

Model Summary:

Tlow=39F; start date = Jan 1	
Event	Dds
approx. time to place t	435
5% trap catch	581
50% or peak trap catc	758
95% trap catch	927

Summary of Data used to derive model: Tlow=39F; start date Jan 1

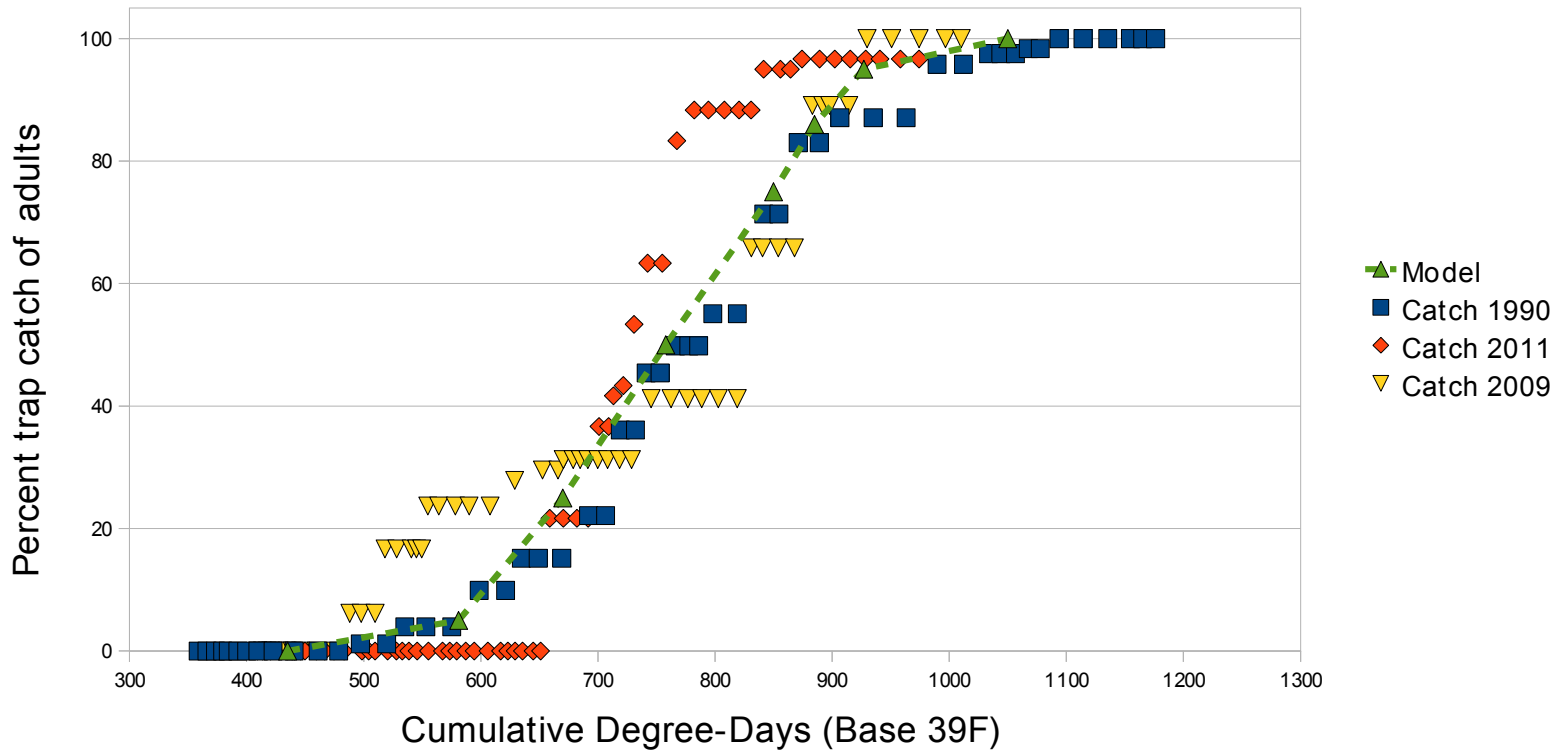
	5% trap catch		50% or peak trap catch		95% flight	
	Date	Deg-Days	Date	Deg-Days	Date	Deg-Days
1990	04/14/90	598	04/23/90	741	05/07/90	989
2009	04/07/09	488	05/05/09	802	05/16/09	950
2010	04/14/10	786	04/22/10	893	na	na
2011	04/22/11	658	04/30/11	730	05/09/11	841
average	04/11/00	581	04/26/00	758	05/08/00	927

Note: 2010 peak flight est. from spray dates; not included in model

Data used to create model plus version 1 of model: note that 2011 was not an outbreak year and displayed a compressed emergence pattern.

Douglas-fir needle midge

W. Oregon data from 3 years and fitted model



Source 1. Penn State Christmas Tree Manual, pages 9-18

<http://extension.psu.edu/ipm/program/christmas-tree/ipm-basics/growing-degree-days.pdf>

Mar 1 Tlow 50 F

200-400 DD Adults emerge from soil

Source 2. Mich. State IPM Christmas tree and forestry update

<http://ipmnews.msu.edu/landscape/Landscape/tabid/92/articleType/ArticleView/articleId/1887/Christmas-tree-and-forestry-pest-update.aspx>

Adults emerge at around 270 DD base 50

assume begin DD calc Jan 1?

Source 3. Douglas-fir_PDA_Bulletin.pdf Pennsylvania Dept Agriculture Bulletin

-emergence generally from mid-April through early May; rain and cool temps delay emergence

-mating and oviposition occur immediately after emergence; adults short-lived

-Peak emergence period lasts about 7-10 days

-larvae form galls in needles

-sample infestations in August

Source 4. West, K., Deangelis, J., B. Simko. 1991. The Biology and Control of the Douglas-fir Needle Midge in Christmas Trees. OR St. Ext. Serv. EC 1373

http://uspest.org/wea/douglas_fir_needle_midge_EC173.pdf

-egg hatch in a couple of days; larvae immediately bore into young needles inside the buds

-larvae feed in the needles throughout the summer, becoming obvious during August

-larvae full grown in the fall; drop from needles to overwinter in the soil as prepupae

-pupate during March

-adults begin emergence in early to mid-April

-emergence typically complete by early May

-clouds of mating and egg-laying midges seen during warm April days (60F or warmer)

when emergence and egg laying peaks

-one gen/yr

-outbreak cycle every several years

-biocontrol agents (Chalcid wasps) attack larvae & overwinter inside the larvae

Source 5. http://www.fs.fed.us/r1-r4/spf/fhp/mgt_guide/dfneedle_midges/dfneedle_midges.pdf

-3 species; *C. pseudotsugae* most abundant

Other 2 are *C. constricta* and *C. cuniculator*

-life cycles similar for all three

Source 6. <http://oregonstate.edu/dept/nurserystartup/onnpdf/onn060108.pdf>
 -adults live 1-2 days (males), 2-4 days (females)

Source 7. Field data – trapping throughout Will. Valley, OR, 2009-11. Data supplied by Dave Silen.

Data from trap_data_summary (see tab below):

Degree-days calculated using single sine method and Corvallis, OR Agrimet station data (CRVO)

Lowest CV – 50% Flight Date; vary Tlow and Start Date

	50% flight Date	DD_35_Jan1	DD_38_Jan1	DD_39_Jan1	DD_40_Jan1	DD_41_Jan1	DD_45_Jan1	DD_50_Jan1
1990	04/23/90	1068	816	741	669	602	379	201
2009	05/05/09	1196	895	802	715	633	364	155
2010								
2011	04/30/11	1112	820	730	646	568	310	105
mean		1125.33	843.67	757.67	676.67	601	351	153.67
sd		65.03	44.5	38.79	35.13	32.51	36.29	48.01
CV		5.78	5.27	5.12	5.19	5.41	10.34	31.25

	50% flight Date	DD_35_Feb1	DD_38_Feb1	DD_41_Feb1	DD_45_Feb1
1990	04/23/90	917	721	546	356
2009	05/05/09	1010	769	555	328
2010					
2011	04/30/11	883	654	453	245
mean		936.67	714.67	518	309.67
sd		65.74	57.76	56.47	57.73
CV		7.02	8.08	10.9	18.64

	50% flight Date	DD_35_Mar1	DD_38_Mar1	DD_41_Mar1	DD_45_Mar1
1990	04/23/90	786	633	493	335
2009	05/05/09	798	621	460	285
2010					
2011	04/30/11	706	534	378	211
mean		763.33	596	443.67	277
sd		50.01	54.03	59.21	62.39
CV		6.55	9.07	13.35	22.52

Lowest CV – 5% Flight Date; vary Tlow and Start Date

	5% flight Date	DD_35_Jan1	DD_38_Jan1	DD_39_Jan1	DD_40_Jan1	DD_41_Jan1	DD_45_Jan1	DD_50_Jan1
1990	04/14/90	890	665	598	535	476	286	142
2009	04/07/01	778	555	488	425	367	186	60
2010	04/14/10							
2011	04/22/11	1010	741	658	581	509	275	90
mean		892.67	653.67	581.33	513.67	450.67	249	97.33
sd		116.02	93.52	86.22	80.16	74.31	54.84	41.49
CV		13	14.31	14.83	15.61	16.49	22.02	42.63

	5% flight Date	DD_35_Feb1	DD_38_Feb1	DD_41_Feb1	DD_45_Feb1	DD_50_Feb1
1990	04/14/90	739	570	421	263	136
2009	04/07/01	592	429	289	150	53
2010	04/14/10					
2011	04/22/11	781	575	394	209	67
mean		704	524.67	368	207.33	85.33
sd		99.24	82.89	69.74	56.52	44.43
CV		14.1	15.8	18.95	27.26	52.07

	5% flight Date	DD_35_Mar1	DD_38_Mar1	DD_41_Mar1	DD_45_Mar1	DD_50_Mar1
1990	04/14/90	608	482	368	196	132
2009	04/07/01	380	281	194	107	44
2010	04/14/10	520	397	287	168	71
2011	04/22/11	603	455	320	176	58
mean		527.75	403.75	292.25	161.75	76.25
sd		106.45	89.19	73.46	38.35	38.77
CV		20.17	22.09	25.14	23.71	50.84

95% flight – use 39 F Jan 1

	95% flight Date	DD_39_Jan1
1990	05/07/90	989
2009	05/16/09	950
2010	na	na
2011	05/09/11	841
mean		926.67
sd		76.71
CV		8.28