Relationships Among Diet, Arthropod Prey Availability and Foraging Patterns of the Golden-cheeked Warbler in Central Texas

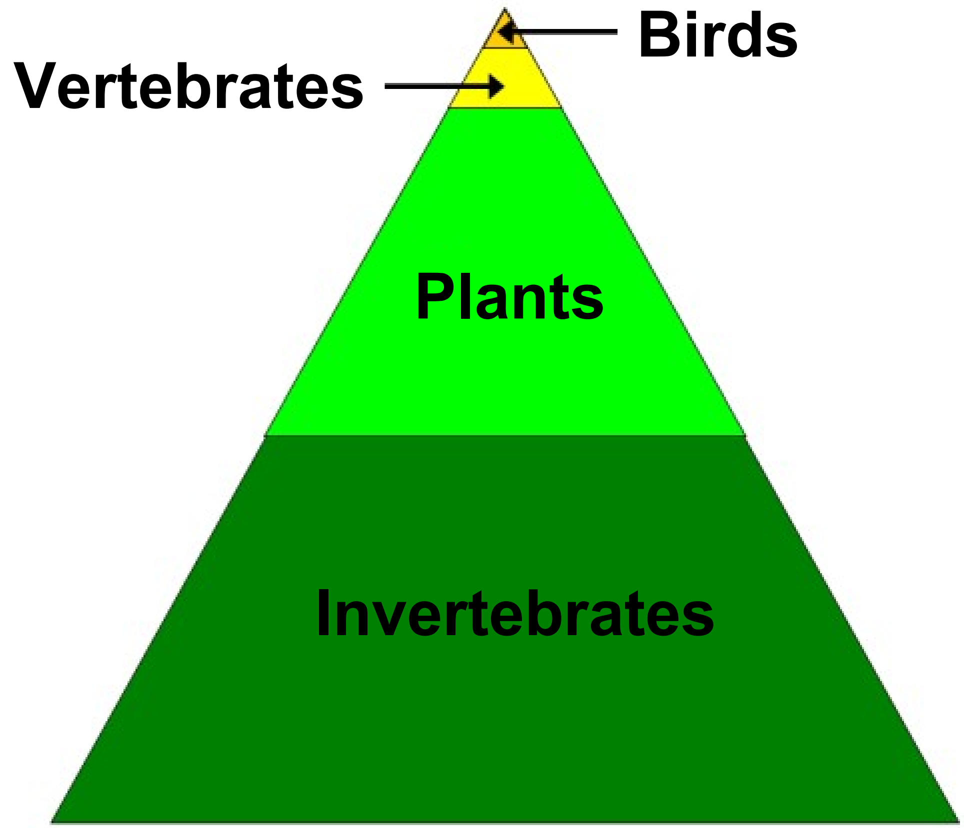
Mike Quinn, M.Sc.

The First Law of Ecology

Everything is connected to everything else.

Barry Commoner (1971) The Closing Circle.

Arthropods are very important to birds, particularly during nesting season



Chris Helzer

But the ecology of arthropods is not well known.

HABITAT USE OF GOLDEN-CHEEKED WARBLERS IN TRAVIS COUNTY, TEXAS

A Thesis by

CAROL JEANNETTE BEARDMORE

Texas A&M University

MASTER OF SCIENCE

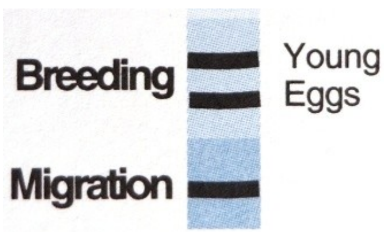
December 1994

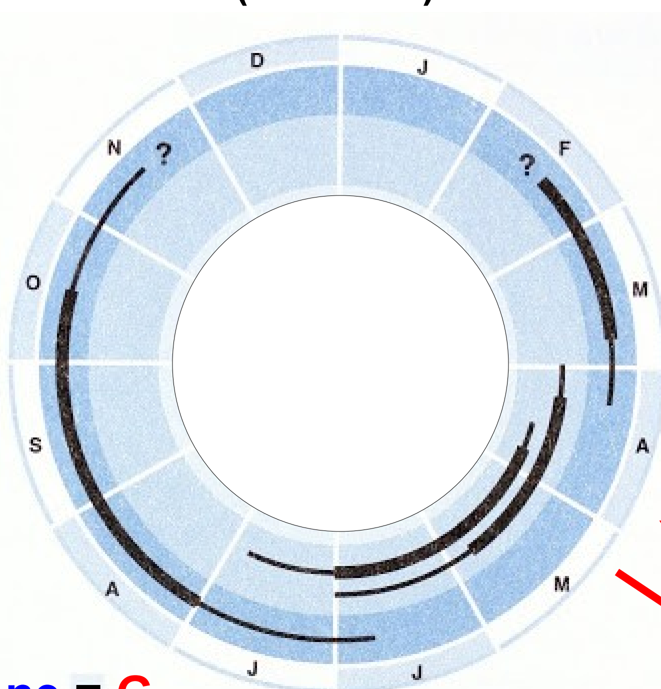
Major Subject: Wildlife and Fisheries Sciences

A E Y D G

Central Texas GCWA Phenology

(C. Amer.)





A = start arriving
early March

E = start egg laying
early April

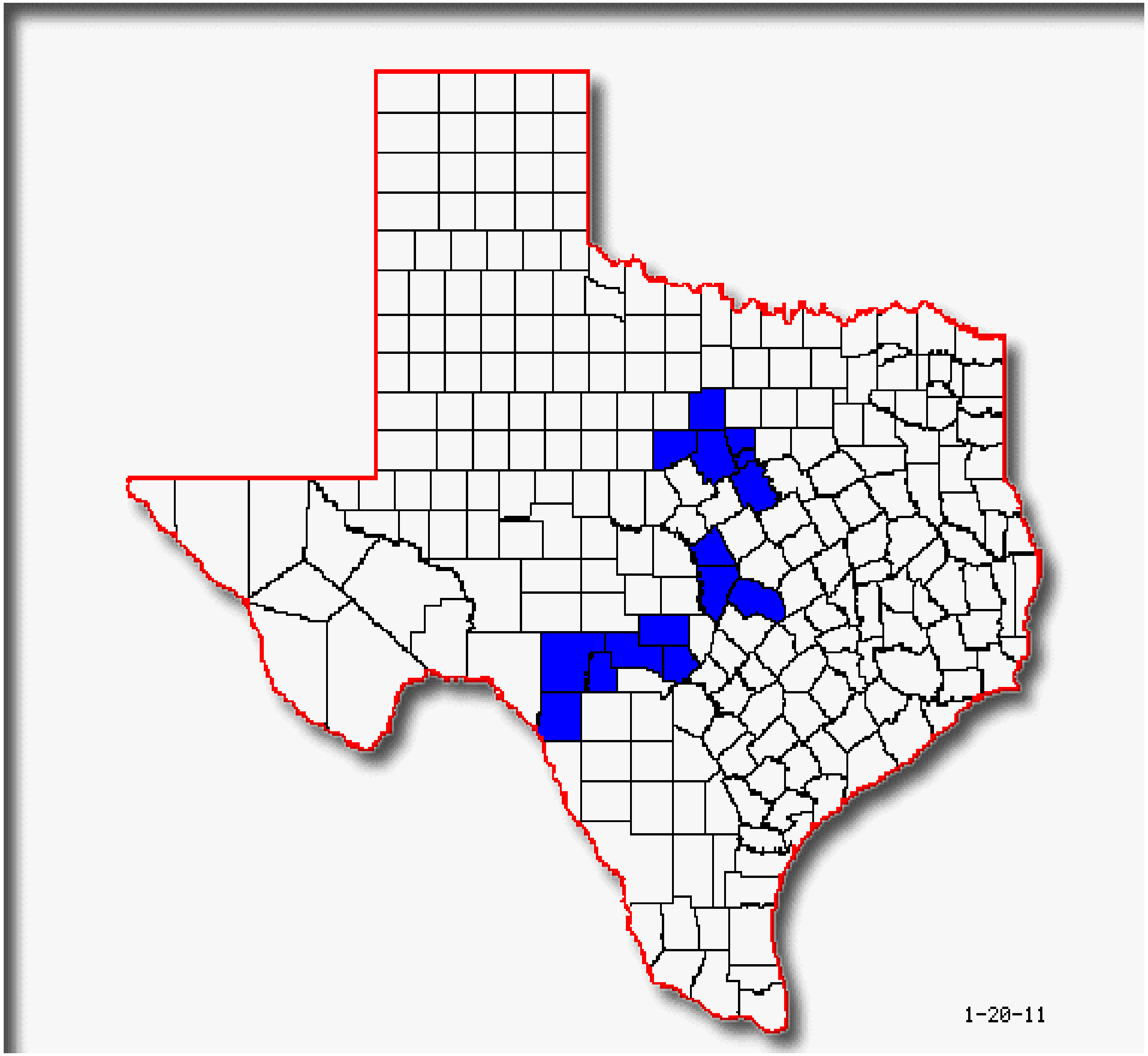
Y = start young hatch
late April

mostly gone = G
end of July

D = start departing
late June

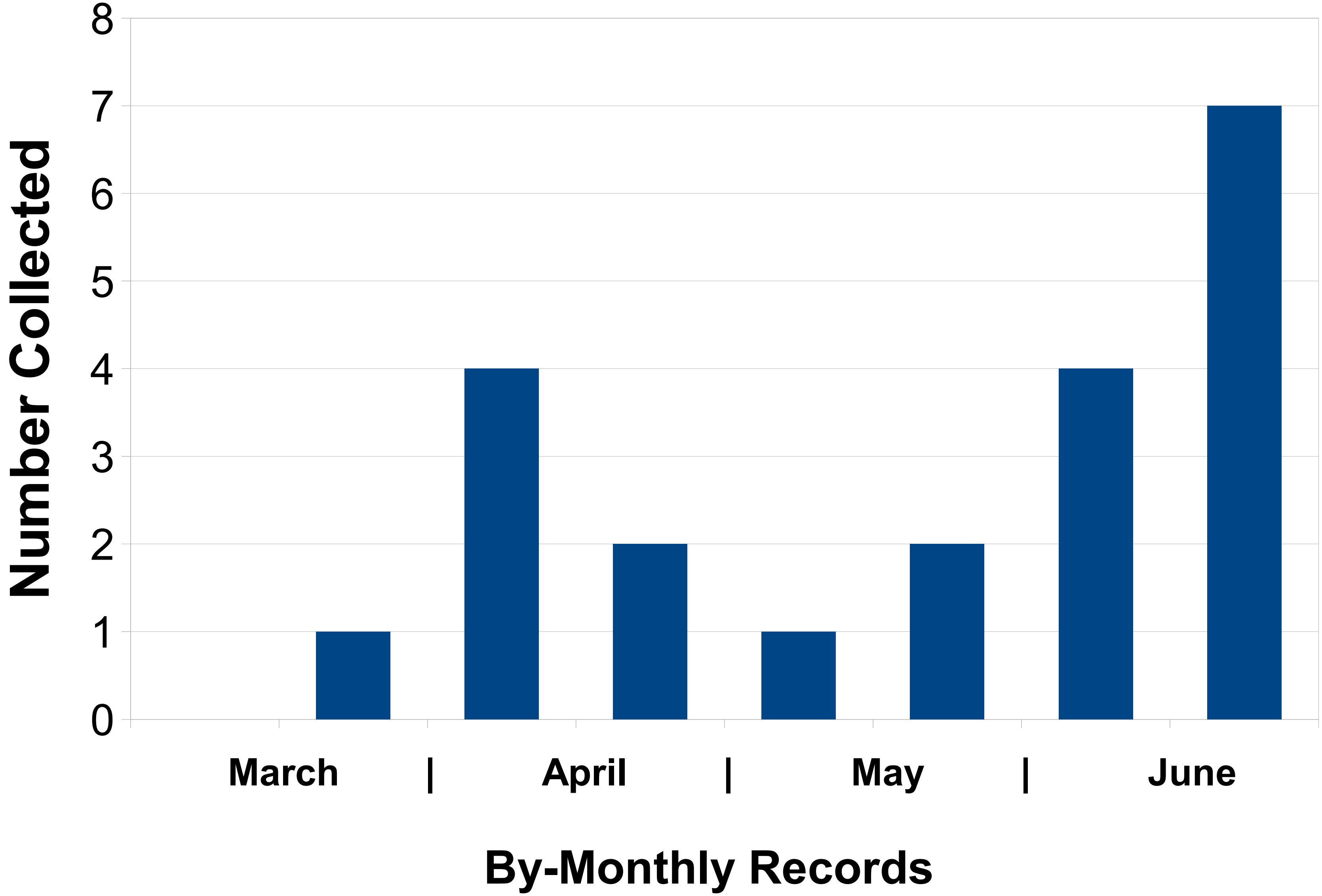
Ladd and Gass (1999)

Distribution of 22 GCWA Stomachs Collected by Warren Pulich 1962-64



Pulich (1976)

Pulich's GCWA Stomachs Coll. 1960-64



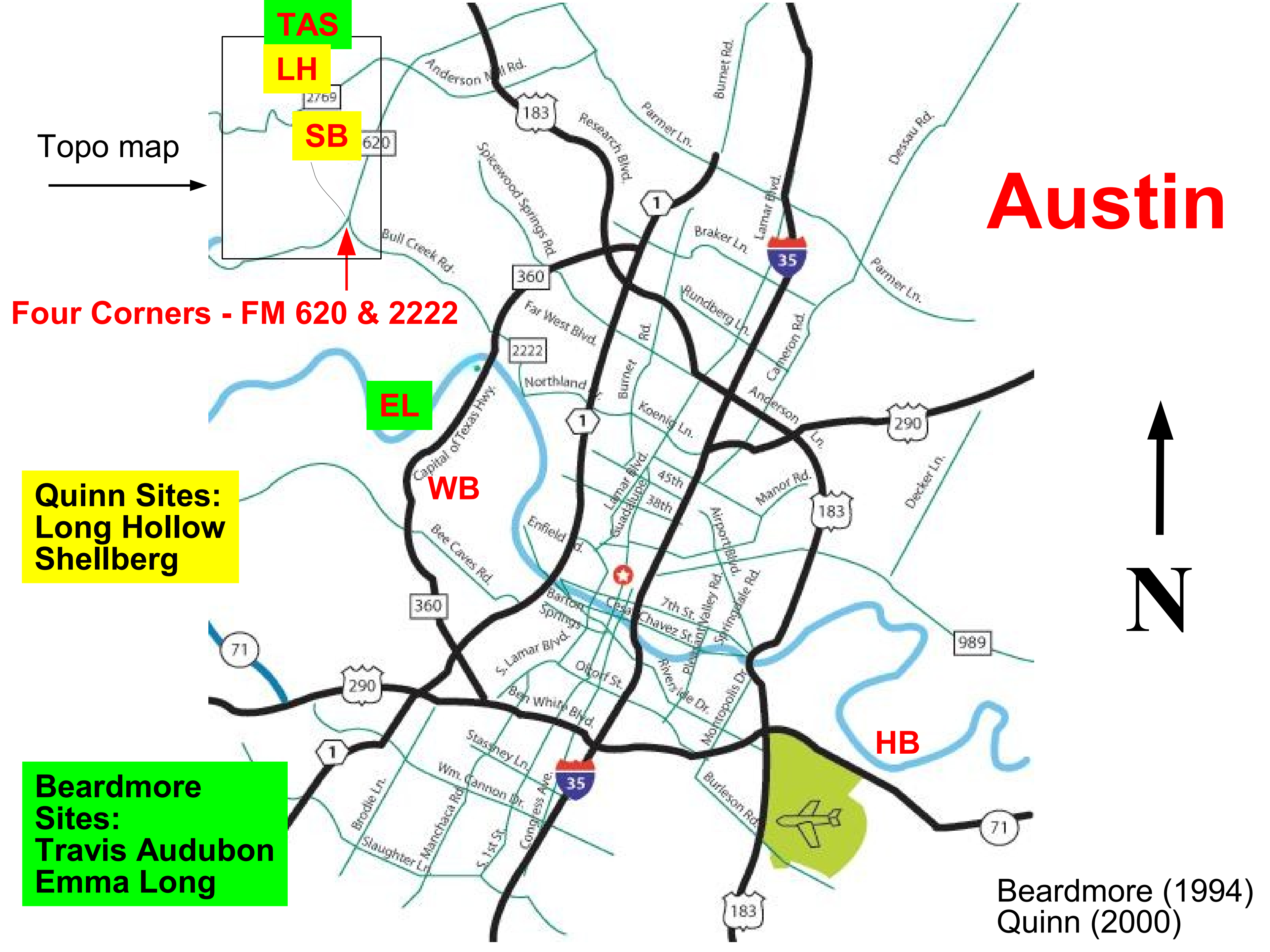
Pulich (1976)

Table 14. Analyses of Golden-cheeked Warbler stomachs.

	Specimen Numbers																				
	984	986	987	988	989	1002	1003	1004	1005	1010	1011	1227	1229	1240	1241	1243	1246	1247	1251	1424	Unmarked	Total
HEMIPTERA (Bugs)																						
Miridae															1				1			2
Pentatomidae						2																2
Reduviidae			1																1			2
Unidentified															3	1						4
HOMOPTERA (Plant lice, etc)																						
Cicadellidae										1												1
Membracidae																					1	1
Unidentified									2	2			1	1	1			3	1			11
LEPIDOPTERA (Moths and butterflies)																						
Larvae																						
Larva inside pupa																						1
Unidentified	3				2	1		2	1		1		1			1		1				12
COLEOPTERA (Beetles)																						
Chrysomelidae																				1		1
Cureulionidae		2	3+	4																		9
Larva												1										1
Unidentified	1				2		2+			2+		2+	1	1			2+		2+			13+
HYMENOPTERA (Ants, etc.)																						
Formicidae																			1			1
Ichneumenidae				1																		1
Unidentified																						
DIPTERA (Flies)																						
Brachyrcera											1											1
Unidentified																				1		1
OTHER ARTHROPODA																						
Araneida (spiders)				1	1		1	2		1										1	1	8
MISCELLANEOUS																						
Insect egg	1																					1
Plant material																					1	1
Shell (calcified material)											1											1
TOTAL	5	2	4+	6	3	3	3+	4	3	6+	3	3+	3	2	5	2	2+	4	6+	3	3	75+

Methods

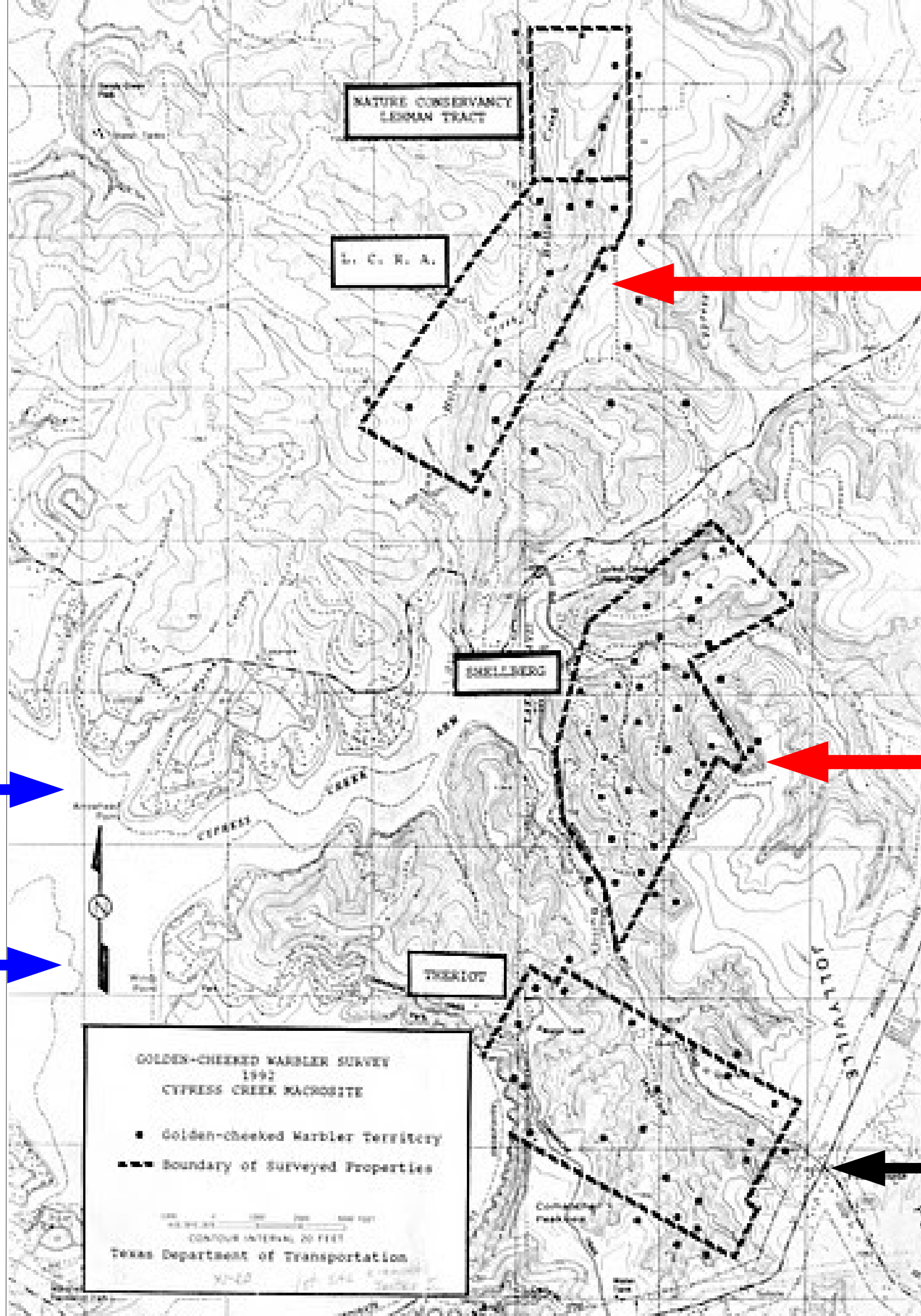
Survey Sites


TAS
LH
SB
Topo map
Four Corners - FM 620 & 2222
EL
WB
HB
Austin
N
Quinn Sites:
Long Hollow
Shellberg
Beardmore Sites:
Travis Audubon
Emma Long
Beardmore (1994)
Quinn (2000)
Anderson Mill Rd.
Research Blvd.
Parmer Ln.
Burnet Rd.
Dessau Rd.
Spicewood Springs Rd.
Bull Creek Rd.
Braker Ln.
Lamar Blvd.
Rundberg Ln.
Far West Blvd.
Cameron Rd.
Northland
Koenig Ln.
Anderson Ln.
Capital of Texas Hwy.
45th
38th
Manor Rd.
Decker Ln.
Enfield Rd.
Bee Caves Rd.
Airport Blvd.
Barton Springs
Cesar Chavez St.
7th St.
Pleasant Valley Rd.
Springdale Rd.
S. Lamar Blvd.
Oltorf St.
Riverside Dr.
Montopolis Dr.
Ben White Blvd.
Stassney Ln.
Wm. Cannon Dr.
Burleson Rd.
Brodie Ln.
Manchaca Rd.
Congress Ave.
S. 1st St.
Slaughter Ln.
2769
620
360
2222
183
1
35
290
71
989

Topo → Map

N

Quinn's Study Sites



Long Hollow - LH

■ GCWA Territory

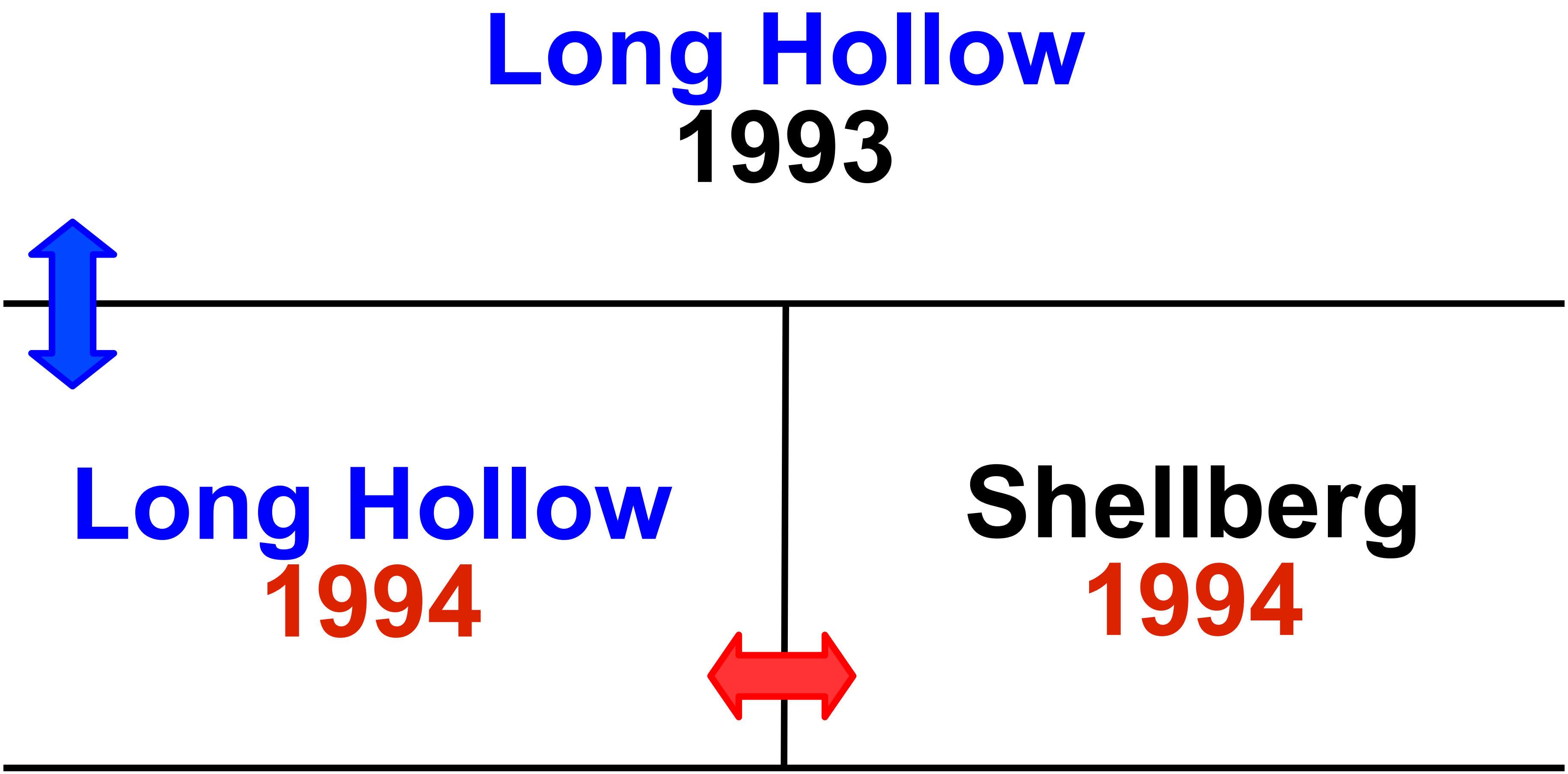
Shellberg - SB

Lake Travis

Scale: 1 Mi

1992 TxDOT Data

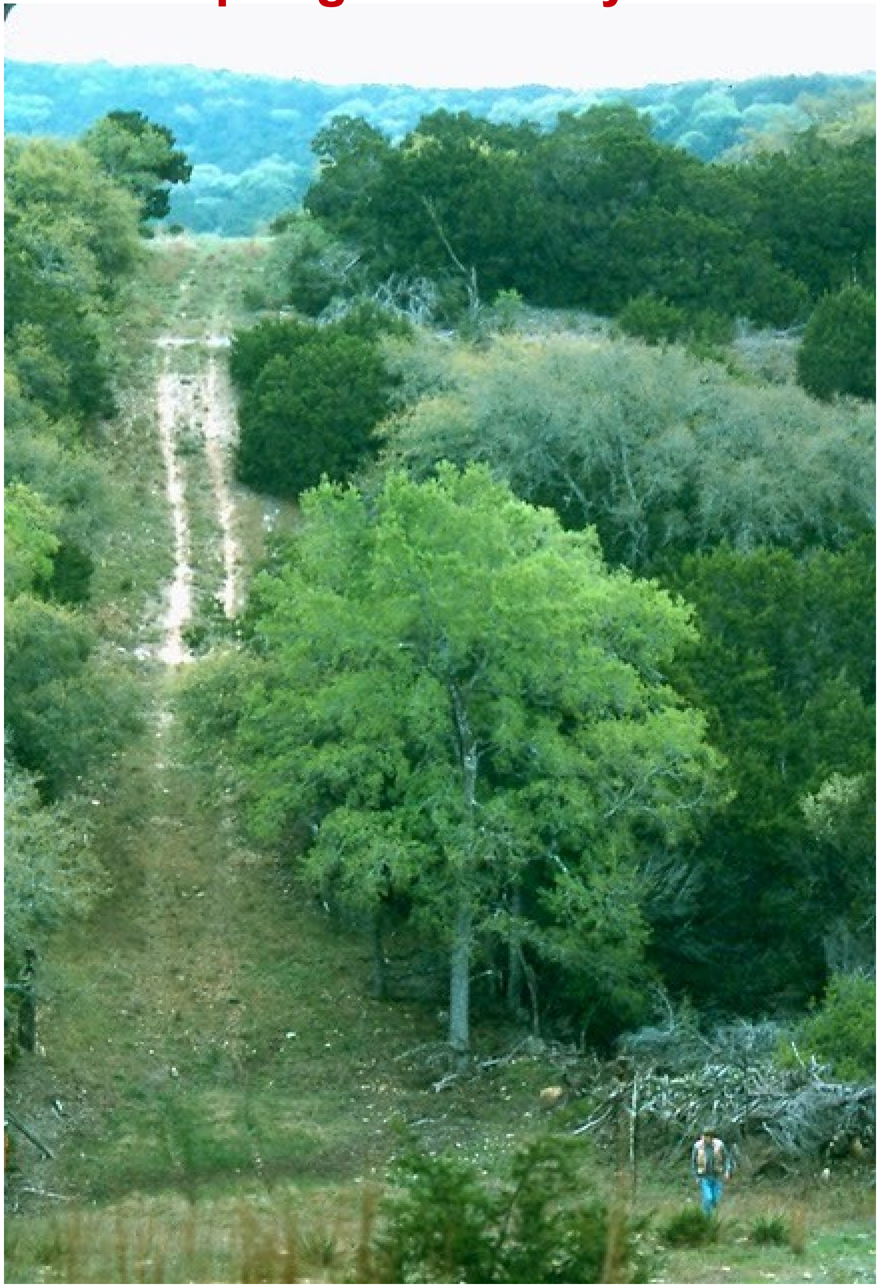
"Four Corners" Intersection of FM 620 & 2222



Sampled three “site years” allowing for comparison betw. years (at Long Hollow) and betw. sites (in 1994)

Spring 1993 – Wet Year

Spring 1994 – Dry Year



Long Hollow Creek

Woody

Plants

Surveyed

Travis Co. trees most frequently foraged in per Beardmore (1994).

***Ja* — "Ashe Juniper"**

Juniperus ashei

***Qt* — "Texas Red Oak"**

Quercus buckleyi

(=*Quercus texana*)

***Qv* — "Texas Live Oak"**

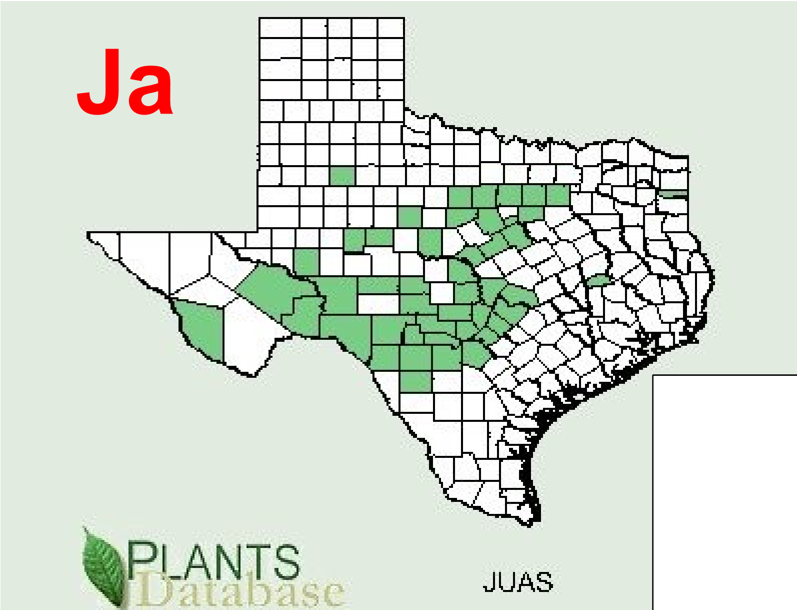
Quercus fusiformis

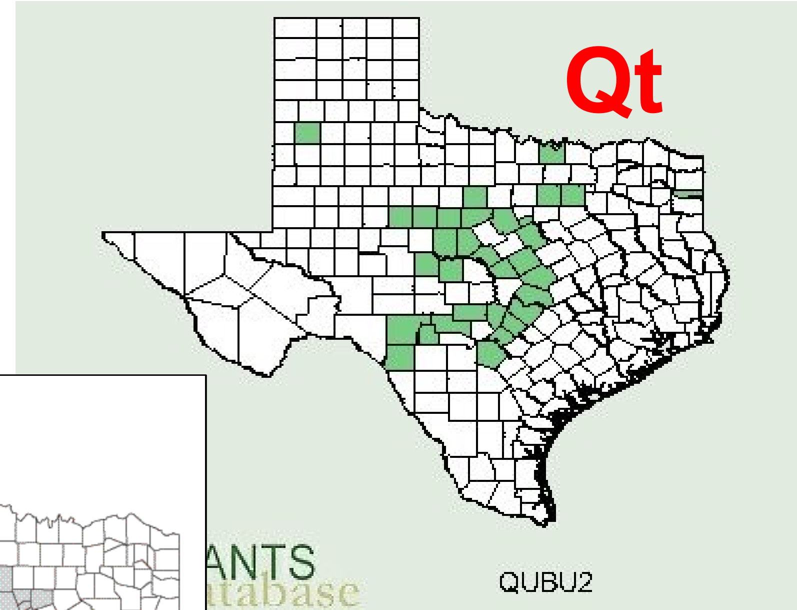
(= *Quercus virginiana* var. *fusiformis*)

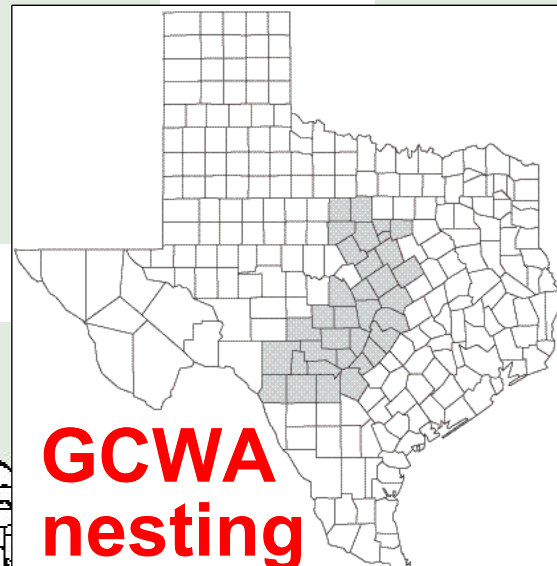
***Uc* — "Cedar Elm"**

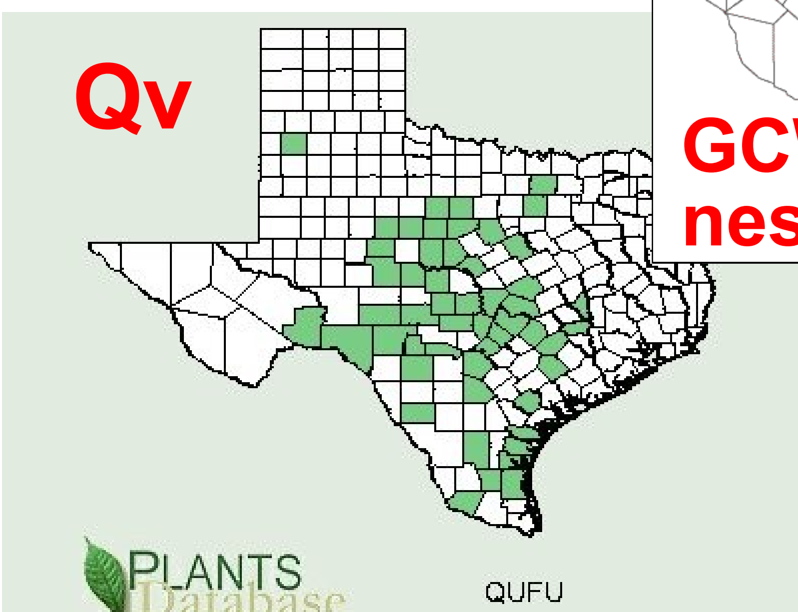
Ulmus crassifolia

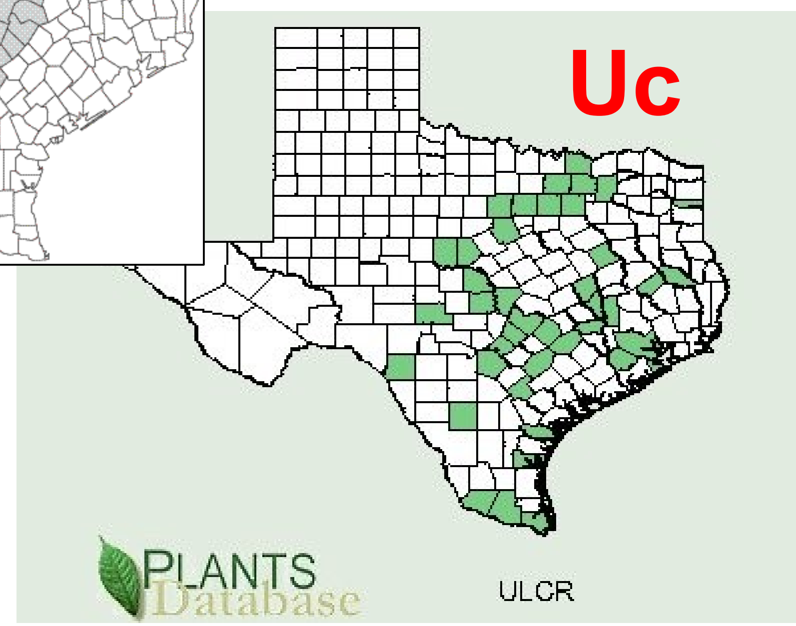
Approximate in-state distributions











Spp most freq foraged in (Beardmore 1994)

TPWD and USDA Maps

Quantitative

Sampling

Protocol

Sweep Net - 79 cm dia.

Beat Sheet - 92 cm sq.

Collecting a "beat" sample

Collecting a "Sweep" sample

"Upper"
>5 m

"Mid"
3-5 m

"Lower"
0-3 m

1 Upper Sweep

2 Mid Sweeps

1 Sweep
1 Beat

Quantitative Sampling

5 samples (@ 3 hts) / tree

x 4 species of trees

x 4 reps (random) / tr sp

= 80 samples / date

x 12 dates X 3 site-yrs

= ~2,800 total samples

Xanthonia sp. 1 (Chrysomelidae)

Hosts on Cedar Elm
N = 583

Results

A E Y D G

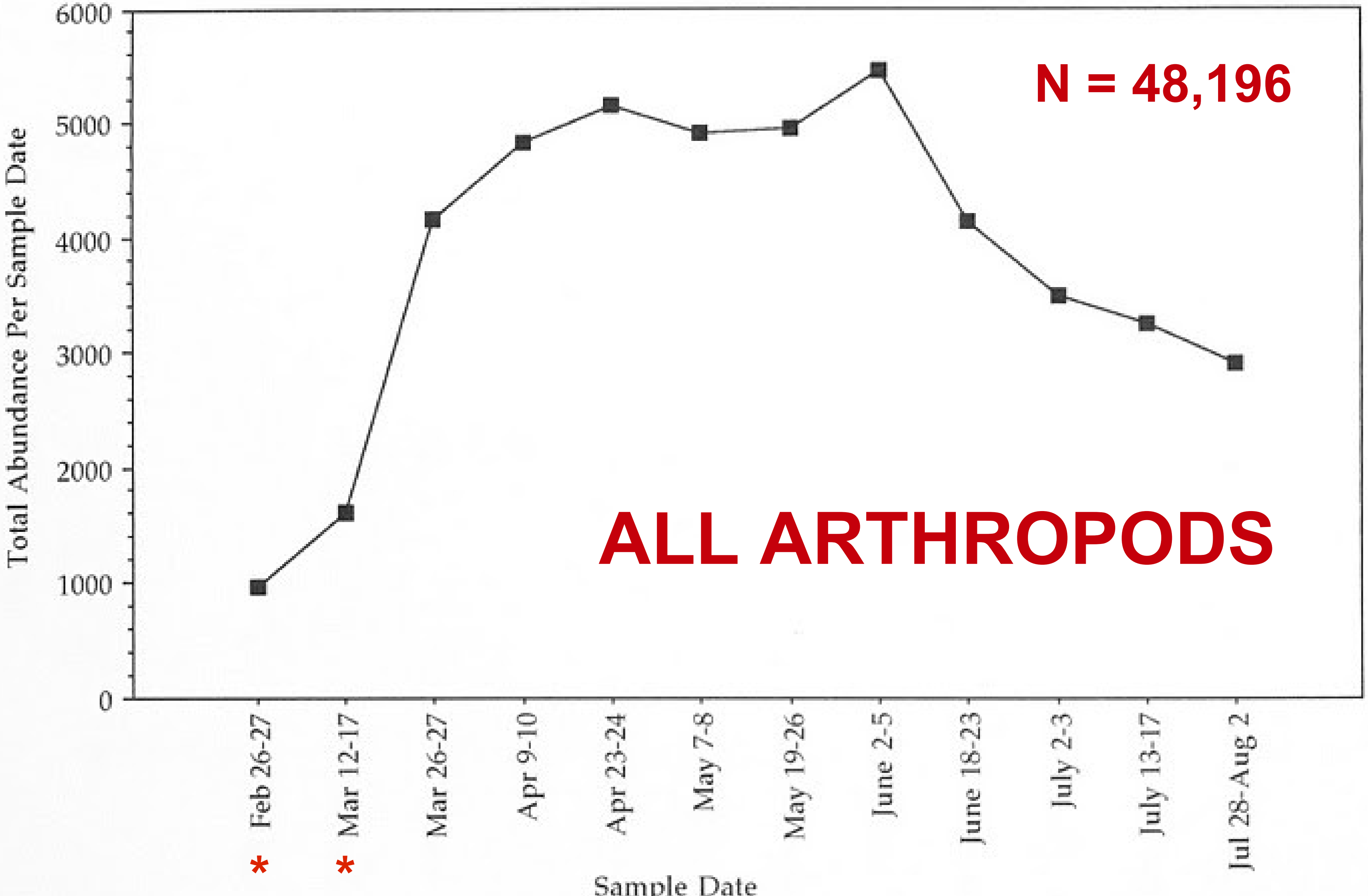
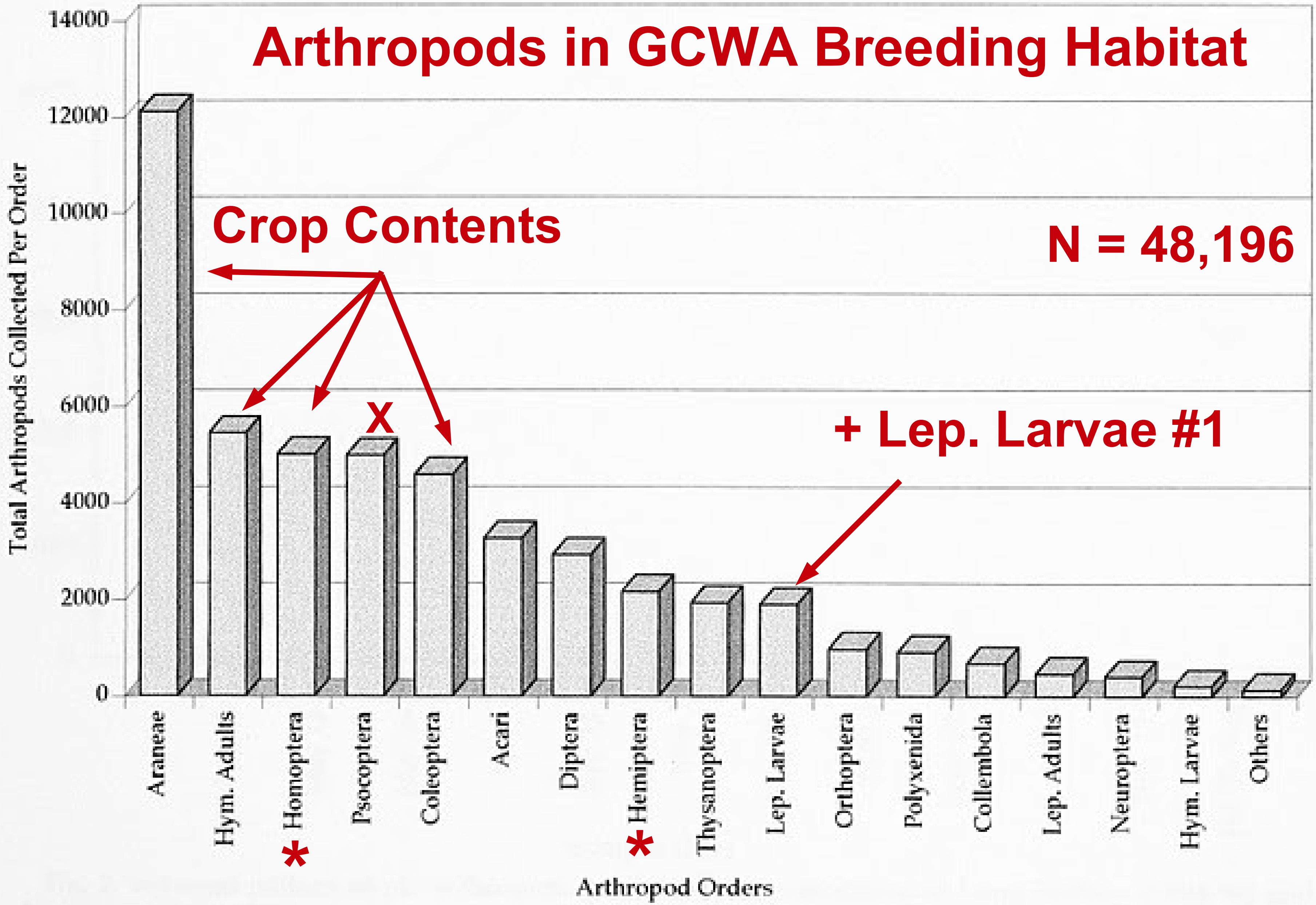


Fig. 2. Seasonal pattern of all Arthropods (excluding Thysanoptera) at Long Hollow (1993-94) and Shellberg (1994). Data for first two dates from 1994 only.

Phenology (Ladd & Gass 1999)



Results closely match the 97% of arthropods found by Nolan (1978) in 208 Prairie Warblers.

Warbler Habitat

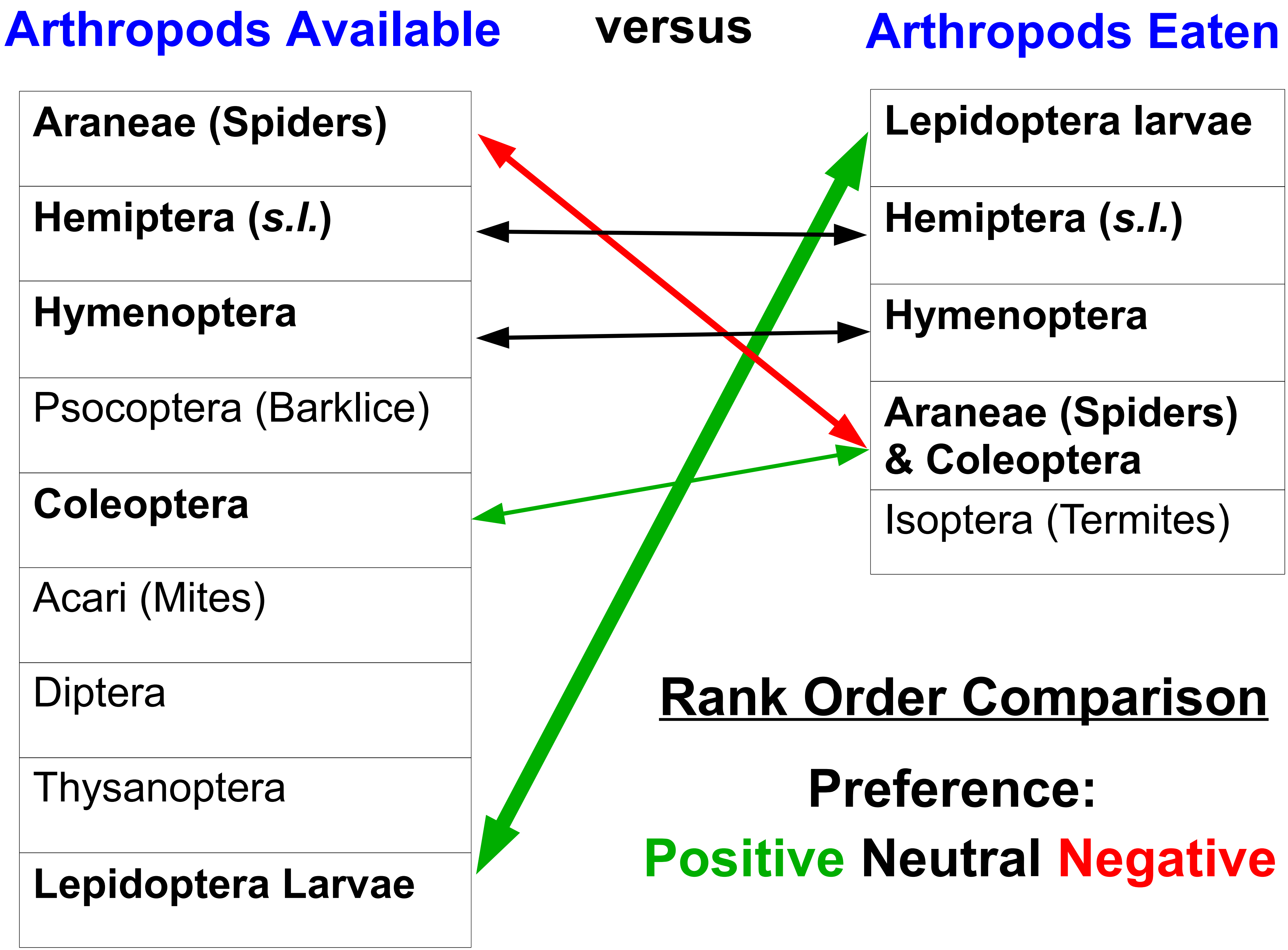
Habitat samples	# Collected
Araneae (Spiders)	12115
Hymenoptera	5459
Homoptera	5012
Psocoptera (Barklice)	4994
Coleoptera	4673
Acari (Mites)	3275
Diptera (True Flies)	2930
Hemiptera (True Bugs)	2167
Thysanoptera (Thrips)	1939
Lepidoptera Larvae	1900
Orthoptera	974
Polyxenida (Millipedes)	915
Colembola	690
Lepidoptera (adults)	471
Neurop, Hym larv, Other	682
Total (~2,800 samples)	**48,196**

Warbler Stomachs

Warren Pulich's GCWs	# ID'ed
Lepidotera larvae	44
Hymenoptera	32
Araneae	29
Coleoptera	29
Homoptera	28
Isoptera (Termites)	18
Hemiptera	12
Diptera	2
Orthoptera	1
Trichoptera	1
Other insects	4
Total (**ex. 22 birds**)	**200**

Warren Pulich collected 22 GCWA's between 1960-64

Data: Quinn 2000


Arthropods Available
versus
Arthropods Eaten
Araneae (Spiders)
Hemiptera (s.l.)
Hymenoptera
Psocoptera (Barklice)
Coleoptera
Acari (Mites)
Diptera
Thysanoptera
Lepidoptera Larvae
Lepidoptera larvae
Hemiptera (s.l.)
Hymenoptera
Araneae (Spiders) & Coleoptera
Isoptera (Termites)
Rank Order Comparison
Preference:
Positive Neutral Negative

Warbler foraging and associated arthropod abundance by <u>tree</u>

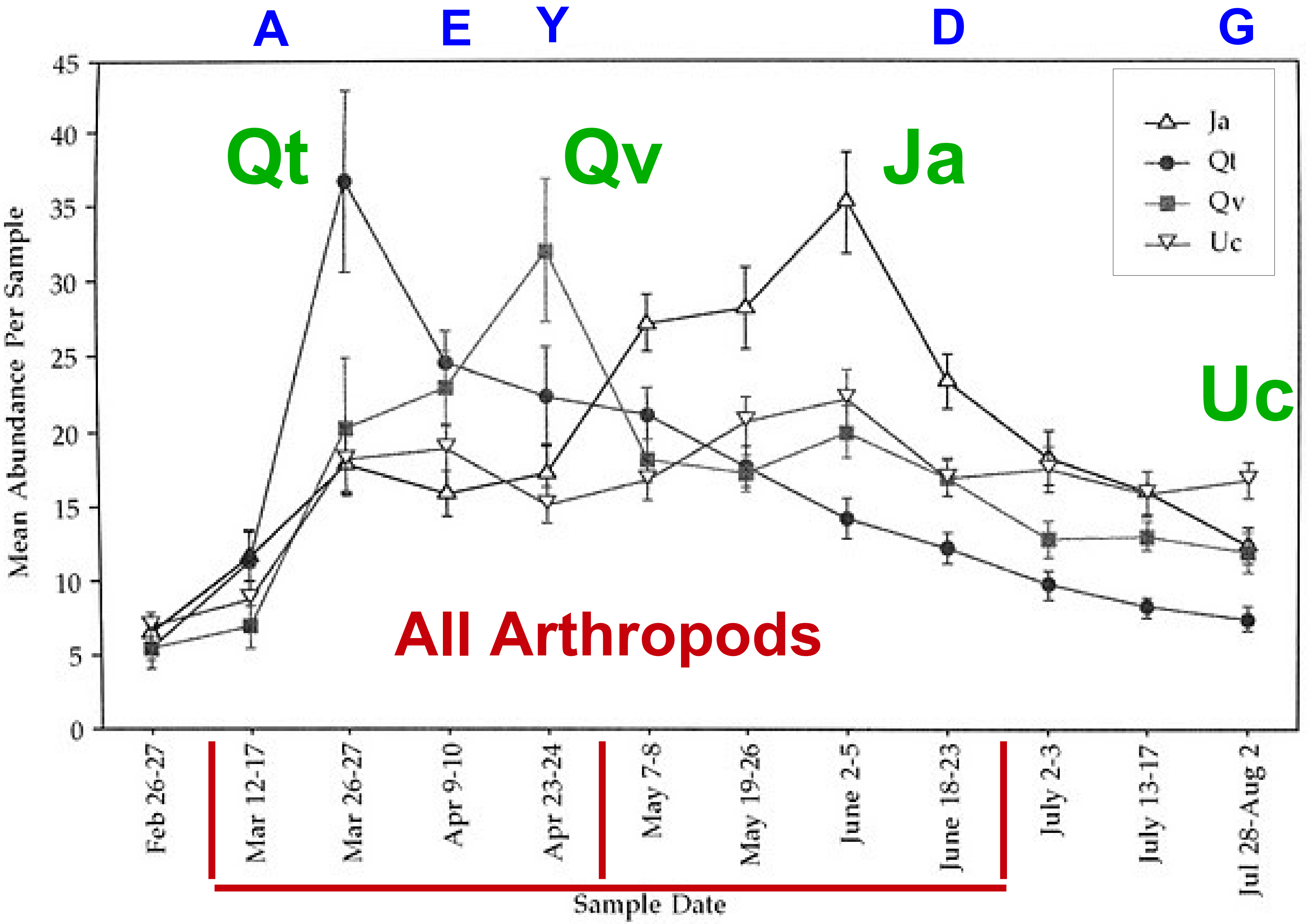
GCWA foraging observations (%) by tree sp. and part of breeding season

Tree Sp.	Mar-April	May-June	Avg % Abd
Ja	6	49%	52
Qv	88%	27	10
Qt	3	10	4
Uc	0	8	8
10 other tree spp.	2	6	29

N = 603 foraging obs.

Modified Tables 3 &12. (Beardmore 1994)

Avg N = 190 PCQM sample points (25 pts / terr. cluster)



Ja, Qt, Qv & Uc are usually dominant trees in CenTex GCWA breeding habitat.

Ladd & Gass (1999)

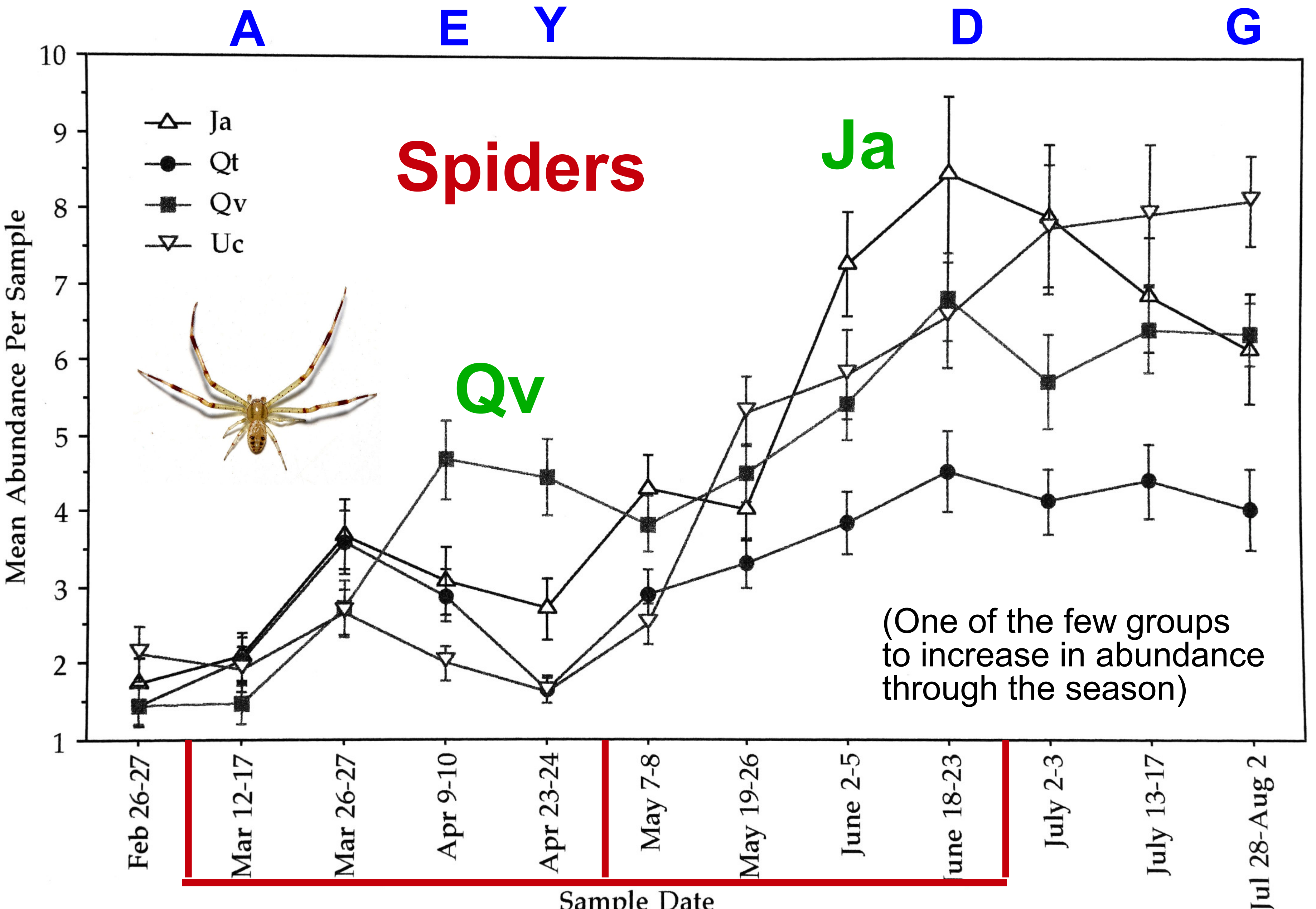


Fig. 63. Seasonal patterns by tree species for Araneae at Long Hollow (1993-94) and Shellberg (1994). Vertical bars represent 1 SEM.

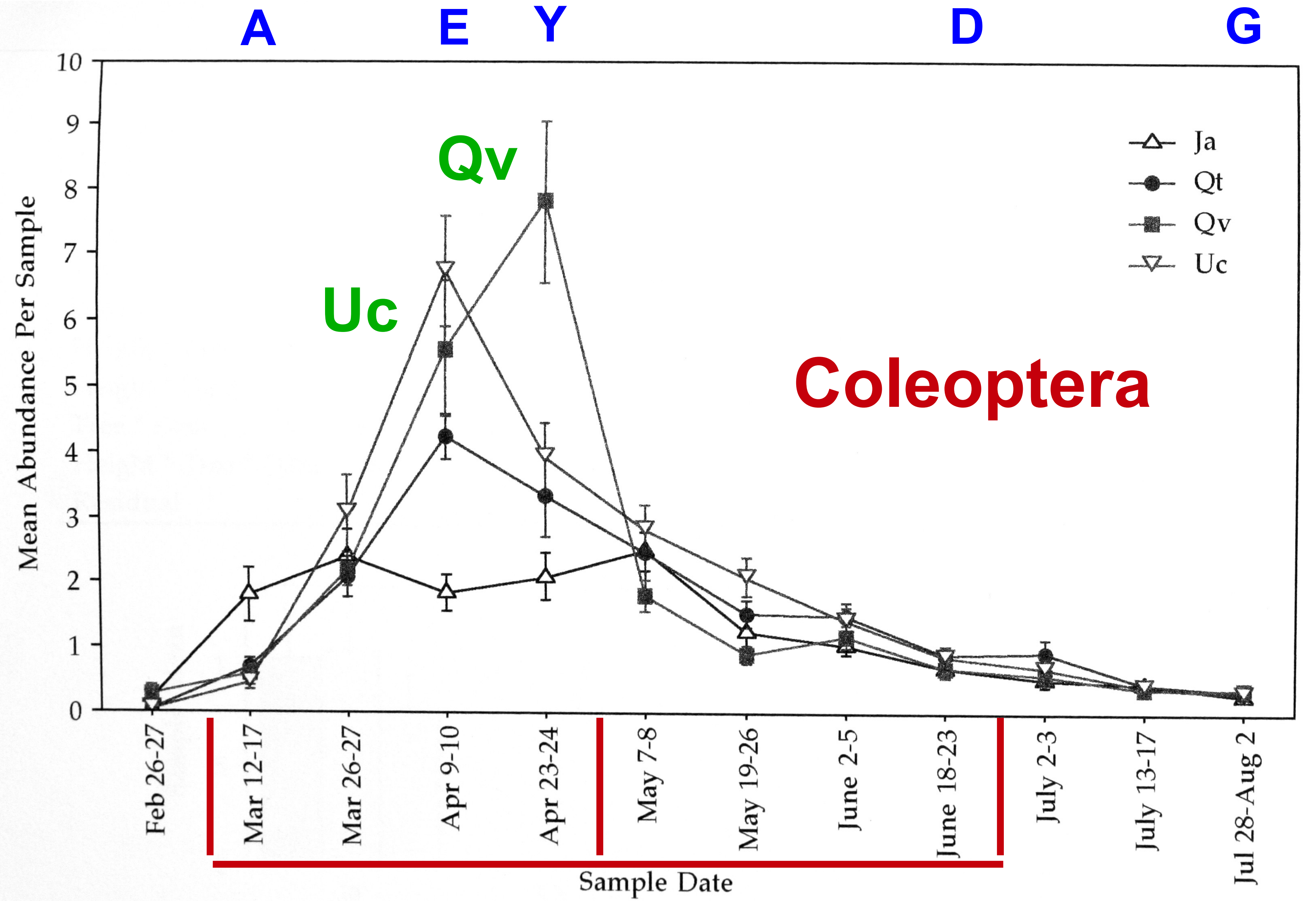


Fig. 72. Seasonal patterns by tree species of Coleoptera at Long Hollow (1993-94) and Shellberg (1994). Vertical bars represent 1 SEM.

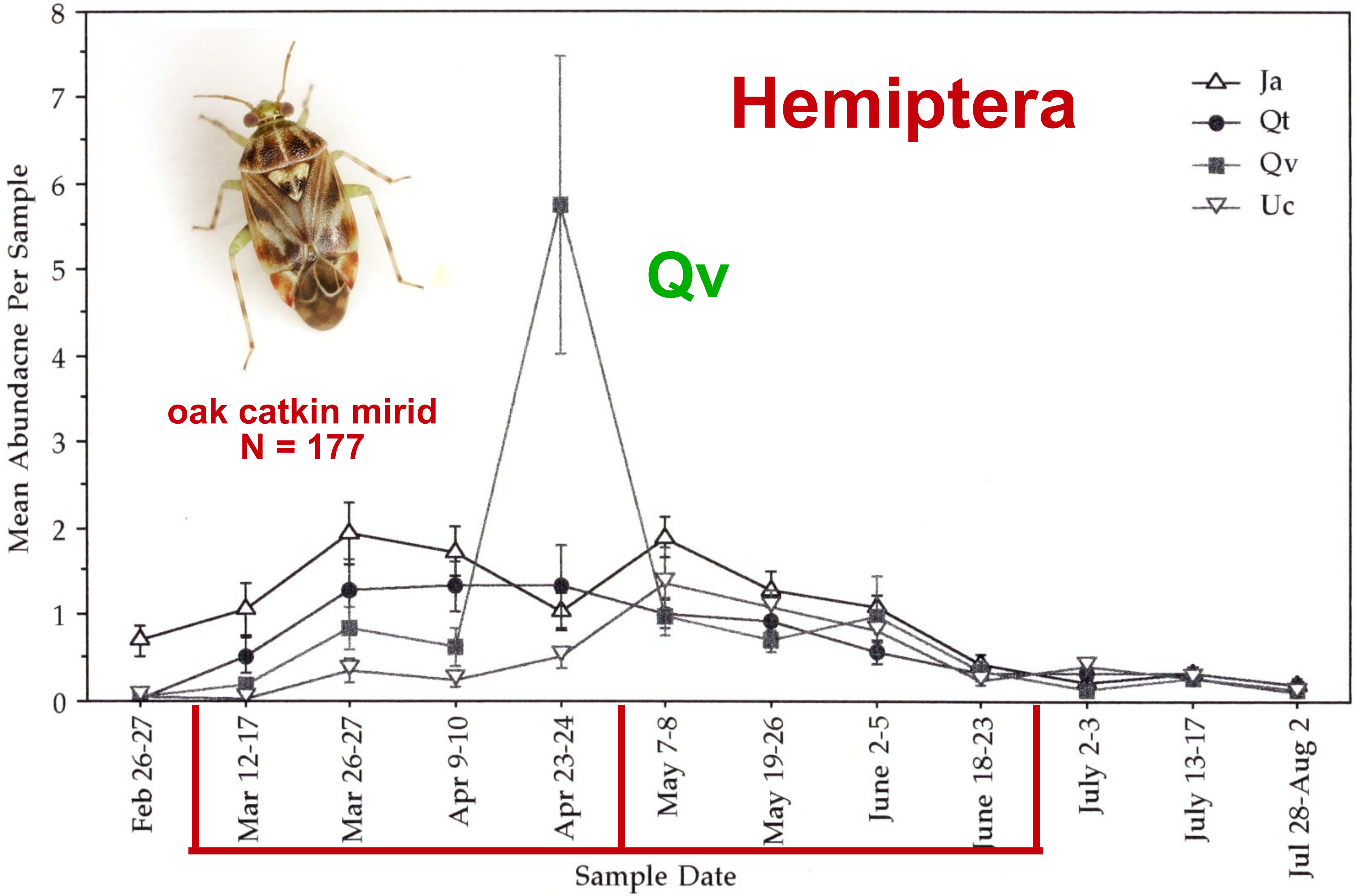


Fig. 78. Seasonal patterns by tree species of Hemiptera at Long Hollow (1993-94) and Shellberg (1994). Vertical bars represent 1 SEM.

Tropidosteptes quercicola (Johnston)

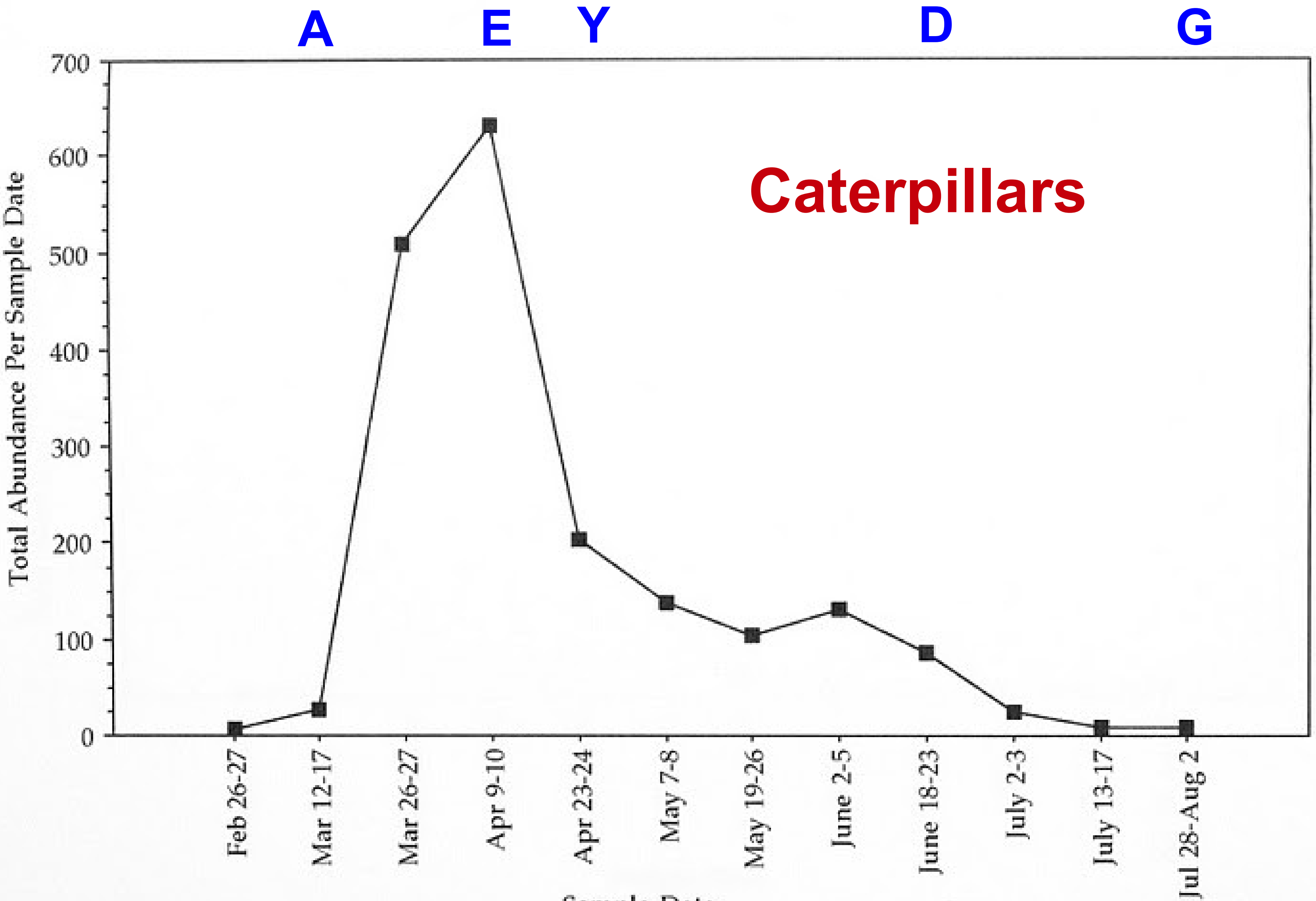


Fig. 19. Seasonal pattern of Lepidoptera larvae at Long Hollow (1993-94) and Shellberg (1994). Data for first two dates from 1994 only.

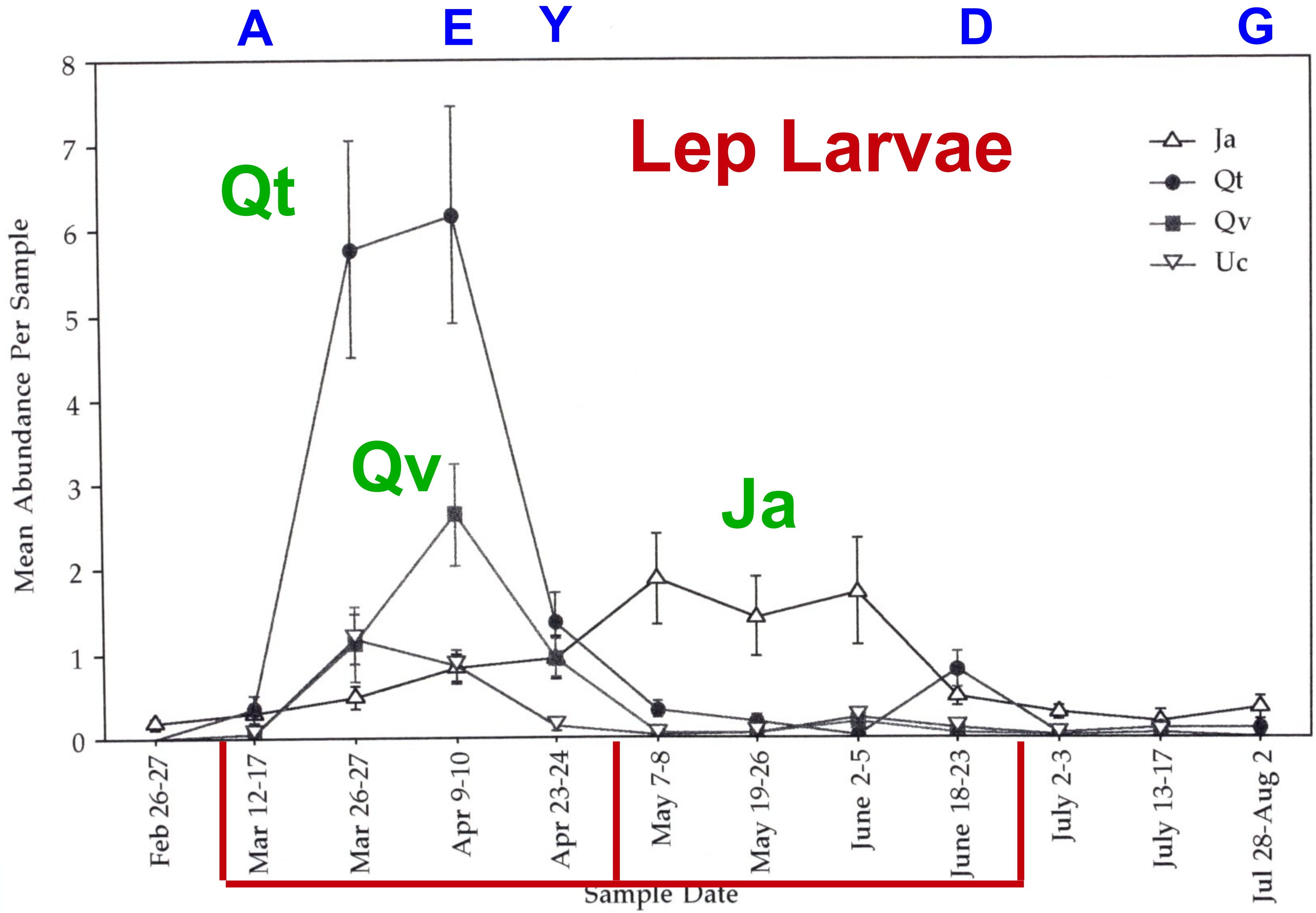
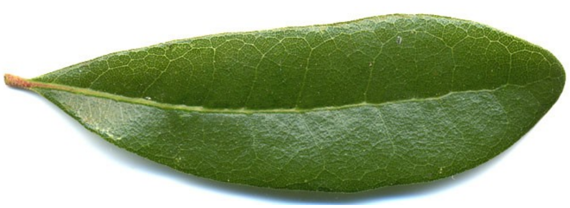
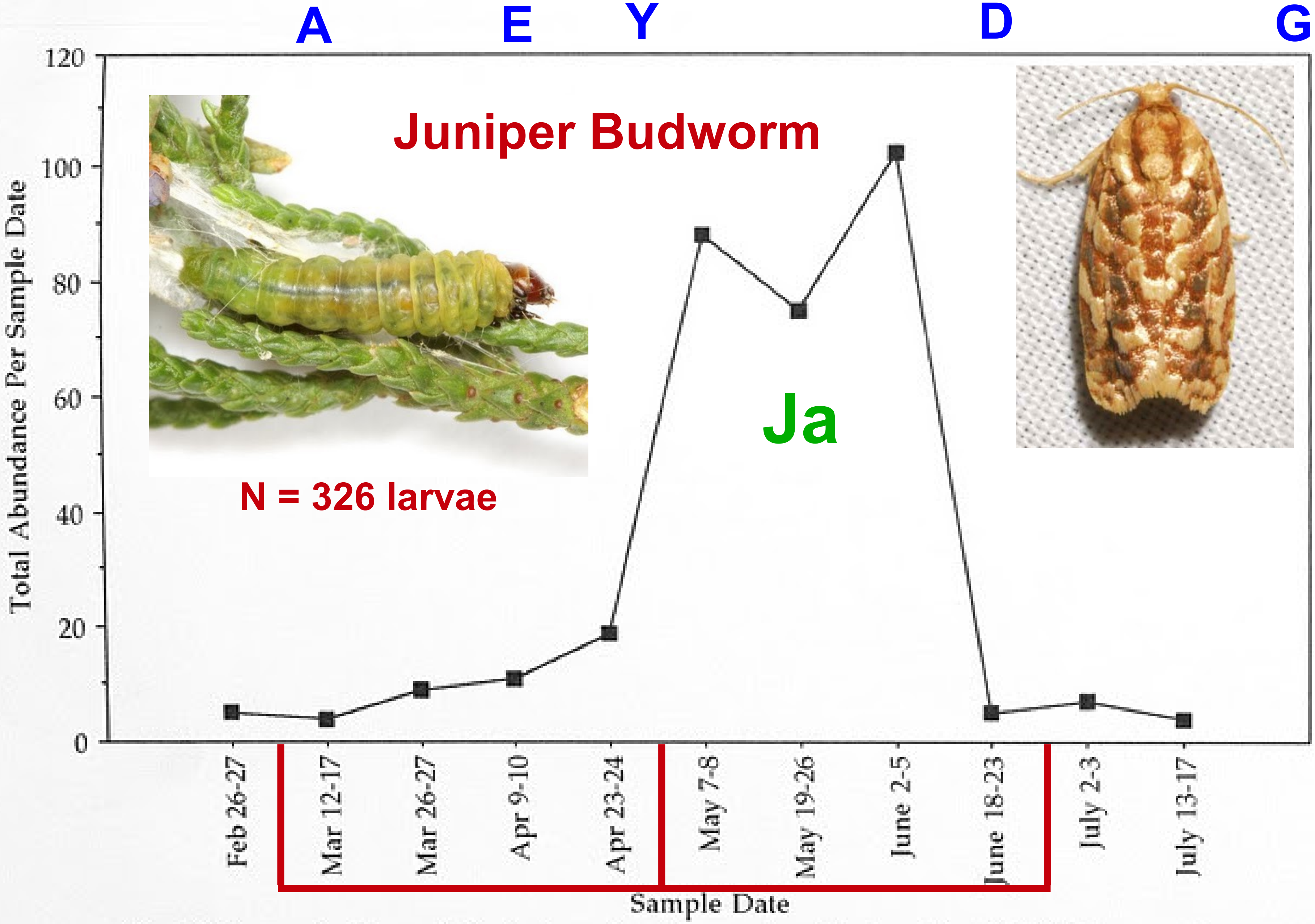


Fig. 90. Seasonal patterns by tree species of Lepidoptera larvae at Long Hollow (1993-94) and Shellberg (1994). Vertical bars represent 1 SEM.

Qt, Ja, Uc, Qv



(not to scale)



Juniper Budworn - *Choristoneura houstonana* (Grote) - Tortricidae

Warbler foraging and associated arthropod abundance by <u>height</u>

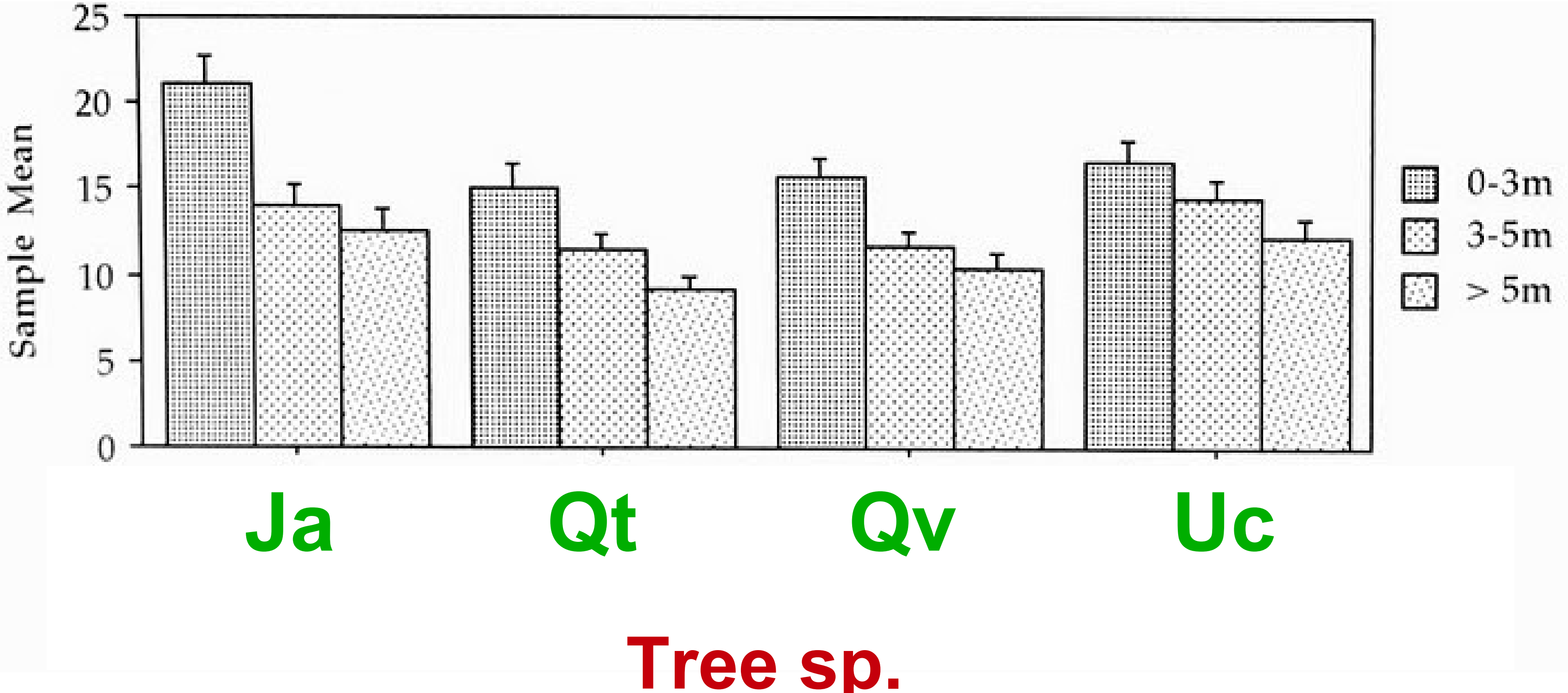
GCWA foraging observations (%) by ht class and part of breeding season

Height	Mar-April	May-June	%Change
>5 m	57	42	-26
3-5 m	28	30	+7
0-3 m	15	28	+83
Totals	126	470	

N = 596 foraging obs.

Modified Table 15. (Beardmore 1994)

All Arthropods by Height Class



Why? Bug, leaf desiccation due to sun, wind? Predation pressure? Gravity?

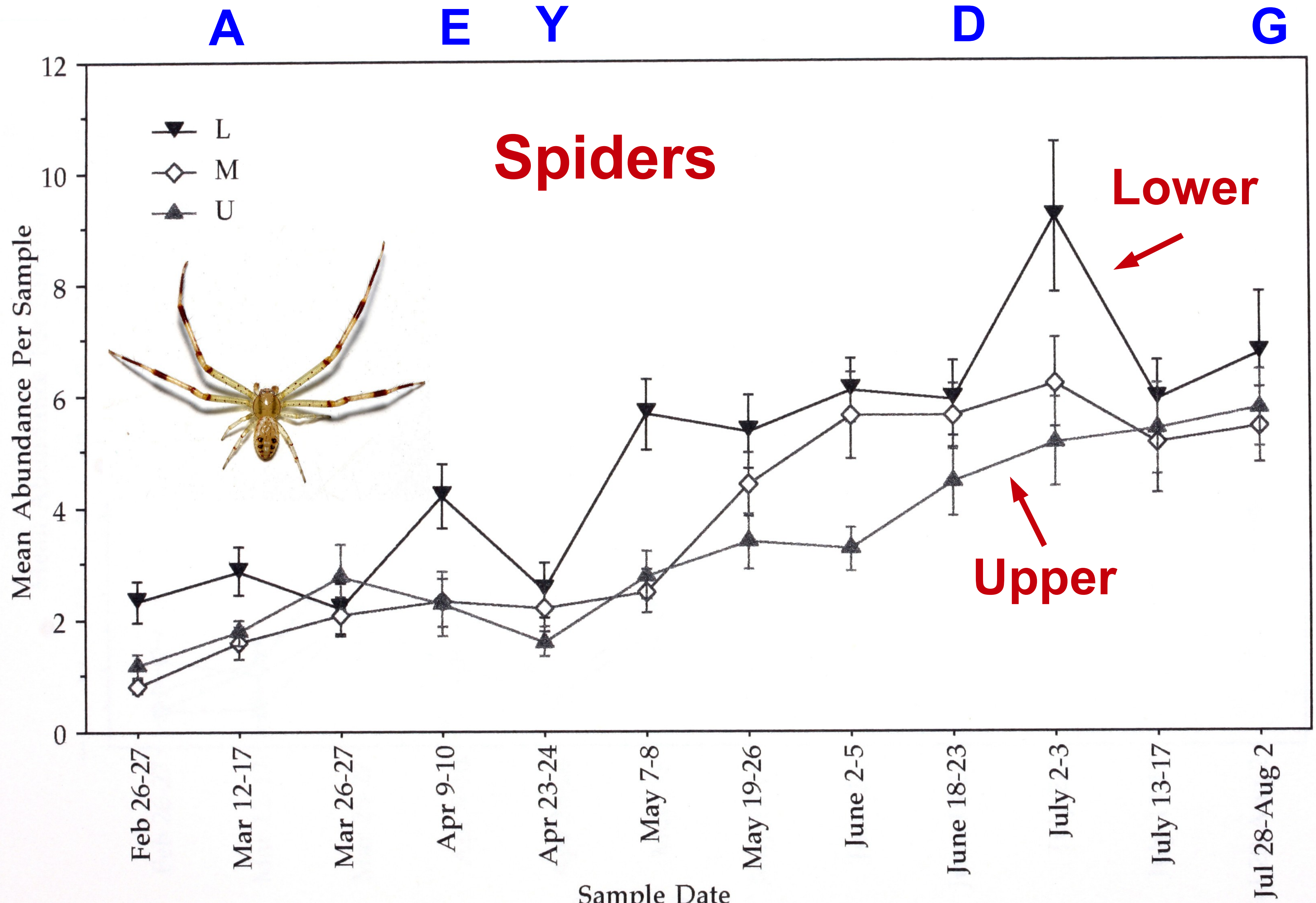


Fig. 62. Seasonal patterns by height class for Araneae at sites Long Hollow and Shellberg in 1994. Error bars represent 1 SEM.

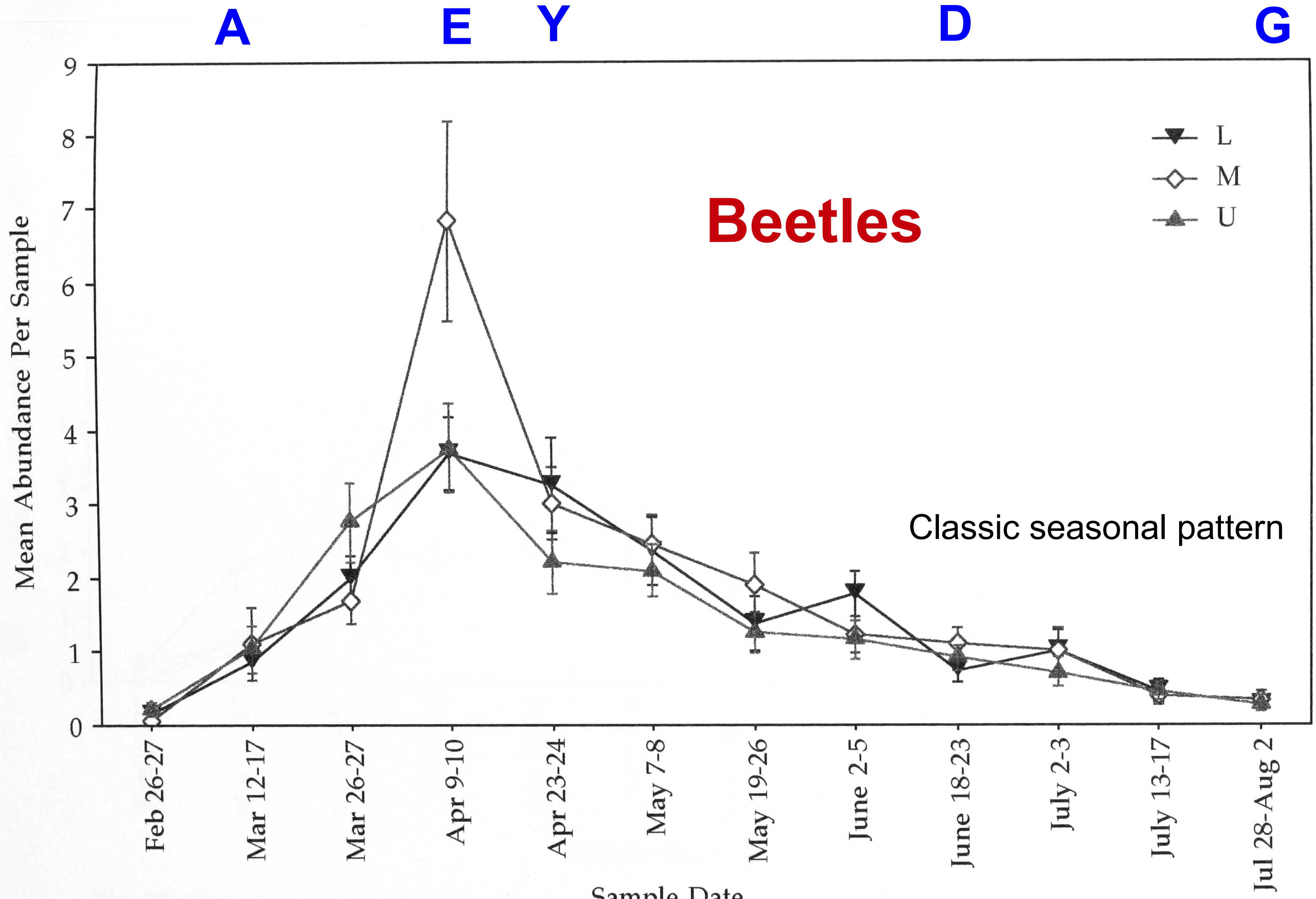
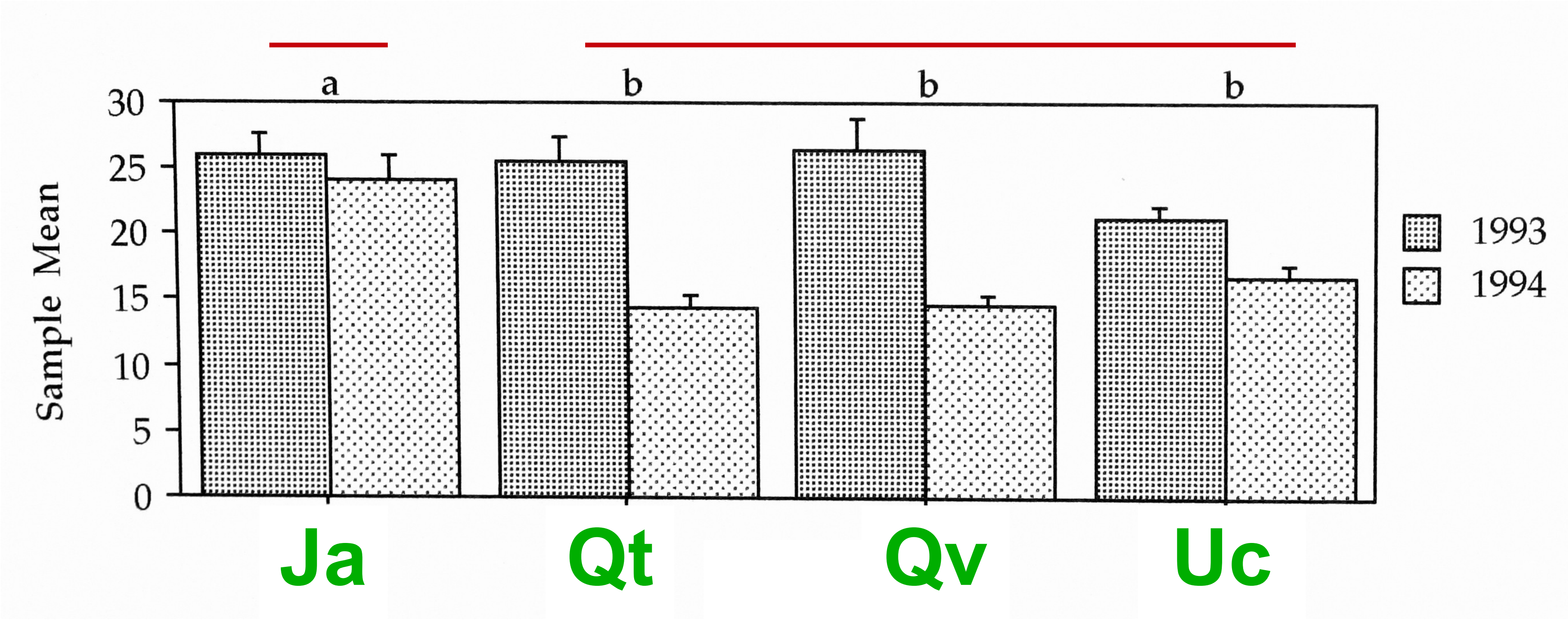


Fig. 71. Seasonal pattern by height class for Coleoptera at Long Hollow and Shellberg in 1994. Error bars represent 1 SEM.

Variation in arthropod abundance by year or site

All Arthropods by Year



Tree sp.

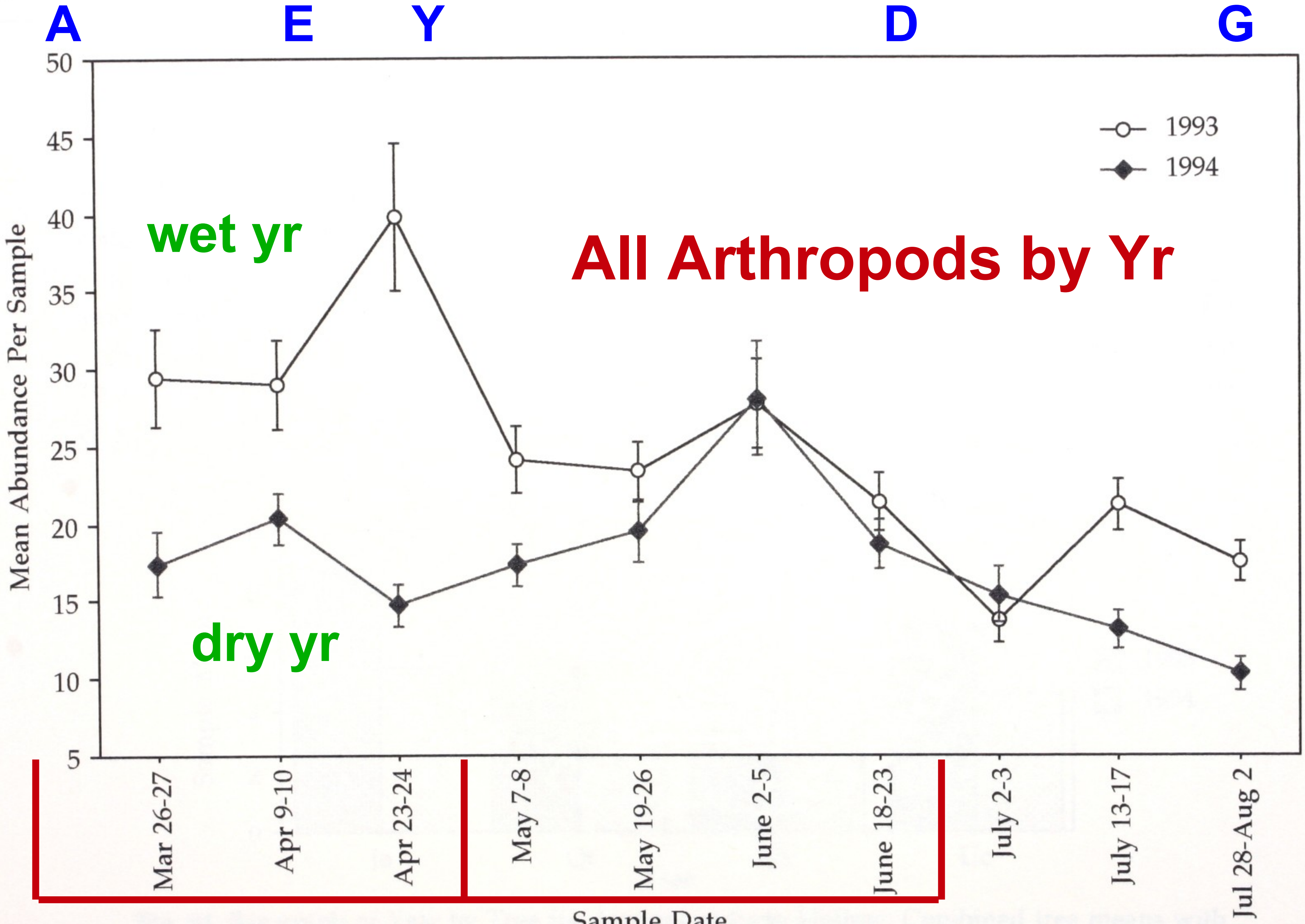
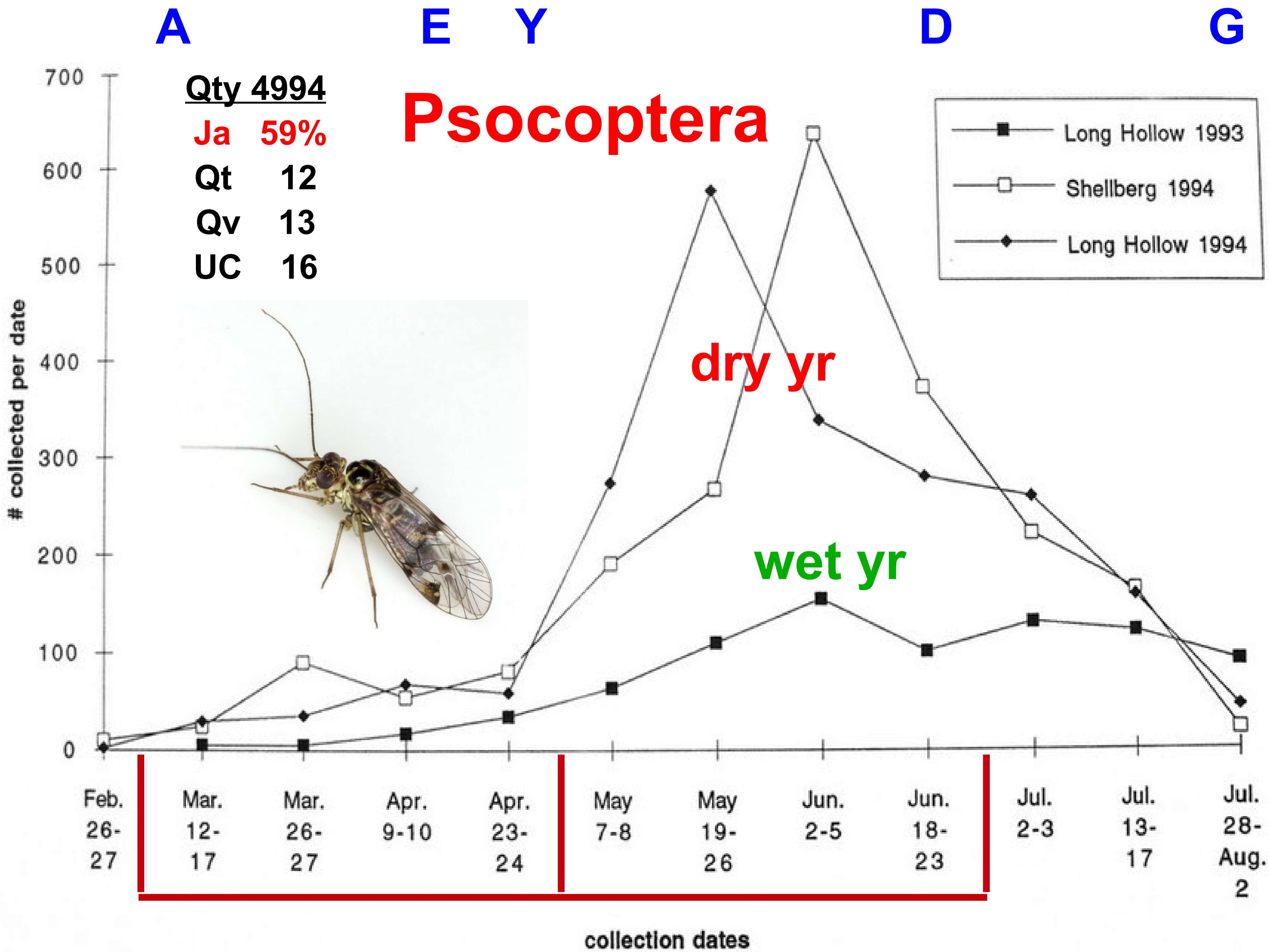


Fig. 93. Seasonal patterns of all Arthropods at Long Hollow by year. Error bars represent 1 SEM.



A
E
Y
D
G
Qty 4994
Ja 59%
Qt 12
Qv 13
UC 16
Psocoptera
Long Hollow 1993
Shellberg 1994
Long Hollow 1994
dry yr
wet yr
collected per date
700
600
500
400
300
200
100
0
Feb. 26-27
Mar. 12-17
Mar. 26-27
Apr. 9-10
Apr. 23-24
May 7-8
May 19-26
Jun. 2-5
Jun. 18-23
Jul. 2-3
Jul. 13-17
Jul. 28-Aug. 2
collection dates

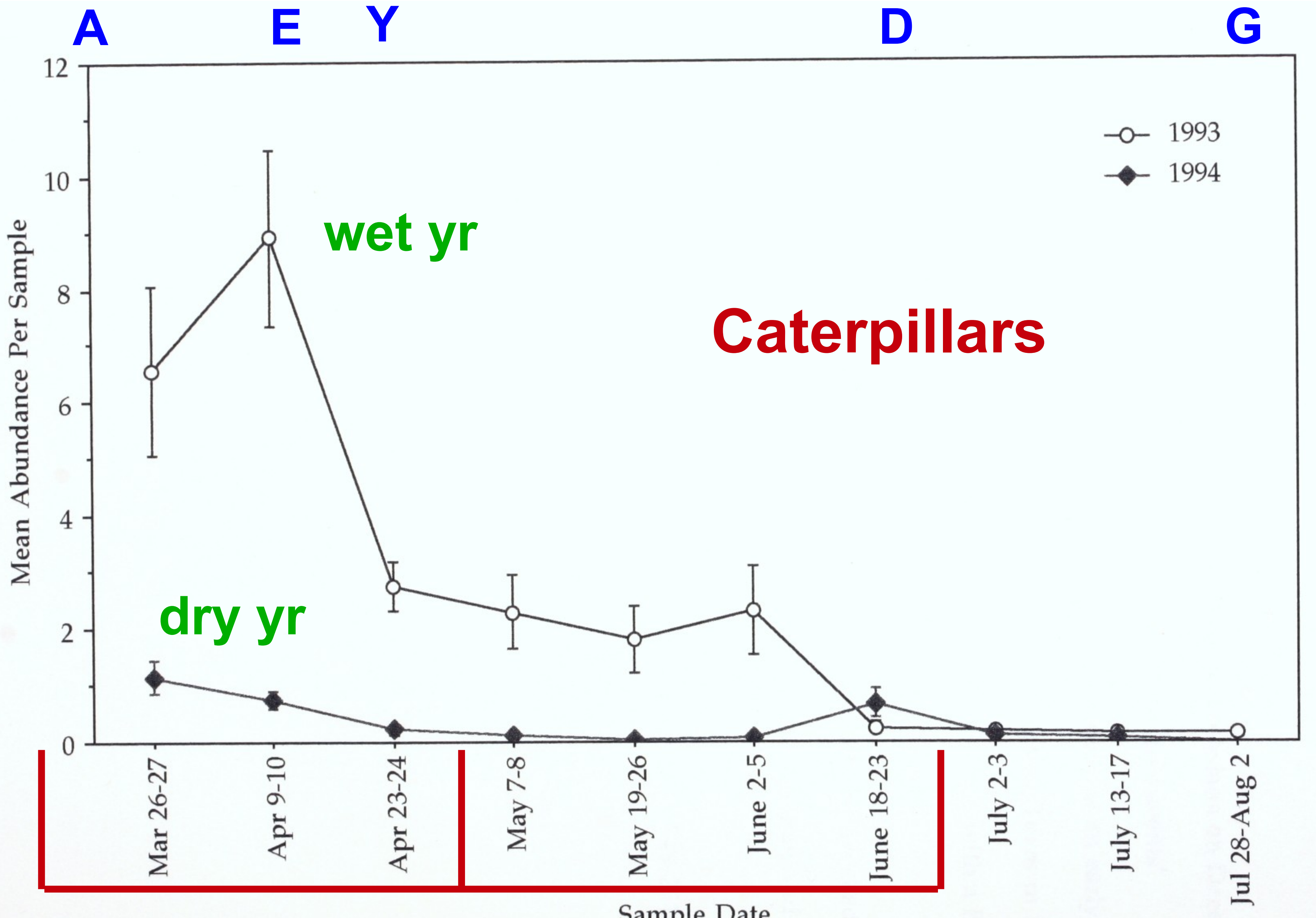
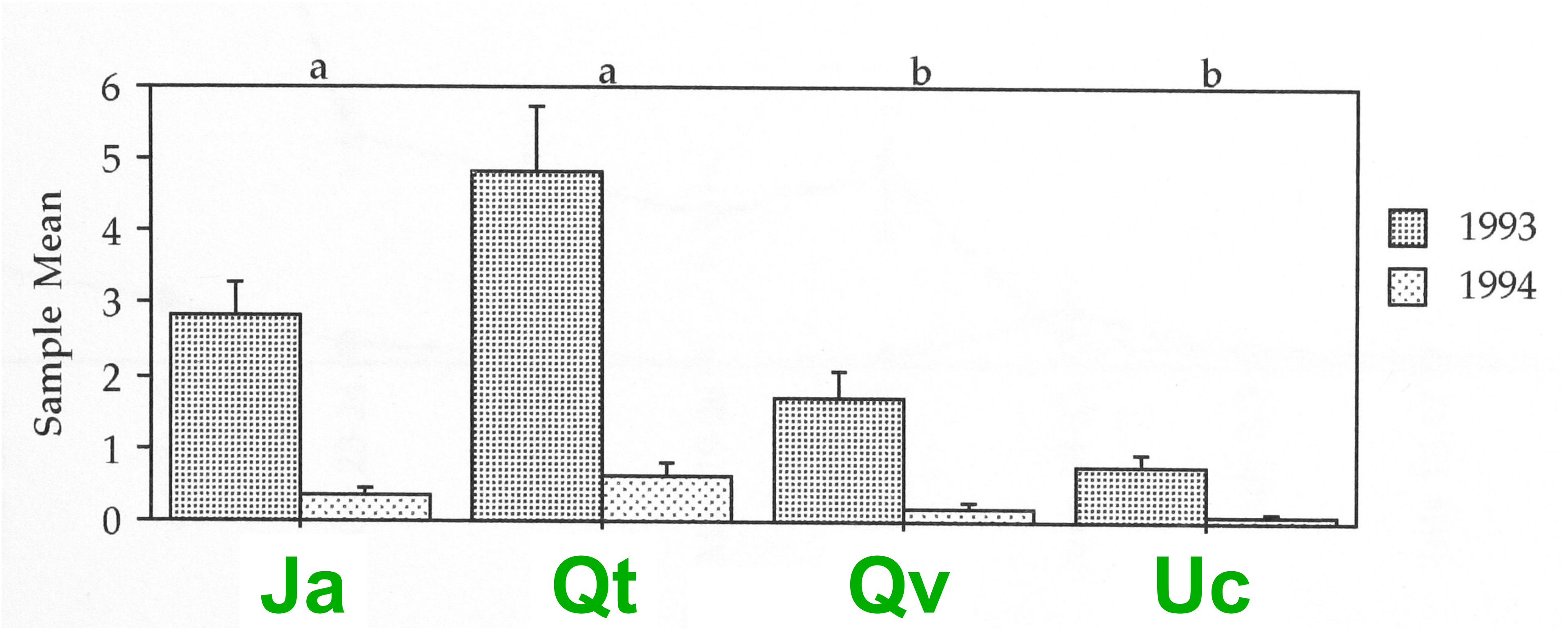


Fig. 108. Seasonal patterns by year of Lepidoptera larvae at Long Hollow. Error bars represent 1 SEM.

Caterpillars by Yr and Tree sp.



Tree sp.

A E Y D G

Spiders by Yr

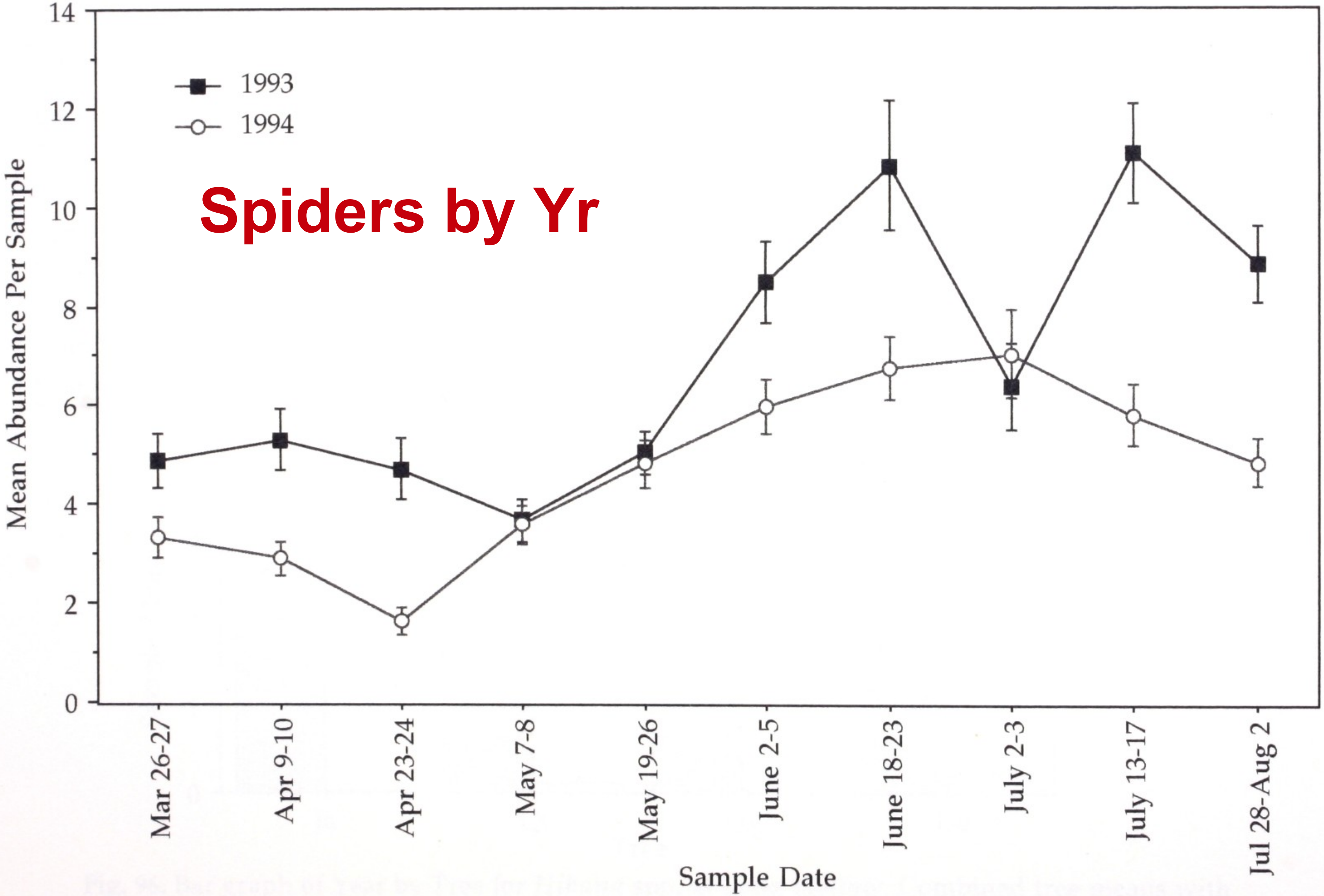
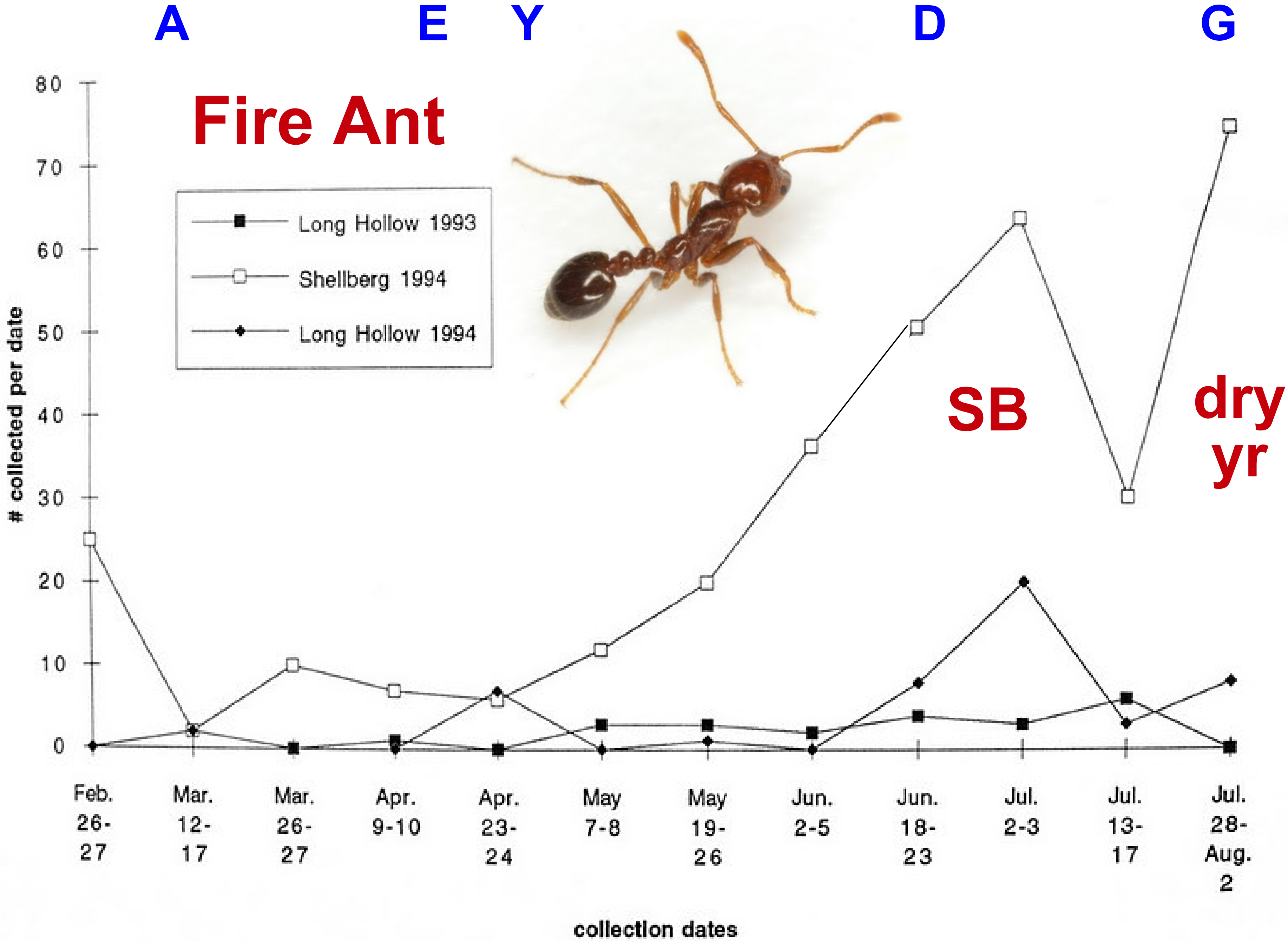


Fig. 95. Seasonal pattern of Araneae at Long Hollow in 1993 and 1994. Error bars represent 1 SEM.



A
E
Y
D
G
Fire Ant
SB
dry
yr
80
70
60
50
40
30
20
10
0
collected per date
Long Hollow 1993
Shellberg 1994
Long Hollow 1994
Feb. 26-27
Mar. 12-17
Mar. 26-27
Apr. 9-10
Apr. 23-24
May 7-8
May 19-26
Jun. 2-5
Jun. 18-23
Jul. 2-3
Jul. 13-17
Jul. 28-Aug. 2
collection dates

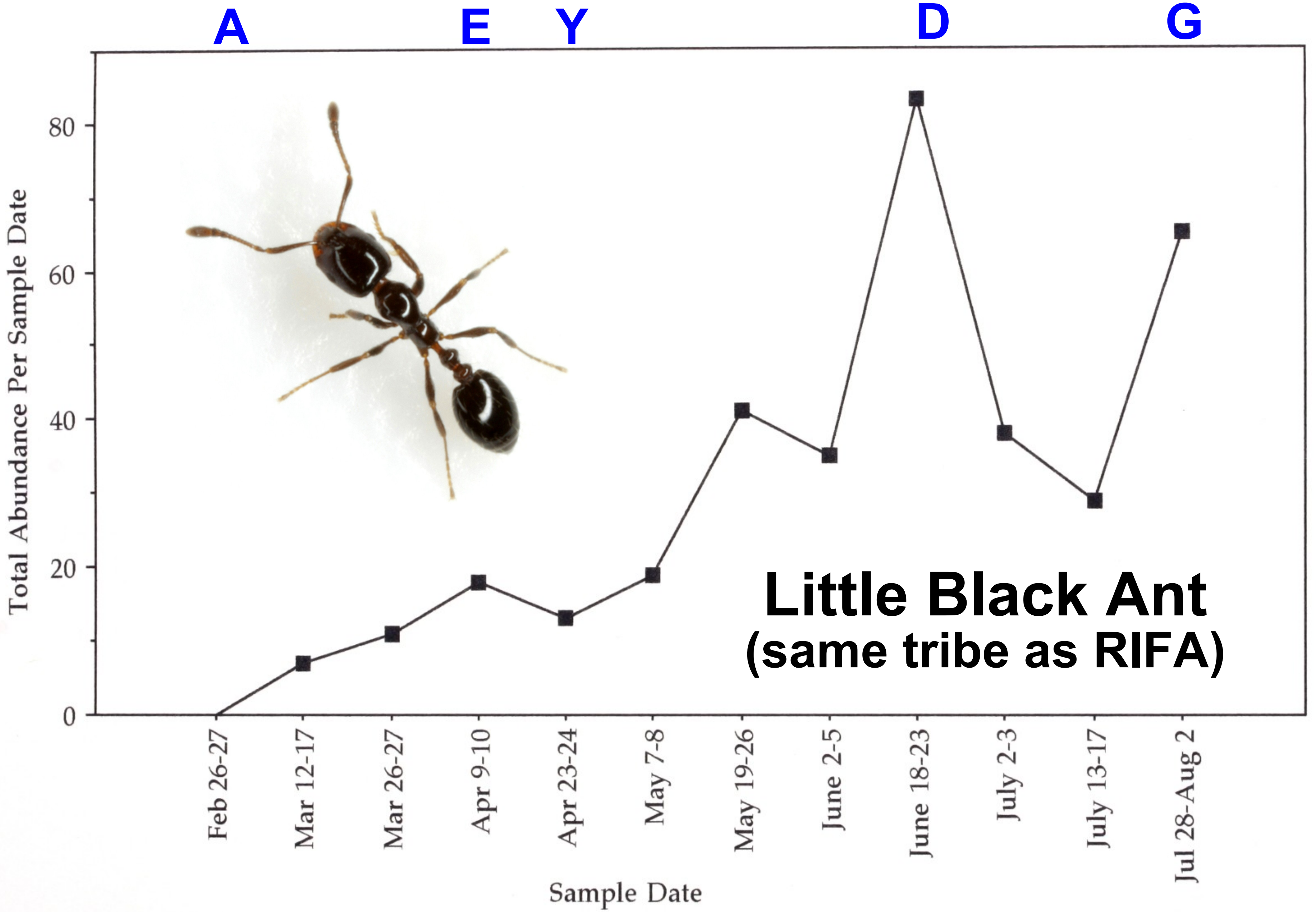


Fig. 18. Seasonal pattern of *Monomorium minimum* (Hymenoptera: Formicidae) at Long Hollow (1993-94) and Shellberg (1994). Data for first two dates from 1994 only.

Conclusions

Peak arthropod abundance occurs during peak warbler demand.

Lepidotpera larvae were the most common arthropod in warbler stomachs even though they are comparatively much less common in the habitat.

Hemiptera, Hymenoptera, and Coleoptera were in similar rank abundance in the habitat as in warbler stomachs.

Spiders were much more common proportionally in the habitat than they were warbler stomachs.

Most other orders were absent or nearly so from stomach data.

Warbler shift in foraging preference from live oaks during March-April to juniper in June and July correlates well with peak arthropod abundance on those trees during those periods as exemplified by spiders, beetles, true bugs, and caterpillars.

Juniper Budworn - *Choristoneura houstonana* (Grote) – Tortricidae is one of the most important insects in the warbler's breeding habitat.

Texas red oak had the most caterpillars of all the trees.

Arthropod abundance was inversely proportional to height class for nearly every order.

Except for Psocoptera, most orders were significantly less common in the dryer year.

Conclusions

Caterpillars were particularly scarce in the dry year.

Spiders likely constitute an important part of the warbler's diet during dry years.

Fire ants increased in abundance late in the season, particularly in the dry year. A similar pattern was see in the related little black ant.

Low caterpillar abundance during the dry year may foreshadow effects of global warming.

Recommendation: Conduct annual quantitative surveys for the juniper budworm to assess caterpillar availability and correlate findings with any available nesting success data.

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