*

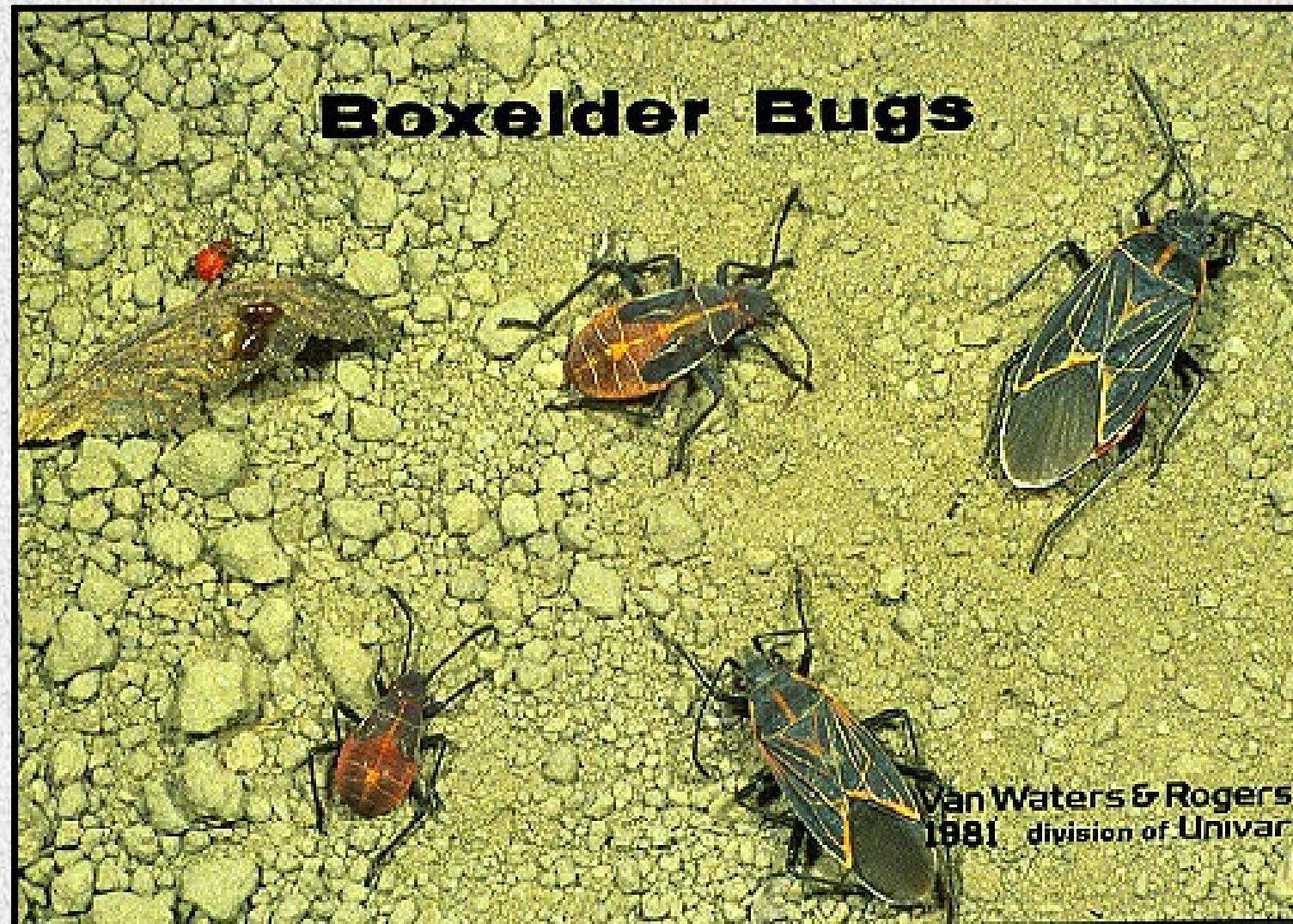


Order Hemiptera

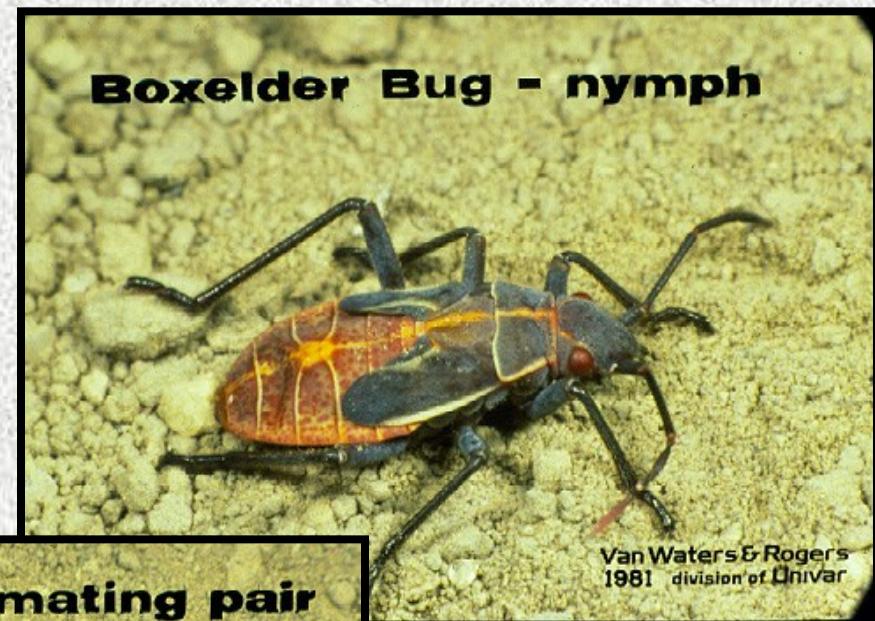
true bugs

- Incomplete metamorphosis
- Front wing called a hemelytron
- Piercing and sucking mouthparts
- Feeding habits varied - plant juices, some predators, some parasites
- Occur in varied habitats

Hemipteran - True Bug! - Lifecycle



Insects and People
Insect Taxonomy



*Egg
Nymph*



Adult

Insects and People
Insect Taxonomy

*True bugs have
piercing and
sucking
mouthparts*



Van Waters & Rogers
1981 division of Univar

Insects and People
Insect Taxonomy

Wing of a true bug - hemelytron



Insects and People
Insect Taxonomy

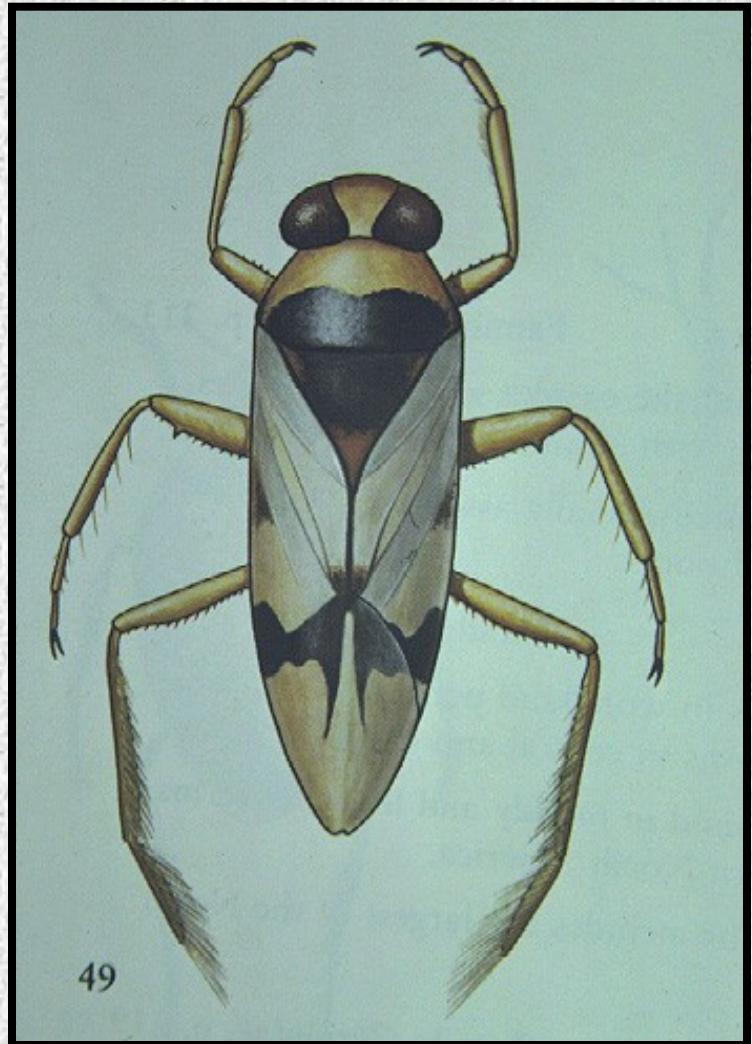
Many true bugs are phytophagous

*This type of
damage is
called
“cat-facing”*





*Many true bugs
are aquatic*



49

Many true bugs are predators



Insects and People
Insect Taxonomy

**Bed Bug adult
feeding on blood**

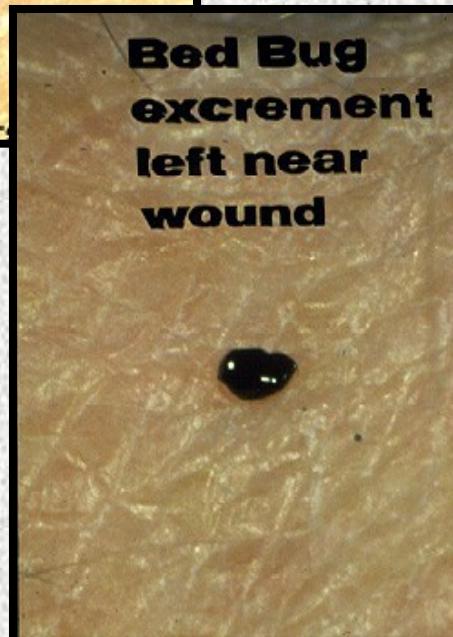


*Bedbugs appear
To be making
A comeback!*

*Bedbugs are
parasitic*

*Leave host after
feeding*

**Bed Bug
excrement
left near
wound**



**Bed Bug bite
on 7th day**

Van Waters & Rogers
1986 division of Univar

Insects and People
Insect Taxonomy



“Kissing Bugs”

*Sign of Romana
Chagas Disease*



Insects and People
Insect Taxonomy

Order Hemiptera (cont.) aphids, leafhoppers, scales, whiteflies, psyllids

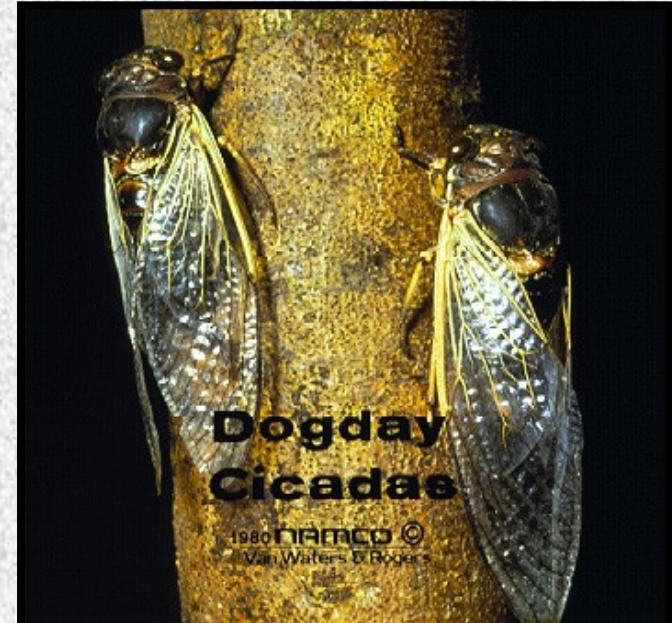
- Incomplete metamorphosis
- Piercing and sucking mouthparts
- All feed on plant juices
- Front and hind wings (when present) are similar
- Some are serious pests



Cicada



1980 NAMCO ©
Van Waters & Rogers



1980 NAMCO ©
Van Waters & Rogers

Insects and People
Insect Taxonomy

Leafhoppers



**Grape Leafhopper
adult & nymph**



Van Waters
1981 division



Spittlebugs



aters & Rogers
division of Univar



Insects and People
Insect Taxonomy

Many aphids are parthenogenetic



Insects and People
Insect Taxonomy

Many homopteran populations can build very quickly



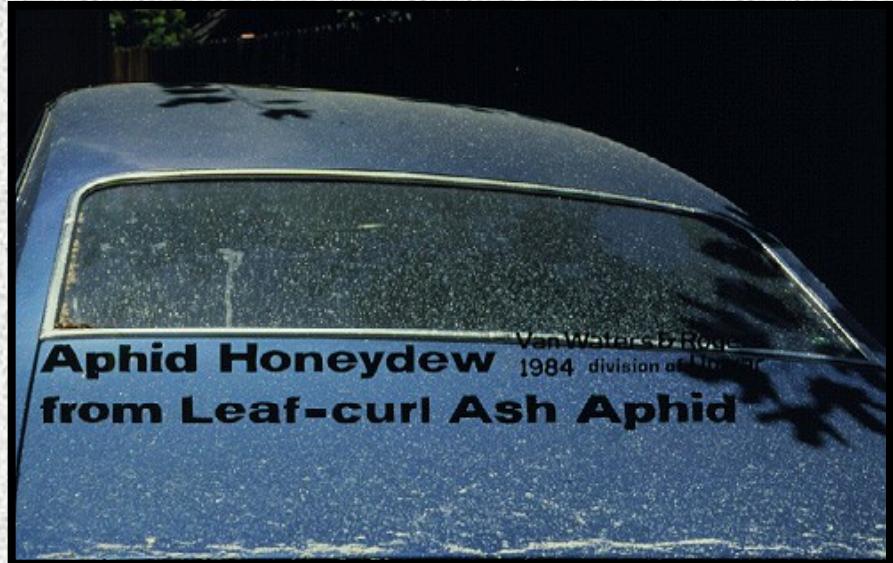
Insects and People
Insect Taxonomy

Cooley Spruce gall aphid



Insects and People
Insect Taxonomy

Honey-dew is the sugary secretion of some homopterans



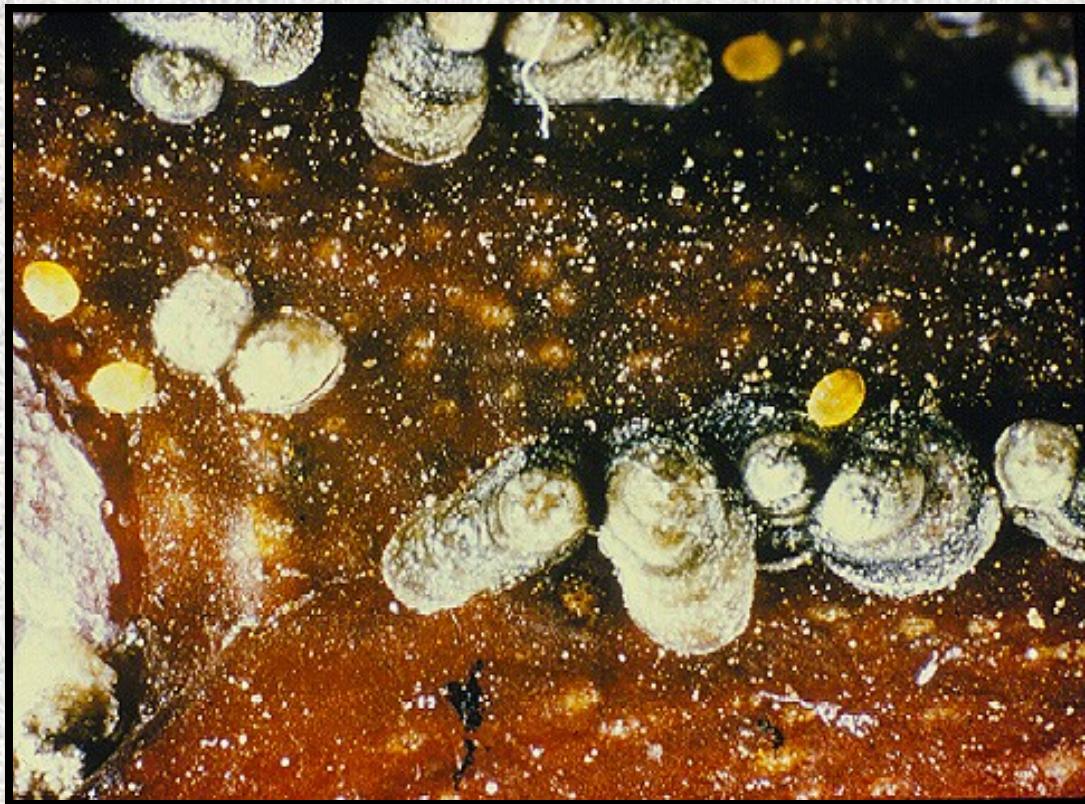
Don't park under a maple tree!



Scales cover themselves in a waxy secretion

San Jose Scale

Scale removed





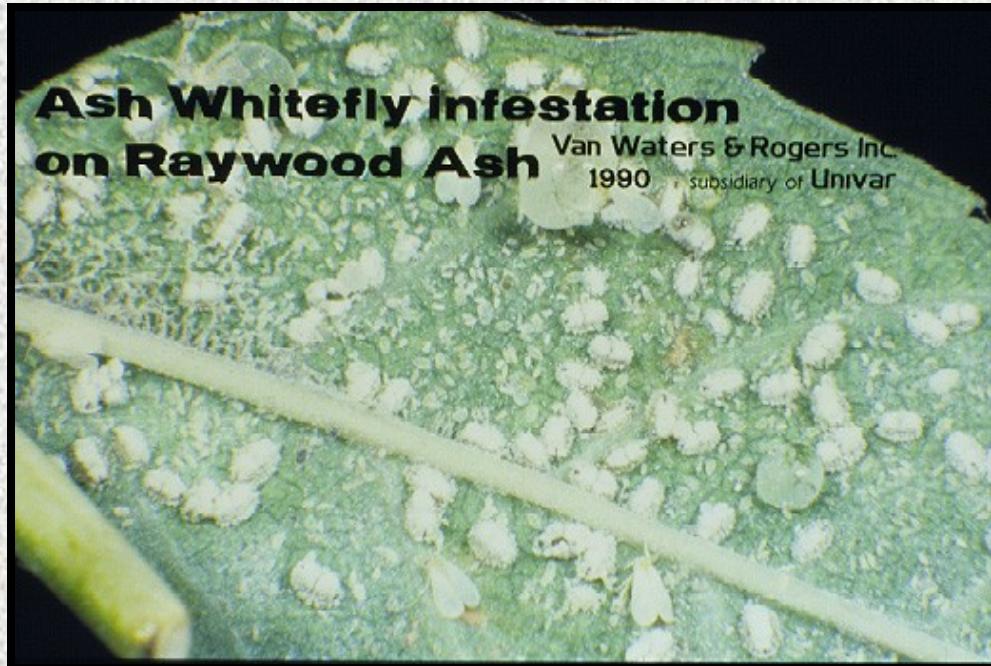
Cottony maple scale

Pine needle scale



Insects and People
Insect Taxonomy

Whiteflies can be pests, especially in greenhouses



*Rapid population
Growth!*



Insects and People
Insect Taxonomy

A beautiful homopteran!



Insects and People
Insect Taxonomy

There are some big homopterans!

*Alligator
“bug”
Peanut-head*



Insects and People
Insect Taxonomy