

Spruce Beetle

Dendroctonus rufipennis Kirby
Coleoptera: Scolytidae

Knight, F. B. 1960. Sequential sampling of Engelmann spruce beetle infestations in standing trees. Res. Note RM-47. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 4 p.

Objective: To develop a sequential sampling procedure for estimating *D. rufipennis* populations and deciding if control is warranted.

Abstract: The spruce beetle, *Dendroctonus rufipennis* Kirby, is the most destructive pest of Engelmann, *Picea engelmannii* Parry ex. Engelm, sitka, *Picea sitchensis* (Bong.) Carr., and white, *Picea glauca* (Moench) Voss, spruce in western North America. Typically, outbreaks have been associated with windthrow, or large accumulations of slash. Recently, a large-scale outbreak has resulted from the Routt Divide Blowdown in Colorado in 1997. Severe infestations cause growth loss and tree mortality.

A sequential sampling plan was developed to estimate *D. rufipennis* populations and classify infestation levels. An early season procedure enables resource managers to make decisions about treatment in the current year. A late season procedure provides information for predicting infestation severity the following year. A 15.2 by 15.2-cm bark sample was removed from the north and south aspect of each of 20 trees. The number of living *D. rufipennis* was counted and recorded, and the sequential sampling plan was referenced. Late season populations were predicted to increase, decrease, or remain static the following year.

Sampling Procedure:

General procedures: Remove one 15.2 by 15.2-cm bark sample from the north and south aspect of each of 20 trees. Bark samples are removed from the bole 1.2-2.1 m above ground. Count and record the number of living *D. rufipennis*.

Early sample: This sequential plan will help determine if immediate control is necessary. Sample at least 20 trees, adding the number of beetles found in each sample. Reference the sequential sampling plan (Table 1), and continue sampling until a decision is met. Infestations will be classified as requiring or not requiring control. If no decision is made after 80 samples, classify the infestation as requiring control. The limits for these classes are 4 beetles per sample for decreasing populations, and 5 beetles for static or increasing populations that warrant control operations.

Late sample: This sequential plan will help predict the severity of infestations the following year. Sample at least 20 trees, reference the sequential sampling plan (Table 2), and continue sampling until a decision is met. Populations are classified as: increasing (emerging beetles will kill more trees than infested currently; 4.5 beetles/sample), static (emerging beetles will kill a similar number of trees as infested currently; 2.5-3.5 beetles/sample), or decreasing (emerging beetles will kill less trees than infested currently; 1.5 beetles/sample).

Notes: Data are collected from standing trees and do not consider the beetles that may occur in windthrown trees, which may be a significant portion of the population. The data follow a negative binomial distribution (for calculations, see Waters 1955).

Reference:

Waters, W. E. 1955. Sequential sampling in forest insect surveys. *Forest Science* 1: 68-79.

Tables:

Table 1. Sequential sampling plan for Engelmann spruce beetle infestations in standing trees for determining treatability (June counts).

No. of samples examined	Cumulative no. of beetles Not treatable	Cumulative no. of beetles Treatable	No. of samples examined	Cumulative no. of beetles Not treatable	Cumulative no. of beetles Treatable
20	27	151	52	170	294
22	36	160	54	179	303
24	45	169	56	188	312
26	54	178	58	197	321
28	63	187	60	205	330
30	71	196	62	214	339
32	80	205	64	223	348
34	89	214	66	232	357
36	98	223	68	241	366
38	107	232	70	250	374
40	116	241	72	259	383
42	125	250	74	268	392
44	134	259	76	277	401
46	143	268	78	286	410
48	152	277	80	294	419
50	161	285			

Table 2. Sequential sample plan for Engelmann spruce beetle infestations in standing trees for predicting infestation trend (August-September counts).

Number of samples examined	Cumulative number of beetles		
	Decreasing	Static	Increasing
20	22	---	137
22	26	---	145
24	30	---	153
26	34	---	161
28	38	---	169
30	42	---	177
32	46	---	185
34	50	---	193
36	54	---	201
38	58	89-91	209
40	61	93-99	217
42	65	97-107	225
44	69	101-115	233
46	73	105-123	241
48	77	109-131	249
50	80	112-139	256
52	84	116-147	264
54	88	120-155	272
56	92	124-163	280
58	96	128-171	288
60	99	132-179	296
62	103	136-187	304
64	107	140-195	312
66	111	144-203	320
68	115	148-211	328
70	119	151-219	335
72	123	155-227	343
74	127	159-235	351
76	131	163-243	359
78	135	167-251	367
80	138	170-258	375