

1 **Supplementary Information**

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21 **Supplementary Methods**

22 *Survey Regions and 20th Century Climate Change*

23 The three regions of montane California differed considerably in climate and
24 physiognomy. The northern region (Lassen) was the coolest and wettest, and had the smallest
25 elevation range and the least topographic complexity. The southern region (Sequoia) was the
26 driest, and had the largest elevation range and greatest topographic complexity. Climate
27 change over the past century differed among the three regions (Fig. 1b). The central region
28 (Yosemite) experienced the greatest and the northern region the least increase in mean annual
29 temperature, whereas precipitation increased in both but not in the southern region. Across all
30 three regions, maximum temperature of the warmest month was constant, whereas minimum
31 temperature of the coldest month increased (Supplementary Figure S1).

32 *Survey and Resurvey Data*

33 We used historical maps, written descriptions in field notes, and modern ground-
34 truthing with historical photographs and hand-held GPS units to georeference historical
35 localities. Modern trapline coordinates were obtained from handheld GPS units, with
36 coordinates recorded at the beginning, middle, and end of each trapline. We determined the
37 elevation of each historical and modern trapline using a digital elevation model (DEM)
38 derived from the Shuttle Radar Topography Mission (v4) with a resolution of 1 arc sec and
39 verified these values by manual comparison to elevations determined on the ground or on
40 topographic maps (Supplementary Table S1).

41 Of the 134 historical localities, 34 were in the Northern, 47 were in the Central, and
42 32 were in the Southern region of montane California (Fig. 1a). Each site was surveyed for 1-
43 16 nights (median = 5) for a total of 681 survey-nights. For most sites, surveys were
44 conducted over consecutive nights. Historical trapping efforts used snap traps, Macabee
45 gopher traps, mole traps, and steel traps that were set in suitable locations in various habitats

46 around a central camp. For each historical site, the average number of traps per night ranged
47 from 6 - 335 (median = 96). Shooting and observations resulted in additional opportunistic
48 records of diurnal mammals, primarily squirrels and pikas. Of the 15,277 historical mammal
49 records used in this study, 8,688 are backed by voucher specimens in the MVZ¹⁻³.

50 Modern mammal resurveys were conducted between 2003 and 2010 as part of the
51 Grinnell Resurvey Project^{4,5}; Fig. 1a). We surveyed a total of 166 sites, including 85 of the
52 134 historical sites; 38 were in the Northern, 81 were in the Central, and 47 were in the
53 Southern region of montane California. Additional modern sites were selected to maximize
54 elevation coverage and to serve as proxies for historical sites that were otherwise
55 inaccessible. We surveyed each site for 1-11 nights (median = 6) for a total of 916 survey-
56 nights. As with historical surveys, most modern surveys at a site were conducted over
57 consecutive nights. Using historical locality maps and habitat descriptions recorded in field
58 notebooks, we set traplines to sample historical sites as closely as possible. We used a
59 combination of Sherman traps and Tomahawk traps, with standard traplines containing 40
60 Sherman traps and 10 Tomahawk traps run for 4 consecutive nights in suitable spots. Pitfall
61 traps, consisting of 32-oz plastic cups placed in the ground, were used to collect shrews and
62 were set at the same time as the Sherman lines. Pocket gophers were trapped using Macabee
63 gopher traps where gopher mounds were observed. For each modern site, the average number
64 of traps per night ranged from 3-339 (median=65). Additional observational records were
65 recorded daily. Of the 14,316 modern mammal records obtained from these surveys, 6,144
66 are backed by voucher specimens in the MVZ⁶⁻⁸.

67

68 *Species Set*

69 Our data set included records for 67 species of small mammals in the modern and/or
70 historical eras (Supplementary Table S2). Our resurvey protocols were not designed to detect

71 carnivores, ungulates, or bats, so these were not included. Following Moritz et al.⁴, we
72 adjusted the slope cut-off for *Peromyscus truei* to reflect known boundaries between Sierra
73 Nevada and Great Basin subspecies⁹. We also considered only those west slope species that
74 are characteristic of the Sierra Nevada and Cascade Range. For example, we did not include
75 Mojave Desert species such as *Neotoma lepida* or *Perognathus longimembris*.

76

77 *Modelling Changes in Elevational Ranges*

78 To simultaneously estimate the probability of detection (p) and the probability of occupancy
79 (Ψ) of each species at each locality, we used the single-season occupancy modelling
80 framework implemented in the program MARK v6.0^{10,11}). Our single-season model
81 implemented an “unpaired-site” framework¹², which tests for temporal changes in occupancy
82 by fitting time period (‘era’) as a covariate effect. To fit these models we included the 28
83 species and 228 sites for which quantitative trapping data were available. We used the
84 package ‘RMark’ v2.0.1 in the R v2.12.2 framework to build design matrices, combine
85 models, and to compare AIC weights among models¹³.

86 To develop detection-adjusted elevation range profiles for each species in each era
87 and region, we parameterized 25 occupancy models (Ψ) building on the model set of Moritz
88 et al.⁴ and Tingley et al.⁵. The 25 models included all 2- and 3-way interactions among the
89 following variables: era (categorical: historical or modern), elevation (linear), elevation
90 (quadratic) and region (categorical: Northern, Central, or Southern), as well as a constant
91 model (.). The full model set is listed in Supplementary Table S5. Following Moritz et al.⁴ we
92 estimated the probability of detection per survey night (p) based on 34 competing models
93 with the following variables: era (historical or modern), trend (linear change in detections
94 over sequential nights due to the collection of trapped individuals, trap habituation or to trap-
95 shyness), trap effort (number of traps/100 and the \log_{10} of the number of traps), the

96 interaction between era and trend, and the interactions between era and trap effort variables.
97 We built detection models with all additive combinations of these independent variables, as
98 well as a constant model (.). The full candidate model set is listed in Supplementary Table
99 S5. We ran this full candidate p model set with two parameterizations of Ψ : a constant model
100 and a fully parameterized model. From these analyses, we selected the set of p models that
101 incorporated the best (lowest AIC) model and all models with $\Delta\text{AIC} < 2$ for each species
102 (Supplementary Table S3). This subset of p models ($n = 16$) were then combined with the
103 full set of 25 Ψ models for a total of 400 competing models that were run for each species
104 and compared using AIC⁴.

105 Following Moritz et al.⁴, we estimated temporal shifts in the lower and upper range
106 limits for each species on each of the three regions. For elevation distributions, we used all
107 detection data including quantitatively trapped specimens, incidentally collected (shot or
108 salvaged) specimens, and observational records (Supplementary Figure S2). We plotted all
109 localities in each transect for each era against elevation, and coded each species at a locality
110 as present or undetected. We then calculated the change in elevation of each range limit from
111 the historical to the modern era. To test the significance of these shifts, we estimated site-
112 specific detection probabilities (p^*) by model averaging model-specific p estimated using
113 AIC weights from our 400 occupancy models^{14,4} (Supplementary Figure S3).

114

115 *Testing Predictions of Range Shifts*

116 We used generalized linear mixed models (GLMM) to examine how patterns of range
117 shifts were related to regional variation and the elevational distributions of species. All
118 GLMM models used a logit link and were run in R with the ‘lme4’ package¹⁵. Species
119 identity was included as a random effect and model performance was assessed by AIC. We
120 first used GLMMs to evaluate what factors were associated with occurrence of a range shift

121 (as a binary variable). Species widespread across elevations (*P. maniculatus* and *O. beecheyi*)
122 were excluded from this analysis. We defined 12 models comprised of a null model (intercept
123 only) and all additive combinations and one-way interactions between 3 categorical
124 explanatory variables: (1) limit (upper or lower elevation range limit), (2) region, and (3)
125 zone (low or high elevation species). Second, to resolve interaction effects associated with
126 zone, we then analysed low elevation and high elevation species separately, retaining limit
127 and region variables.

128 We used one-sided binomial tests to evaluate whether upslope shifts were the most
129 common across regions (Prediction 1), whether range contractions were more likely in high
130 elevation species and range expansions were more common in low elevation species
131 (Prediction 2), and to evaluate whether the patterns of range shifts were consistent across
132 regions (Prediction 3). For each of these analyses, we included only those species that
133 exhibited significant shifts determined from the P_{fa} analysis above.

134

135 *Climatic Nearest Neighbour*

136 We examined spatial heterogeneity in climate change (Prediction 4) by identifying the
137 nearest climatic neighbours of historical localities under modern climate conditions,
138 following the approach described in Tingley et al.⁵. Using four standard BIOCLIM variables
139 (mean annual temperature, B1; maximum temperature of the warmest month, B5; minimum
140 temperature of the coldest month, B6; and mean annual precipitation, B12) from the
141 Parameter-elevation Regressions on Independent Slope Model (PRISM¹⁶ at a resolution of 30
142 arc-second (1 km²), we calculated 20-year averages for the historical (1910-1930) and
143 modern (1989-2009) survey periods. Climatic distances for each of the BIOCLIM variables
144 were calculated between each historical locality and modern era PRISM grid cells within the
145 same region, which was defined by a 20-kilometer buffer around the minimum convex

146 polygon that encompassed all survey sites. For each historical site, we identified the 5% of
147 modern cells that were nearest climatically and the 5% of historical cells that were nearest
148 climatically. This was calculated separately for each climatic variable using the Euclidian
149 distance. We subtracted the elevation of the historical site from the average elevation of the
150 modern nearest climate neighbour cells; positive values indicated upslope movement in
151 climate space. We recorded these values (positive or negative) for the two historical localities
152 defining the upper and lower limits of each species on each transect. These values provided a
153 climate-based prediction for movement of species at their range limits for each region (i.e.,
154 upslope or downslope). We compared these climate-data derived models to an “overall
155 warming model” that assumes an increased temperature at all grid cells over the same time
156 period, which always predicted upslope movements. For each climatic variable at each site,
157 we also identified rare or disappearing climates using climatic thresholds of 1 °C temperature
158 or 10 cm precipitation. We defined rare climates as those that occurred within climatic
159 thresholds at < 2.5% of historical cells. We defined disappearing climates as those that
160 occurred within climatic thresholds at \geq 5% of historical cells and < 2.5% of modern cells.
161 We excluded this subset of site-specific climate change from nearest neighbour comparisons
162 because they violate an assumption of the method that climatically similar sites are available.
163 We used a one-sided binomial to test if the upslope movement predicted from the overall
164 warming model and predictions from each of the BIOCLIM variables were consistent with
165 the direction of observed shifts (Prediction 4).

166 **Supplementary Methods References**

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168 1. <http://arctos.database.museum/project/historic-grinnell-survey-lassen-transect>

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- 198

199 **Supplementary Figure Legends**

200

201 Supplementary Figure S1. Violin plot of BIOCLIM variables included in this study. Each
202 plot represents all cells within 20-kilometer buffer around the minimum convex polygon that
203 encompassed all survey sites for (a) B1 (mean annual temperature), (b) B5 (maximum
204 temperature of the warmest month), (c) B6 (minimum temperature of the coldest month), and
205 (d) B12 (mean annual precipitation) for each region in the historical and modern eras. Median
206 and the upper and lower quartiles are represented by the white circle and black bar,
207 respectively.

208

209 Supplementary Figure S2. Distribution by elevation and region of all 67 species of small
210 mammal detected within the study regions over both eras. Green diamonds and crosses
211 represent species presences recorded through quantitative (e.g., Sherman live trap) or non-
212 quantitative (e.g., Shotgun) trapping effort, respectively. Blue crosses represent species
213 presences recorded through observation alone. For species subject to detectability analysis,
214 the size of the open circle represents site-specific detectability. Grey circles represent
215 elevation of surveyed sites for those species not subject to detectability analysis.

216

217

218 Supplementary Figure S3. Occupancy curves in the historical and modern eras by region for
219 the 28 occupancy-modelled small mammal species. Curves represent the probability of
220 occupancy in the historical (dark blue) and modern (green) eras across elevations with the
221 elevation of sites surveyed in each era given by triangles (historical) and circles (modern).

222

Supplementary Tables

223

Supplementary Table S1. Historical and modern locality data for sites included in this study.

	Aggregate name	Latitude	Longitude	Era	Slope	Region	Elevation (m)
Red Bluff 4		40.1903286	-122.2252066	H	W	N	83
Red Bluff 5		40.2121782	-122.2297661	H	W	N	89
Red Bluff 3		40.1707	-122.1254	H	W	N	90
Red Bluff 1		40.1339	-122.2061	H	W	N	92
Battle Creek		40.37479	-122.18016	H	W	N	103
Red Bluff 2		40.24038	-122.110955	H	W	N	167
Red Bluff 6		40.3221638	-122.2855723	H	W	N	177
Dales, Payne Creek		40.3146	-122.0695	H	W	N	208
Manton		40.425439	-121.889271	H	W	N	535
Lymans		40.3096	-121.7678	H	W	N	1051
Turners		40.30825	-121.738116	H	W	N	1335
Petes Valley		40.52927	-120.46209	H	E	N	1382
Mineral 3		40.3377636	-121.5961291	H	W	N	1478
Eagle Lake 3		40.5729252	-120.838016	H	W	N	1561
Eagle Lake 2		40.6709426	-120.7895831	H	W	N	1564
Mineral, Summit Creek 2		40.3628	-121.5663	H	W	N	1583
Eagle Lake 1		40.73439	-120.719636	H	W	N	1586
Grasshopper Valley		40.850087	-120.756895	H	E	N	1616
Termo		40.8915	-120.4564	H	E	N	1622
West Red Rock PO		40.8995	-120.25399	H	E	N	1626
Mineral, Summit Creek 1		40.3489	-121.5878	H	W	N	1627
North Observation Peak 1		40.86135	-120.17049	H	E	N	1628
East Ravendale		40.79823	-120.23207	H	E	N	1668
Willow Lake		40.4052369	-121.3657268	H	W	N	1672
Kellys 2		40.4326779	-121.3520687	H	W	N	1675
North Fredonyer Peak		40.801001	-120.61175	H	E	N	1711
South West Ravendale		40.6969	-120.409	H	E	N	1717

Hot Spring Valley	40.44423	-121.3938	H	W	N	1784
Manzanita Lake	40.5314	-121.5648	H	W	N	1790
Butte Lake	40.5642	-121.3023907	H	W	N	1845
Black Butte	40.4147	-121.5319	H	W	N	1971
Warner Creek 1	40.4596926	-121.4418428	H	W	N	2061
Warner Creek 2	40.4635115	-121.4719669	H	W	N	2462
Lake Helen	40.469128	-121.518495	H	W	N	2514
Sacramento River, Blue Tent Creek	40.2026	-122.21628	M	W	N	80
Coyote Creek	40.09325	-122.22687	M	W	N	92
Sacramento River, Perry Riffle	40.29721	-122.17534	M	W	N	97
Jellys Ferry	40.319965	-122.18149	M	W	N	103
Reading Island	40.38927333	-122.1922033	M	W	N	111
Paynes Creek	40.30254	-122.10614	M	W	N	168
Dales Lake	40.330645	-122.072605	M	W	N	207
Hog Lake	40.28261	-122.12289	M	W	N	270
Vasquez Ranch	40.436528	-121.875444	M	W	N	608
Lyman Springs	40.31124	-121.764275	M	W	N	1044
Petes Valley	40.52613667	-120.4655133	M	E	N	1383
Battle Creek	40.34945	-121.631705	M	W	N	1459
Battle Creek Meadows	40.33948	-121.609185	M	W	N	1468
Eagle Lake, Merrill Creek	40.552305	-120.814665	M	W	N	1559
Eagle Lake Pine Creek	40.66796	-120.78612	M	W	N	1566
Eagle Lake, Brockman	40.59293	-120.844295	M	W	N	1584
Summit Creek	40.35804	-121.55757	M	W	N	1616
Wilson Lake	40.344115	-121.439425	M	W	N	1620
Coyote Flat	40.88974	-120.26846	M	E	N	1621
Eagle Lake, Papoose Meadow	40.525815	-120.76727	M	W	N	1628
Observation Peak 1	40.86155	-120.1599	M	E	N	1631
Observation Peak 2	40.84532	-120.17653	M	E	N	1632
Dodge Ranch	40.89014	-120.17355	M	E	N	1632
Horne Ranch	40.82822	-120.13889	M	E	N	1647
Slate Creek	40.842596	-120.769944	M	E	N	1663
Willow Lake	40.40586	-121.362885	M	W	N	1680

Tuledad Road	40.92563	-120.13857	M	E	N	1696
Bailey Creek	40.805722	-120.610026	M	E	N	1702
Summit Creek North	40.3689	-121.53831	M	W	N	1723
Dodge Reservoir	40.96926	-120.135055	M	E	N	1759
Pole Spring	40.5872	-121.2870167	M	W	N	1783
Drakesbad	40.444655	-121.4085	M	W	N	1785
Manzanita Lake	40.53759	-121.57018	M	W	N	1791
Butte Lake	40.562405	-121.29966	M	W	N	1850
Bluff Falls	40.4122025	-121.531905	M	W	N	1990
Kings Creek Falls	40.45971	-121.44478	M	W	N	2100
Upper Kings Creek Meadow	40.46521	-121.4764	M	W	N	2276
Helen, Emerald Lakes	40.4697275	-121.5139775	M	W	N	2491
Minkler	36.7166	-119.4641	H	W	S	118
Bakersfield	35.4198391	-119.0087676	H	W	S	180
Dunlap	36.717103	-119.132257	H	W	S	636
Bodfish	35.600131	-118.496674	H	W	S	721
Mill Creek	35.5305856	-118.6221592	H	W	S	787
Weldon, South	35.666083	-118.28948	H	W	S	809
Onyx	35.685739	-118.21827	H	E	S	865
Weldon, Fay Creek North	35.7412	-118.31	H	W	S	1261
Walker Pass 06	35.6692	-118.0371	H	E	S	1416
Walker Pass 05	35.6877503	-118.0493023	H	E	S	1424
Walker Pass 07, Freeman Canyon	35.6501	-118.0109	H	E	S	1481
Kings River Canyon	36.7938	-118.581	H	W	S	1529
Hume Lake	36.787727	-118.913013	H	W	S	1592
Carroll Creek	36.5051	-118.10244	H	E	S	1699
Smith Meadow, Trout Creek	35.96474	-118.22947	H	W	S	1860
Kiawah Mountain, Scodie Mountains	35.682227	-118.085094	H	E	S	1959
Jordan Hot Springs	36.229654	-118.30169	H	W	S	1984
Hockett Trail 1	36.49339	-118.13676	H	E	S	2000
Hockett Trail 4	36.49577	-118.1123	H	E	S	2142
Taylor Meadow	35.830658	-118.29175	H	W	S	2147
Cannell Meadow	35.825082	-118.36717	H	W	S	2268

Hockett Trail 3	36.477695	-118.137275	H	E	S	2281
Hockett Trail 5	36.49732	-118.11483	H	E	S	2313
Horse Corral Meadow	36.74744	-118.75404	H	W	S	2314
Jackass Meadow	36.092861	-118.2262	H	W	S	2364
Broder/Monache Meadow	36.16332	-118.18188	H	W	S	2424
Dry Meadows	36.214523	-118.25257	H	W	S	2624
Redrocks Meadow	36.270108	-118.271385	H	W	S	2657
Onion Valley	36.77438267	-118.3310457	H	W	S	2732
Sirretta Meadows	35.942	-118.328	H	W	S	2755
Little Pete Meadow	37.101522	-118.5958	H	W	S	2761
Aster Lake	36.6001448	-118.6748248	H	W	S	2796
McClure/Colby Meadows	37.1713	-118.7024	H	W	S	2952
Rock Creek	36.496066	-118.326482	H	W	S	2954
Whitney Meadow	36.434131	-118.2671	H	W	S	2969
Little Cottonwood Creek	36.47914	-118.128635	H	W	S	2997
Little Brush Meadow, Olancha Peak	36.2541	-118.13	H	W	S	3005
Hockett Trail 2	36.49415	-118.09586	H	E	S	3036
Bubbs Creek	36.763891	-118.406272	H	W	S	3040
Mitchell Peak	36.732308	-118.713693	H	W	S	3128
Crabtree Meadow, Whitney Creek	36.551234	-118.35854	H	W	S	3147
Flower/Heart Lake	36.7695434	-118.3561116	H	W	S	3177
Moose Lake	36.600674	-118.637441	H	W	S	3214
Bullfrog Lake	36.772973	-118.403983	H	W	S	3249
Olancha Peak, West Slope	36.259758	-118.123273	H	W	S	3287
Evolution Lake	37.1686	-118.6933	H	W	S	3313
Cottonwood Lakes	36.498147	-118.220007	H	W	S	3384
Dusy Lake	37.102299	-118.555	H	W	S	3392
Humphreys Basin	37.2653	-118.7056	H	W	S	3460
Piute Pass, off trapline	37.231039	-118.68916	H	W	S	3474
Cirque Peak	36.461735	-118.238346	H	W	S	3503
Kearsarge Pass	36.7725	-118.3761	H	E	S	3575
Mt. Gould	36.78039	-118.37854	H	W	S	3940
Minkler 04, Jesse Morrow Mountain	36.712887	-119.416629	M	W	S	135

Minkler 01, 02, 03	36.7504894	-119.4403854	M	W	S	138
Bakersfield	35.5138617	-118.8709479	M	W	S	231
Bakersfield, Jackrabbit Flat	35.49501	-119.0572608	M	W	S	250
Dunlap, Mill Creek	36.7301617	-119.1186399	M	W	S	583
Bodfish 04, Sandy Flat Campground	35.587765	-118.440047	M	W	S	705
Bodfish 01, 02	35.599554	-118.4967251	M	W	S	732
Mill Creek	35.5353281	-118.6173197	M	W	S	741
Weldon 02, 03, 06, 08, South	35.6785335	-118.2953012	M	W	S	810
Kelso Creek Road	35.63622	-118.24572	M	W	S	861
Onyx 01, 03, Canebrake Ecological Reserve	35.7284779	-118.1716634	M	E	S	866
Onyx 02, 04, Scodie Canyon	35.6794096	-118.2144064	M	E	S	906
Bodfish 03, Erskine Creek	35.587765	-118.440047	M	W	S	932
Weldon 01, 05, 07, 09, Fay Ranch Road, Fay Creek North	35.7163161	-118.3052221	M	W	S	999
Olancha Creek	36.27383	-118.02917	M	E	S	1221
Walker Pass 04	35.725013	-118.075586	M	E	S	1226
Kings River Canyon	36.791109	-118.600285	M	W	S	1507
Walker Pass 01, Freeman Canyon	35.6556102	-118.0138127	M	E	S	1514
Smith Meadow, Trout Creek	35.965359	-118.2266916	M	W	S	1542
Hume Lake	36.7919836	-118.9040388	M	W	S	1614
Walker Pass 02	35.663848	-118.026011	M	E	S	1625
Carroll Creek	36.510223	-118.1029541	M	E	S	1672
Walker Pass 03	35.6663777	-118.040982	M	E	S	2071
Taylor Meadow	35.8300014	-118.2957237	M	W	S	2167
Horse Corral Meadow	36.746714	-118.7664448	M	W	S	2262
Cannell Meadow	35.8334444	-118.3707494	M	W	S	2282
Jackass Meadow	36.0929196	-118.2269272	M	W	S	2373
Broder/Monache Meadow	36.1660483	-118.1919061	M	W	S	2413
Evolution Valley 5	37.0991	-118.597	M	W	S	2710
Sirretta Meadows	35.9447078	-118.3274356	M	W	S	2760
Onion Valley	36.77509	-118.334185	M	W	S	2772
Aster Lake	36.60162	-118.6779	M	W	S	2785
Little Cottonwood Creek 01, 02	36.4753532	-118.120386	M	W	S	2905
Little Brush Meadow, Olancha Peak	36.2532438	-118.1341831	M	W	S	2940

Whitney Meadow	36.4314867	-118.2748239	M	W	S	2990
Little Cottonwood Creek 03	36.47915687	-118.1286138	M	W	S	2997
Evolution Valley 2	37.1717	-118.716	M	W	S	3012
Little Cottonwood Creek, camp	36.45175	-118.17046	M	W	S	3072
Crabtree Meadow, Whitney Creek	36.552653	-118.3576782	M	W	S	3166
Bullfrog Lake	36.7701135	-118.4040739	M	W	S	3240
Moose Lake	36.603901	-118.641	M	W	S	3269
Rocky Basin Lakes	36.4444875	-118.3181318	M	W	S	3298
Evolution Valley 4	37.1623	-118.691	M	W	S	3316
Cottonwood Lakes	36.49873	-118.20772	M	W	S	3398
Evolution Valley 3	37.188599	-118.702	M	W	S	3441
Evolution Valley 6	37.1027	-118.556	M	W	S	3454
Evolution Valley 1	37.2099	-118.689	M	W	S	3640
La Grange 1	37.6661	-120.469857	H	W	C	52
Snelling 1	37.52686909	-120.4374364	H	W	C	80
Pleasant Valley 1	37.65638	-120.29042	H	W	C	251
Pleasant Valley 2	37.64441	-120.30118	H	W	C	335
Coulterville 1	37.710817	-120.214514	H	W	C	493
El Portal 2	37.673726	-119.7935365	H	W	C	583
Mt. Bullion 1	37.50822	-120.043898	H	W	C	661
El Portal 1	37.67989	-119.783175	H	W	C	752
Coulterville 3	37.753536	-120.1058	H	W	C	904
Coulterville 2	37.73845	-120.14187	H	W	C	975
Sweetwater 1	37.588966	-119.881282	H	W	C	1068
Cascade 1	37.725765	-119.710935	H	W	C	1101
El Portal 3	37.688188	-119.764217	H	W	C	1202
Yosemite Valley 2	37.73731867	-119.6024683	H	W	C	1211
Yosemite Valley 3	37.739314	-119.572044	H	W	C	1213
Happy Isles 1	37.7316	-119.561	H	W	C	1231
Yosemite Valley 1	37.74984527	-119.5905486	H	W	C	1251
Yosemite Valley 4	37.7458	-119.6054	H	W	C	1420
Merced Grove 1	37.74872617	-119.83866	H	W	C	1647
Cascade Creek 1	37.73869815	-119.7029034	H	W	C	1803

Aspen Valley 1	37.827725	-119.771211	H	W	C	1878
Chinquapin 1	37.65236433	-119.702601	H	W	C	1884
Crane Flat 1	37.75558867	-119.7980497	H	W	C	1896
Mono PO 1	37.990578	-119.141074	H	E	C	1953
Glen Aulin 2	37.928858	-119.461163	H	W	C	1971
Salmon Ranch 1	37.96326	-118.9236	H	E	C	2001
Dry Creek 1	37.9346515	-118.935186	H	E	C	2076
Williams Butte 1	37.90891	-119.1053	H	E	C	2090
Mono Craters 2	37.90167	-118.9914	H	E	C	2167
Mono Meadow 1	37.663396	-119.592267	H	W	C	2176
Indian Canyon 1	37.77432	-119.56902	H	W	C	2195
Silver Lake 1	37.79923	-119.1213	H	E	C	2216
Merced Lake 1	37.728064	-119.391793	H	W	C	2228
Mono Mills 1	37.887635	-118.959868	H	E	C	2241
Glen Aulin 1	37.91206	-119.42135	H	W	C	2386
Walker Lake 1	37.87338	-119.171	H	W	C	2438
Porcupine Flat 1	37.80526	-119.55632	H	W	C	2464
Tuolumne Meadows 2	37.8785	-119.3665	H	W	C	2622
Tuolumne Meadows 1	37.87941	-119.39498	H	W	C	2632
Warren Fork 1	37.95505	-119.2283	H	W	C	2773
Gem Lake 1	37.75857	-119.1594	H	W	C	2773
Ten Lakes 1	37.9038915	-119.5255205	H	W	C	2784
Mt. Hoffman 1	37.84461	-119.50018	H	W	C	3026
Lyell Canyon 1	37.773896	-119.260877	H	W	C	3026
Young Lakes 1	37.9378	-119.340629	H	W	C	3047
Vogelsang 1	37.790895	-119.34256	H	W	C	3161
Lyell Canyon 2	37.76408752	-119.2520804	H	W	C	3281
LG2	37.621805	-120.525885	M	W	C	50
LG3	37.66747286	-120.4679471	M	W	C	57
LG1	37.6248	-120.56688	M	W	C	76
S2	37.53619	-120.48598	M	W	C	89
S1	37.51121	-120.38391	M	W	C	90
S3	37.529065	-120.35093	M	W	C	115

S4	37.54692	-120.35495	M	W	C	118
CPV6	37.70881	-120.22121	M	W	C	420
CPV2	37.65594	-120.22132	M	W	C	545
CPV4	37.72381333	-120.2637533	M	W	C	557
CPV8	37.71951	-120.17941	M	W	C	569
CPV5	37.73883	-120.24826	M	W	C	646
CPV1	37.64055333	-120.21173	M	W	C	728
CPV3	37.614215	-120.18232	M	W	C	832
MD2	37.74401	-120.03202	M	W	C	853
CPV9	37.73636	-120.166455	M	W	C	873
MD1	37.75542	-120.08468	M	W	C	887
CPV7	37.68405	-120.12141	M	W	C	899
Ca1	37.72315	-119.7120025	M	W	C	1045
FM3	37.54498	-119.83822	M	W	C	1122
FM2	37.5790375	-119.88213	M	W	C	1129
YV1	37.71515	-119.665	M	W	C	1191
YV2	37.72193	-119.63632	M	W	C	1205
YV5	37.74053	-119.57217	M	W	C	1209
YV4	37.74276333	-119.58765	M	W	C	1209
YV3	37.73242333	-119.6077033	M	W	C	1219
YV6	37.73267	-119.55807	M	W	C	1227
YV7	37.753365	-119.54557	M	W	C	1256
FM1	37.56624	-119.86851	M	W	C	1268
YV8	37.75236	-119.58723	M	W	C	1321
F1	37.70369	-119.740075	M	W	C	1354
HM1	37.79611	-119.86781	M	W	C	1424
MG1	37.748264	-119.839376	M	W	C	1646
HG1	37.76525	-119.86233	M	W	C	1701
MG2	37.76208	-119.84264	M	W	C	1811
AV1	37.82534	-119.77221	M	W	C	1872
CF2	37.75287813	-119.7976925	M	W	C	1881
Ch1	37.68598667	-119.7243933	M	W	C	1951
CF1	37.75331	-119.8089	M	W	C	1956

TF1	37.75456	-119.74298	M	W	C	2018
CF3	37.75775	-119.7699	M	W	C	2098
MMe3	37.667798	-119.623188	M	W	C	2126
TC1	37.81096	-119.71286	M	W	C	2143
MoMe1	37.66637333	-119.6721133	M	W	C	2153
MMe2	37.66671667	-119.5944433	M	W	C	2166
WB1	37.90766	-119.12214	M	E	C	2180
BC1	37.90028	-119.12977	M	E	C	2199
ML2	37.73970714	-119.40517	M	W	C	2222
WC1	37.89667	-119.13013	M	E	C	2231
IC1	37.77716	-119.566745	M	W	C	2232
SM1	37.673565	-119.654315	M	W	C	2237
ML1	37.729643	-119.392858	M	W	C	2238
MMi1	37.88811	-118.96021	M	E	C	2239
YC1	37.85038333	-119.5763733	M	W	C	2283
MMe1	37.69924	-119.58647	M	W	C	2372
WW3	37.83879	-119.59254	M	W	C	2383
WW1	37.85844	-119.651202	M	W	C	2426
GA1	37.91117	-119.42495	M	W	C	2433
WW2	37.849072	-119.622823	M	W	C	2455
WL1	37.8730675	-119.1629695	M	W	C	2474
PF1	37.80894333	-119.5686267	M	W	C	2495
FD1	37.87649	-119.41609	M	W	C	2554
SN1	37.822	-119.504705	M	W	C	2610
JR1	37.88358	-119.3634	M	W	C	2685
GM1	38.16254	-119.60461	M	W	C	2745
WF1	37.954035	-119.22714	M	W	C	2784
LM1	37.8827	-119.34655	M	W	C	2815
DeM1	37.89922	-119.3477	M	W	C	2866
DL1	38.1729675	-119.5947525	M	W	C	2874
TL1	37.90404	-119.533565	M	W	C	2883
KM1	38.12200714	-119.48195	M	W	C	2884
LC1	37.779085	-119.26102	M	W	C	2936

MF1	37.84097	-119.49964	M	W	C	2938
DD1	37.90828	-119.3475	M	W	C	2961
RC1	38.06129	-119.33899	M	W	C	3014
WF2	37.95899	-119.26701	M	W	C	3052
V1	37.792494	-119.348524	M	W	C	3074
LC2	37.76912667	-119.2568567	M	W	C	3097
V2	37.79766	-119.335133	M	W	C	3131
TP1	37.90811	-119.26396	M	W	C	3148
LC3	37.76164333	-119.25687	M	W	C	3255

224 H = Historical, M = Modern; E = East Slope, W = West Slope; N = Northern, C = Central, S = Southern

Supplementary Table S2. List of small mammal species examined in this study.

Species	Detection method§	Occupancy analysis†	Northern‡			Central			Southern		
			Slope	H	M	Slope	H	M	Slope	H	M
<i>Ammospermophilus leucurus</i>	St	-	E	0	1		---		E + W	1	1
<i>Ammospermophilus nelsoni</i>	St	-		---			---		W	1	0
<i>Apodemus rufa</i>	Sp	-	W	0	1	E + W	1	1		---	
<i>Brachylagus idahoensis</i>	Obs	-	E	1	0		---			---	
<i>Callospermophilus lateralis</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1	1
<i>Chaetodipus californicus</i>	St	Y		---		E + W	1	1	E + W	1	1
<i>Clethrionomys californicus</i>	St	-	W	1	1		---			---	
<i>Dipodomys agilis</i>	St	Y		---			---		E + W	1	1
<i>Dipodomys californicus</i>	St	-	E + W	1	1		---			---	
<i>Dipodomys heermanni</i>	St	Y		---		E + W	1	1	E + W	1	0
<i>Dipodomys merriami</i>	St	-		---			---		E + W	1	1
<i>Dipodomys nitratoides</i>	St	-		---			---		W	1	0
<i>Dipodomys ordii</i>	St	-	E	1	1		---			---	
<i>Dipodomys panamintinus</i>	St	-		---		E	1	1	E + W	1	1
<i>Glaucomys sabrinus</i>	St	-	W	1	1	W	1	1		---	
<i>Lemmiscus curtatus</i>	St	-	E	1	1	E	1	1		---	
<i>Marmota flaviventris</i>	Obs	N	E + W	1	1	E + W	1	1	W	1	1
<i>Microdipodops megacephalus</i>	St	-	E	1	1	E	1	0		---	
<i>Microtus californicus</i>	St	Y	W	1	1	E + W	1	1	E + W	1	1
<i>Microtus longicaudus</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1	1
<i>Microtus montanus</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1	1
<i>Neotoma bryanti</i>	St	-		---			---		E + W	1	1
<i>Neotoma cinerea</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1	1
<i>Neotoma fuscipes</i>	St	Y	E + W	1	1		---			---	
<i>Neotoma lepida</i>	St	-	E	1	1		---		E + W	1	1
<i>Neotoma macrotis</i>	St	Y		---		E + W	1	1	E + W	1	1
<i>Ochotona princeps</i>	Obs	N	E + W	1	1	W	1	1	W	1	1

<i>Onychomys leucogaster</i>	St	-	E	1	1	E	1	1	---	
<i>Onychomys torridus</i>	St	-		---			---		E + W	1
<i>Otospermophilus beecheyi</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1
<i>Perognathus inornatus</i>	St	-		---		W	1	1	W	1
<i>Perognathus longimembris</i>	St	-		---			---		E + W	1
<i>Perognathus parvus</i>	St	-	E + W	1	1	E + W	1	1	E	1
<i>Peromyscus boylii</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1
<i>Peromyscus californicus</i>	St	-		---		W	1	1	W	1
<i>Peromyscus crinitus</i>	St	-	E	1	1		---		E + W	1
<i>Peromyscus maniculatus</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1
<i>Peromyscus truei</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1
<i>Phenacomys intermedius</i>	St	-		---		W	1	1	W	1
<i>Reithrodontomys megalotis</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1
<i>Scapanus latimanus</i>	Sp	-	E + W	1	1	E + W	1	1	W	1
<i>Sciurus griseus</i>	Obs	N	W	1	1	W	1	1	W	1
<i>Sorex merriami</i>	St	-	E	1	0		---		---	
<i>Sorex monticolus</i>	St	Y		---		E + W	1	1	E + W	1
<i>Sorex ornatus</i>	St	Y		---		E + W	1	1	E + W	1
<i>Sorex palustris</i>	St	Y	W	1	1	E + W	1	1	E + W	1
<i>Sorex tenellus</i>	St	-		---		W*	0	1	W	0
<i>Sorex trowbridgii</i>	St	Y	E + W	1	1	W	1	1	W*	0
<i>Sorex vagrans</i>	St	Y	E + W	1	1		---		---	
<i>Sylvilagus audubonii</i>	Obs	-	W	1	0	W	1	1	E + W	1
<i>Sylvilagus bachmani</i>	Obs	-	W	1	0	W	1	1	W	1
<i>Sylvilagus nuttallii</i>	Obs	-	E + W	1	1	E	1	1	W	0
<i>Tamias alpinus</i>	St	Y		---		E + W	1	1	E + W	1
<i>Tamias amoenus</i>	St	Y	E + W	1	1	E + W	1	1	---	
<i>Tamias merriami</i>	St	Y		---		E + W	1	1	E + W	1
<i>Tamias minimus</i>	St	-	E + W	1	1	E + W	1	1	W	1
<i>Tamias panamintinus</i>	St	-		---			---		E + W	1
<i>Tamias quadrivittatus</i>	St	Y		---		E + W	1	1	---	

<i>Tamias senex</i>	St	Y	E + W	1	1	E + W	1	1	---	
<i>Tamias speciosus</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1
<i>Tamias umbrinus</i>	St	-		---			---		E + W	1
<i>Tamiasciurus douglasii</i>	Obs	N	E + W	1	1	W	1	1	W	1
<i>Thomomys bottae</i>	Sp	N	W	1	1	W	1	1	W	1
<i>Thomomys monticola</i>	Sp	N	W	1	1	W	1	1	---	
<i>Thomomys talpoides</i>	Sp	-	E	1	0	E + W	1	1	---	
<i>Urocitellus beldingi</i>	St	Y	E + W	1	1	E + W	1	1	E + W	1
<i>Zapus princeps</i>	St	Y	W	1	1	E + W	1	1	E + W	1
Total	67	54	34	45	45	48	48	50	50	

226 §Detection methods were standardized trapping (St), specialized trapping (Sp), or observation (Obs).

227 †Species included in the analysis of range shifts were both species with (Y) and without (N) sufficient data for occupancy analysis. Of the 67 species we
 228 examined, 54 were detected using standardized trapping, 28 were included in the occupancy analyses and an additional 6 species were included in the
 229 analysis of range shifts.

230 ‡Species were detected on the east (E) and/or west (W) slopes within each region and detections within each region are listed as detected (0) or not
 231 detected (1) in the historical (H) or the modern (M) eras.

232 * New species records detected during our surveys.

Supplementary Table S3. Generalized linear mixed models examining patterns of range limit shifts of 32 montane small mammals of California.

Elevation Range Metric	Model	Parameters*	AIC	ΔAIC	AIC Weight
All Species	Basic	Zone:Limit	170.80	0.00	1.00
Any Shift	-	Null	189.90	19.10	0.00
	-	Zone	190.50	19.70	0.00
	-	Limit	191.90	21.10	0.00
	-	Limit+Zone	192.50	21.70	0.00
	-	Region	193.60	22.80	0.00
	-	Region+Zone	194.10	23.30	0.00
	-	Limit+Region	195.60	24.80	0.00
	-	Limit+Zone+Region	196.10	25.30	0.00
	-	Region:Zone	196.60	25.80	0.00
	-	Region:Limit	197.60	26.80	0.00
High Elevation Species	Basic	Limit	109.50	0.00	0.63
Any Shift	-	Region:Limit	111.90	2.40	0.19
	-	Region+Limit	112.20	2.70	0.16
	-	Null	117.70	8.20	0.01
	-	Region	120.80	11.30	0.00
Low Elevation Species	Basic	Limit	63.19	0.00	0.73
Any Shift	-	Region+Limit	65.66	2.47	0.21
	-	Region:Limit	68.53	5.34	0.05
	-	Null	74.46	11.27	0.00
	-	Region	77.44	14.25	0.00
High Elevation Species	Basic	Region+Limit	35.80	0.00	0.82
Shift up vs down	-	Limit	39.98	4.18	0.10
	-	Region:Limit	42.56	6.76	0.03
	-	Region	42.58	6.78	0.03
	-	Null	43.34	7.54	0.02

Low Elevation Species	Basic	Null	32.84	0.00	0.52
Shift up vs down	-	Limit	34.04	1.20	0.29
	-	Region	36.02	3.18	0.11
	-	Region+Limit	37.11	4.27	0.06
	-	Region:Limit	39.09	6.25	0.02

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* Model parameters included: Region (Northern, Central, Southern), Limit (upper elevation limit, lower elevation limit), and Zone (high or low elevation species).

Supplementary Table S4. Range limits and shifts of the 34 modelled species examined in this study.

	Species	Region	$p(H)$ §	$p(M)$	Historical Elevation Range (m)	Lower Limit Shift	Upper Limit Shift	Pattern	Best Occupancy Model†	AICc Weight	Historical Life Zone¶
1 <i>Sorex ornatus</i>	Northern	NA 0.5 5	NA 0.32	NA 549-914	NA -492	NA	NA	NA	era + elev + elev ² + region	0.2246	Upper Sonoran (L)
	Central	NA 0.3 5	0.49	118-180	No Change	+1362	Expand +U				
	Southern	NA 1									
2 <i>Dipodomys heermanni</i>	Northern	NA 0.3 5	NA 0.61	NA 52-975	NA No Change	NA -247	NA	NA	era + elev + region + era*elev	0.2148	Lower-Upper Sonoran (L)
	Central	NA 0.9 5	Undetecte d	52-975	Undetected Current	Undetected Current	Contract -U				
	Southern	NA 5		118-636			NA				
3 <i>Microtus californicus</i>	Northern	0.8 3	0.89	79-1335	No Change	No Change	No Change	No Change	era + elev + region + elev*region	0.0669	Lower-Upper Sonoran (L)
	Central	0.7 6	0.60	52-1647	No Change	No Change	No Change	No Change			
	Southern	0.9 6	0.90	118-1261	+465	No Change	Contract +L				
4 <i>Reithrodontomys megalotis</i>	Northern	0.8 2	0.86	79-1478	No Change	-434	Contract -U	elev	0.1738	Lower-Upper Sonoran (L)	
	Central	0.9 0	0.64	52-1158	No Change	+110	Expand +U				
	Southern	0.9 6	0.90	118-1860	No Change	-861	Contract -U				
5 <i>Chaetodipus californicus</i>	Northern	NA 0.3	NA 0.75	NA 183-914	NA No Change	NA +787	NA	NA	era + elev + elev ² + region	0.2355	Lower-Upper Sonoran (L)
	Central	NA 0.8	0.91	118-2147	+113‡	+226	Expand +U				
	Southern	NA 3					Shift +LU				
6 <i>Neotoma fuscipes/macrotis</i>											

	<i>Neotoma fuscipes</i>	Northern	0.6 9	0.98	79-1051	+32‡	+515	Expand +U	elev + elev ² + region	0.2508	Lower Sonoran–Transition (L)
	<i>Neotoma macrotis</i>	Central	0.5 7	0.78	183-1647	No Change	No Change	No Change	elev + elev ² + region +	0.1464	Lower Sonoran–Transition (L)
	<i>Neotoma macrotis</i>	Southern	0.5 9	0.91	118-2147	+113‡	+226	Shift +LU	elev*region + elev ² *region		
7	<i>Peromyscus truei</i>								era + elev + elev ² + region + era*elev + era*elev ² +		
		Northern	0.6 7	0.60	79-1051	+529	+408	Shift +LU	era*region + elev*region + elev ² *region +		
		Central	0.8 5	0.74	183-975	+374	+836	Shift +LU	era*elev*region + era*elev ² *regio	0.4677	Upper Sonoran (L)
		Southern	0.8 2	0.74	636-3147	-53‡	-207	Contract -U	n		
*8	<i>Sciurus griseus</i>								*Not subject to occupancy analyses		
		Northern			103-1051	No Change	+671	Expand +U			
		Central			183-1951	No Change	-262	Contact -U			
		Southern			787-2364	+720	-750	Contract +L, - U			
*9	<i>Dipodomys agilis</i>										
		Northern	NA	NA	NA	NA	NA	NA	era + elev + elev ² + region	0.2470	Lower–Upper Sonoran (L)
		Central	NA	NA	NA	NA	NA	NA			
		Southern	0.4 9	0.49	721-1860	+89‡	+307	Expand +U			
10	<i>Tamias merriami</i>										
		Northern	NA 0.2	NA	NA	NA	NA	NA			
		Central	5	0.21	488-1524	No Change	No Change	No Change	elev + region	0.1284	Lower–Upper Sonoran (L)
		Southern	0.4 3	0.59	636-2732	No Change	No Change	No Change			
11	<i>Peromyscus boylii</i>										
		Northern	0.8 5	0.99	79-1051	+89‡	No Change	Contract +L	era + elev + elev ² + region +		
		Central	0.8 8	0.88	183-2464	-126‡	No Change	Expand -L	elev*region + elev ² *region	0.5811	Upper Sonoran–Transition (L)
		Southern	0.9 7	0.99	118-3147	+20‡	-865	Contract -U			

12	<u><i>Thomomys bottae</i></u>	Northern Central Southern	75-1335 57-1676 118-3384	No Change No Change No Change	No Change No Change No Change	No Change No Change No Change	*Not subject to occupancy analyses	Lower Sonoran-Transition (L)
13	<u><i>Otospermophilus beecheyi</i></u>	Northern Central Southern	0.05 0.28 0.07	0.67 0.42 0.82	79-1051 61-2632 118-2997	No Change No Change No Change	+734 No Change -57‡	Expand +U No Change No Change
							era + elev + elev ² + era*elev + era*elev ²	0.1069
14	<u><i>Peromyscus maniculatus</i></u>	Northern Central Southern	0.94 0.95 0.99	0.99 0.93 0.99	79-2514 52-3281 118-3384	No Change No Change No Change	No Change No Change No Change	era + elev + elev ² + region + era*elev + era*elev ² + era*region + elev*region + elev ² *region + era*elev*region + era*elev ² *region n
								0.4195
15	<u><i>Sorex trowbridgii</i></u>	Northern Central Southern	0.49 0.65 0.76	0.68 0.68 0.69	1051-2061 1068-2286 1507-2373 (Modern)	No Change No Change Undetected Historical	No Change -54‡ Undetected Historical	No Change No Change New record Modern
							elev + elev ² + region	0.0988
16	<u><i>Tamias quadrimaculatus</i></u>	Northern Central Southern	NA 0.54 NA	NA 0.49 NA	NA 1494-2210 NA	NA No Change NA	NA No Change NA	elev + elev ² + region
								0.1681
17	<u><i>Sorex vagrans</i></u>	Northern	0.6	0.96	1335-	No Change	No Change	elev + region
								0.0963
								Transition-Canadian (H)

		2	2514						
	Central	NA	NA	NA	NA	NA	NA		
	Southern	NA	NA	NA	NA	NA	NA		
18	<i>Tamias senex</i>								
	Northern	0.5 5	0.99	1478- 2462	No Change	No Change	No Change	elev + elev ² + region	0.2866
	Central	0.8 7	0.49	1402- 2743	+981	-360	Contract +L-U		Canadian (H)
	Southern	NA	NA	NA	NA	NA	NA		
*1 9	<i>Tamiasciurus douglasii</i>								
	Northern			886-2061 1229-	No Change	+430	Expand +U	*Not subject to occupancy analyses	
	Central			3185 1592-	No Change	No Change	No Change		Transition-Hudsonian (H)
	Southern			3384	No Change	No Change	No Change		
20	<i>Zapus princeps</i>								
	Northern	0.7 8	0.87	1478- 2462	+138	No Change	Contract +L	elev + elev ² + region	0.1800
	Central	0.9 2	0.86	1211- 3281	+213	No Change	Contract +L		Transition-Hudsonian (H)
	Southern	0.9 2	0.85	1592- 2657	+821	+583	Shift +LU		
21	<i>Microtus montanus</i>								
	Northern	0.7 7	0.92	1335- 1784	+133	+66‡	Shift +L	elev + elev ² + region + elev*region + elev ² *region	0.6766
	Central	0.6 5	0.90	1211- 3161	No Change	No Change	No Change		Transition-Hudsonian (H)
	Southern	0.9 5	0.89	1984- 3384	No Change	No Change	No Change		
22	<i>Microtus longicaudus</i>								
	Northern	0.9 5	0.84	1672- 2462	-204	No Change	Expansion	elev + elev ²	0.2043
	Central	0.9 4	0.81	583-3281	+644	No Change	Contract +L		Transition-Hudsonian (H)
	Southern	0.9 9	0.88	1529- 3474	+638	No Change	Contract +L		
*2 3	<i>Thomomys monticola</i>							*Not subject to occupancy analyses	Canadian-Hudsonian (H)

				3353						
			Southern	2268-3503	No Change	No Change	No Change			
29	<i>Urocitellus beldingi</i>									
			Northern	0.7 1	0.88 1485-1845	No Change	-217	Contract -U	elev + elev ² + region + elev*region + elev ² *region	0.1967 Canadian–Arctic-Alpine (H)
			Central	0.7 4	0.66 2286-3281	+399	No Change	Contract +L		
			Southern	0.8 6	2761-3474	+555	No Change	Contract +L		
30	<i>Callospermophilus lateralis</i>									
			Northern	0.6 0	0.89 1561-3124	No Change	No Change	No Change	era + elev + elev ² + region	0.1752 Transition-Hudsonian (H)
			Central	0.6 1	1646-3200	+305	No Change	Contract +L		
			Southern	0.8 3	2147-3474	+115‡	No Change	Contract +L		
31	<i>Sorex monticolus</i>									
			Northern	0.5 9	0.67 NA	NA	NA	NA	era + elev + elev ² + region	0.1349 Canadian–Hudsonian (H)
			Central	0.7 4	0.68 2176-3281	-971	No Change	Expand -L		
			Southern	0.8 4	1529-3474	No Change	No Change	No Change		
*3	<i>Ochotona princeps</i>									
2					1478-2514	No Change	No Change	No Change	*Not subject to occupancy analyses	Canadian–Arctic-Alpine (H)
			Northern		2377-					
			Central		3871	No Change	No Change	No Change		
			Southern		2732-3384	No Change	No Change	No Change		
33	<i>Tamias alpinus</i>									
			Northern	NA 0.8	NA 2386-	NA	NA	NA	era + elev + region	0.0603 Hudsonian–Arctic-Alpine (H)
			Central	6	3353	+497	No Change	Contract +L		
			Southern	0.9 2	2314-3503	+471	No Change	Contract +L		

237 §Detectability (p) for the historical (H) and modern (M) era is the average detectability of a given species over all sites within that region.

238 †The best performing occupancy model is given with the corresponding AICc weight.

239 ¶Historical life zone was used to determine whether a species was classified as a low elevation species (L), high elevation species (H) or widespread species
240 (W) following Moritz et al.⁴.

241 Species not subject to occupancy modelling are designated with an asterisk (*) and those with a statistically significant, but biologically trivial limit shift (i.e.,
242 <10% of the species' historical elevation range and <100 meters in elevation; see Methods) are represented by a double dagger (‡).

243 **Supplementary Table S5. Model parameterizations of detectability (p) and occupancy**
244 **(ψ) run for each species with quantifiable trapping effort data (see Supplementary**
245 **Table S2 for list of modelled species).**

Detectability models (p)

1. null
2. Era+LogT+Era*LogT+T100+Time
3. Era+LogT+Era*LogT+Time+Era*Time+T100
4. Era+LogT+Era*logT+Time+Era*Time
5. Era+logT+Era*logT+Time
6. Era+logT+Time
7. Era+T100+Era*T100+logT+Era*logT+Time
8. Era+T100+Era*T100+logT+Time
9. Era+T100+Era*T100+Time+Era*Time
10. Era+T100+Era*T100
11. Era+Time+Era*Time+logT
12. Era+Time+Era*Time+T100+logT
13. T100+logT+Time
14. T100+Time
15. Time
16. Era+T100+Era*T100+logT+Era*logT+Time+Era*Time

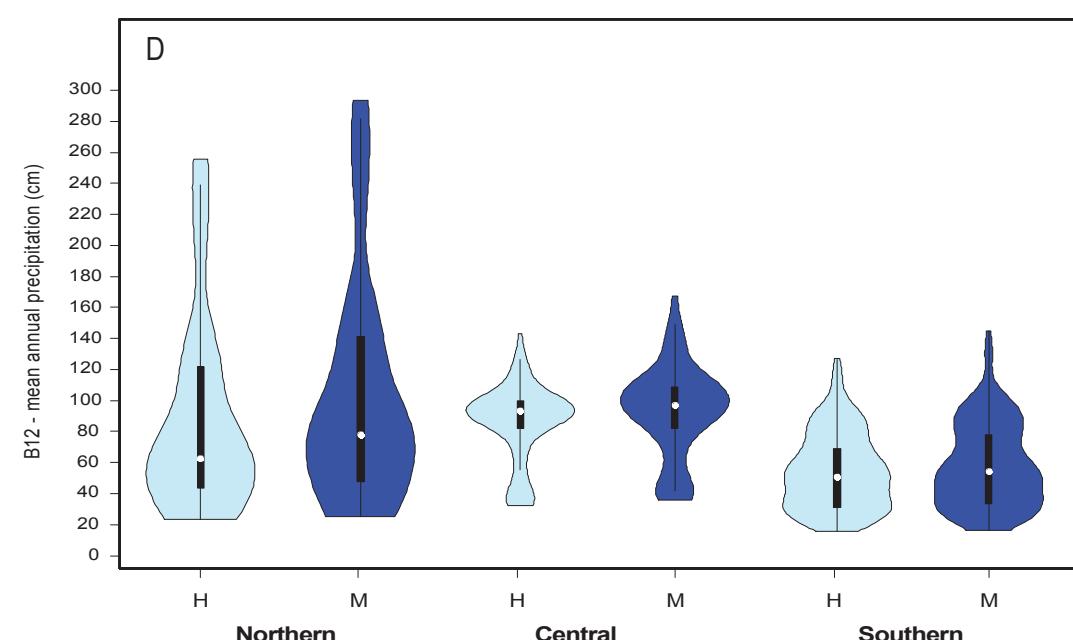
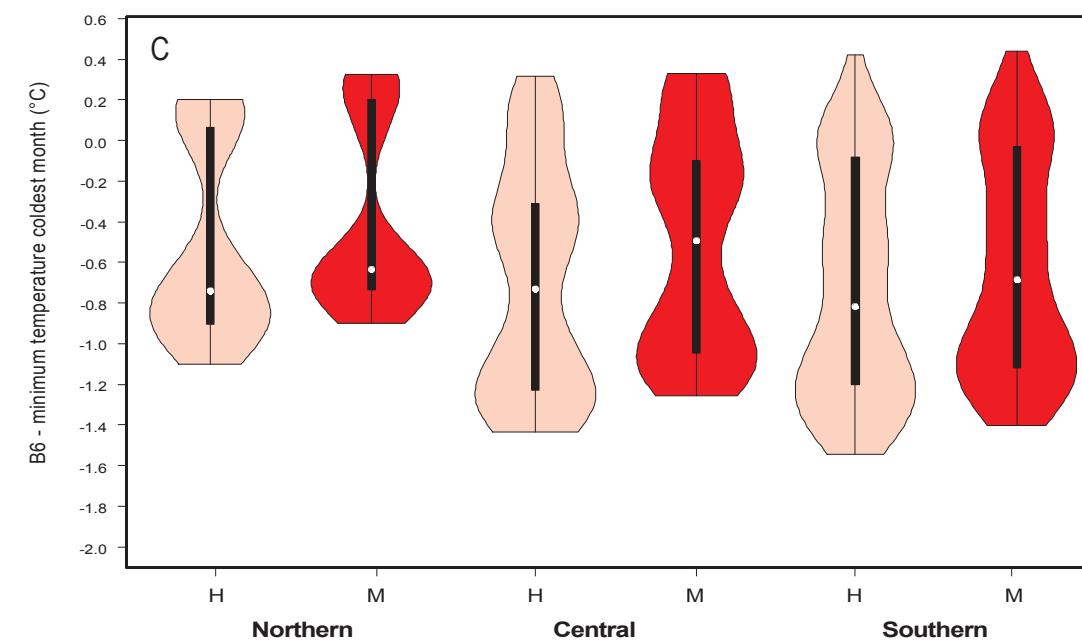
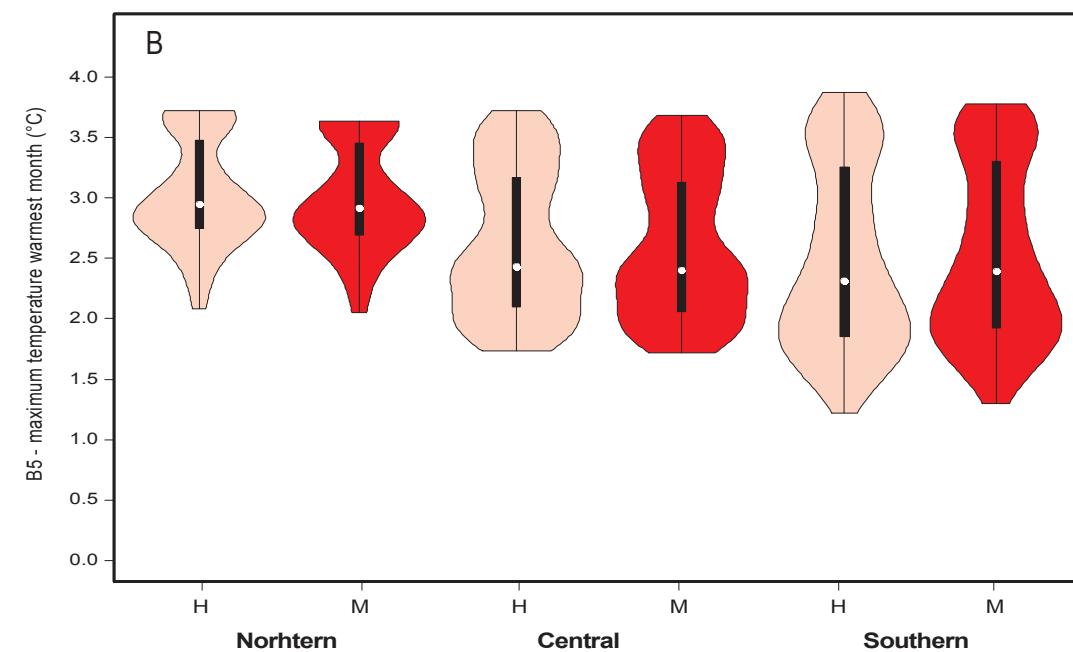
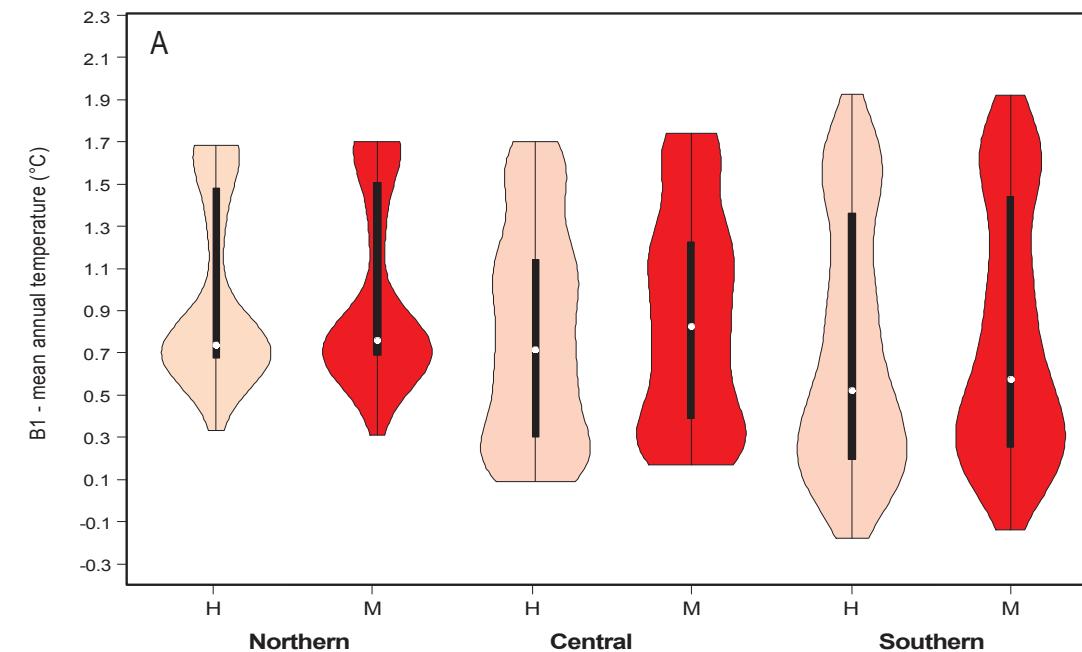
Occupancy models (ψ)

1. null
2. Era
3. Elev
4. Elev+Elev²
5. Region
6. Era+Elev
7. Era+Elev+Elev²
8. Era+Elev+Era*Elev
9. Era+Elev+Elev²+Era*Elev+Era*Elev²
10. Era+Region
11. Era+Region+Era*Region
12. Elev+Region
13. Elev+Elev²+Region
14. Elev+Region+Elev*Region
15. Elev+Elev²+Region+Elev*Region+Elev²*Region
16. Era+Elev+Region
17. Era+Elev+Elev²+Region
18. Era+Elev+Region+Era*Elev

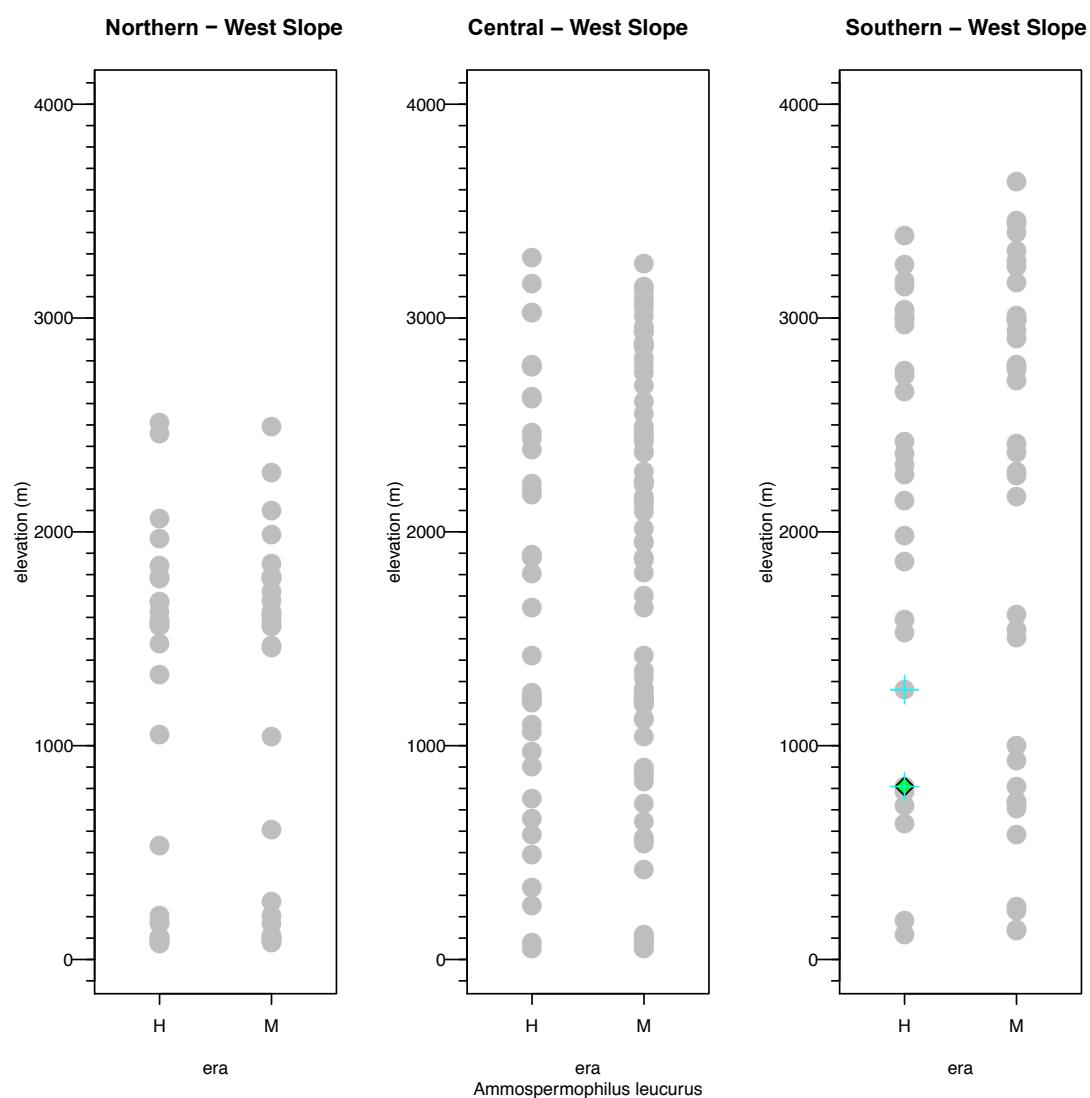
19. Era+Elev+Elev²+Region+Era*Elev+Era*Elev²
 20. Era+Elev+Region+Elev*Region
 21. Era+Elev+Elev²+Region+Elev*Region+Elev²*Region
 22. Era+Elev+Region+Era*Region
 23. Era+Elev+Elev²+Region+Era*Region
 24. Era+Elev+Region+Era*Elev+Era*Region+Elev*Region+Era*Elev*Region
 25. Era+Elev+Elev²+Region+Era*Elev+Era*Elev²+Era*Region+Elev*Region+Elev²*Region+Era*Elev*Region+Era*Elev²*Region
-

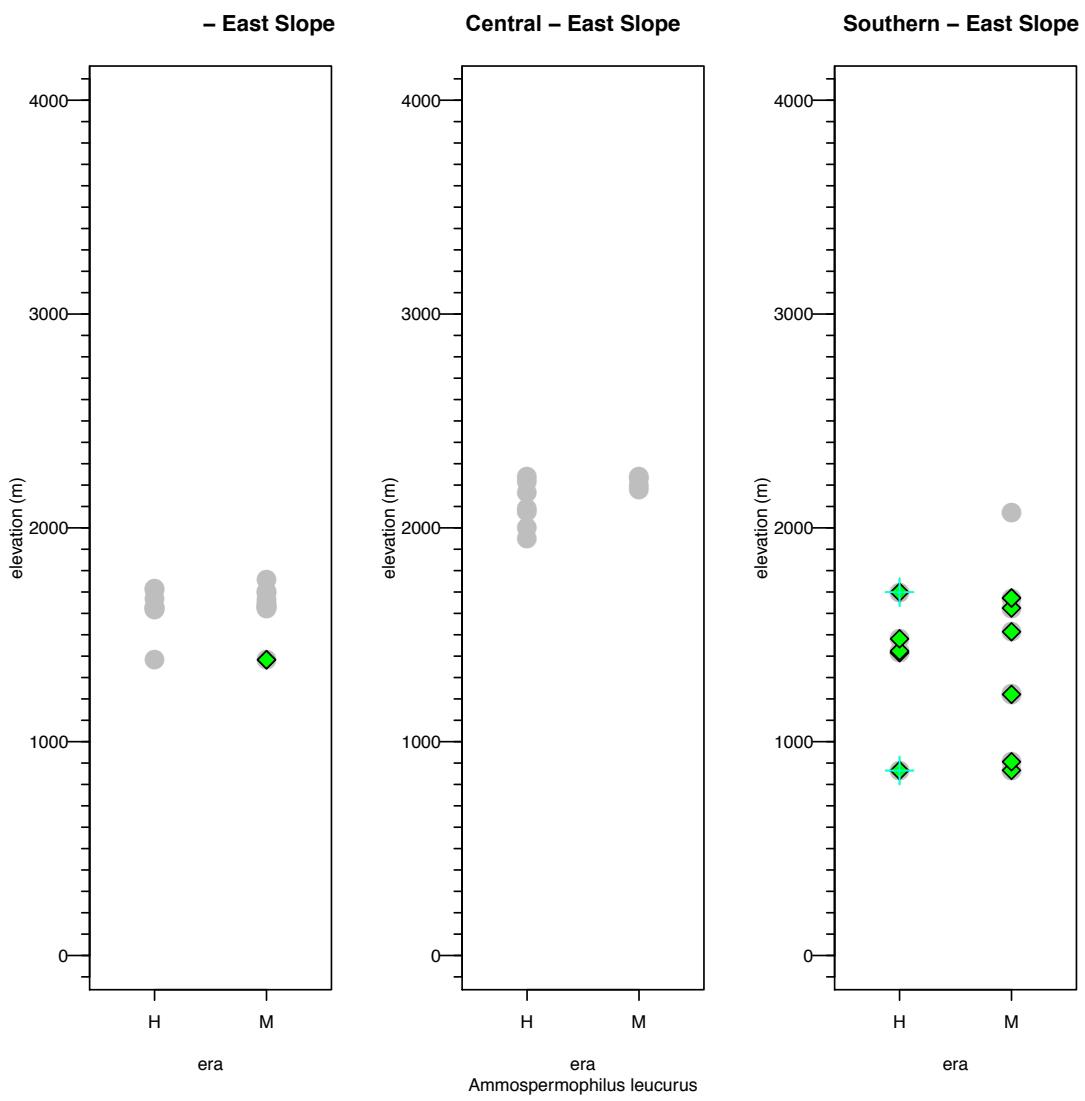
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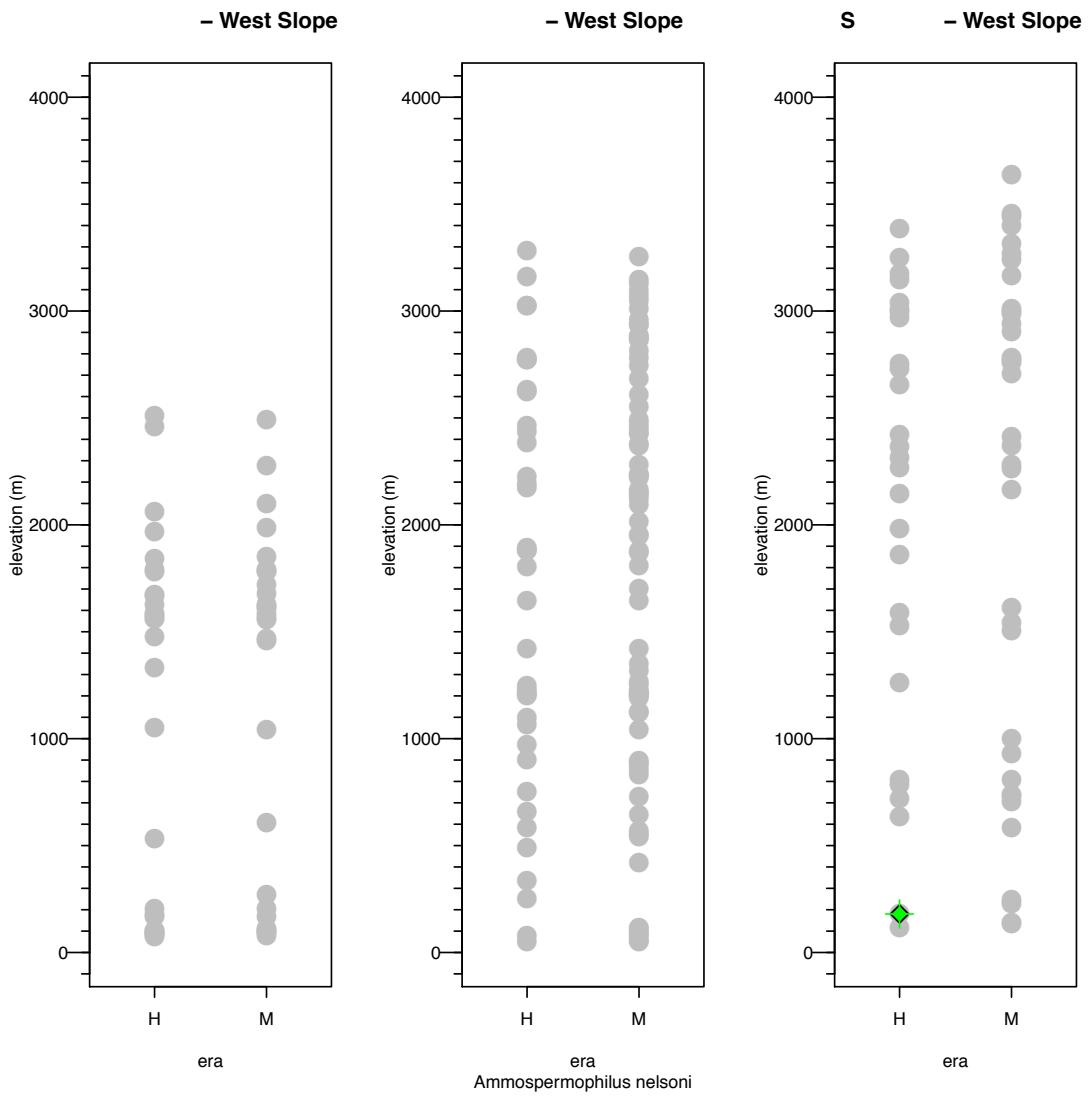
Supplementary Figure S1.

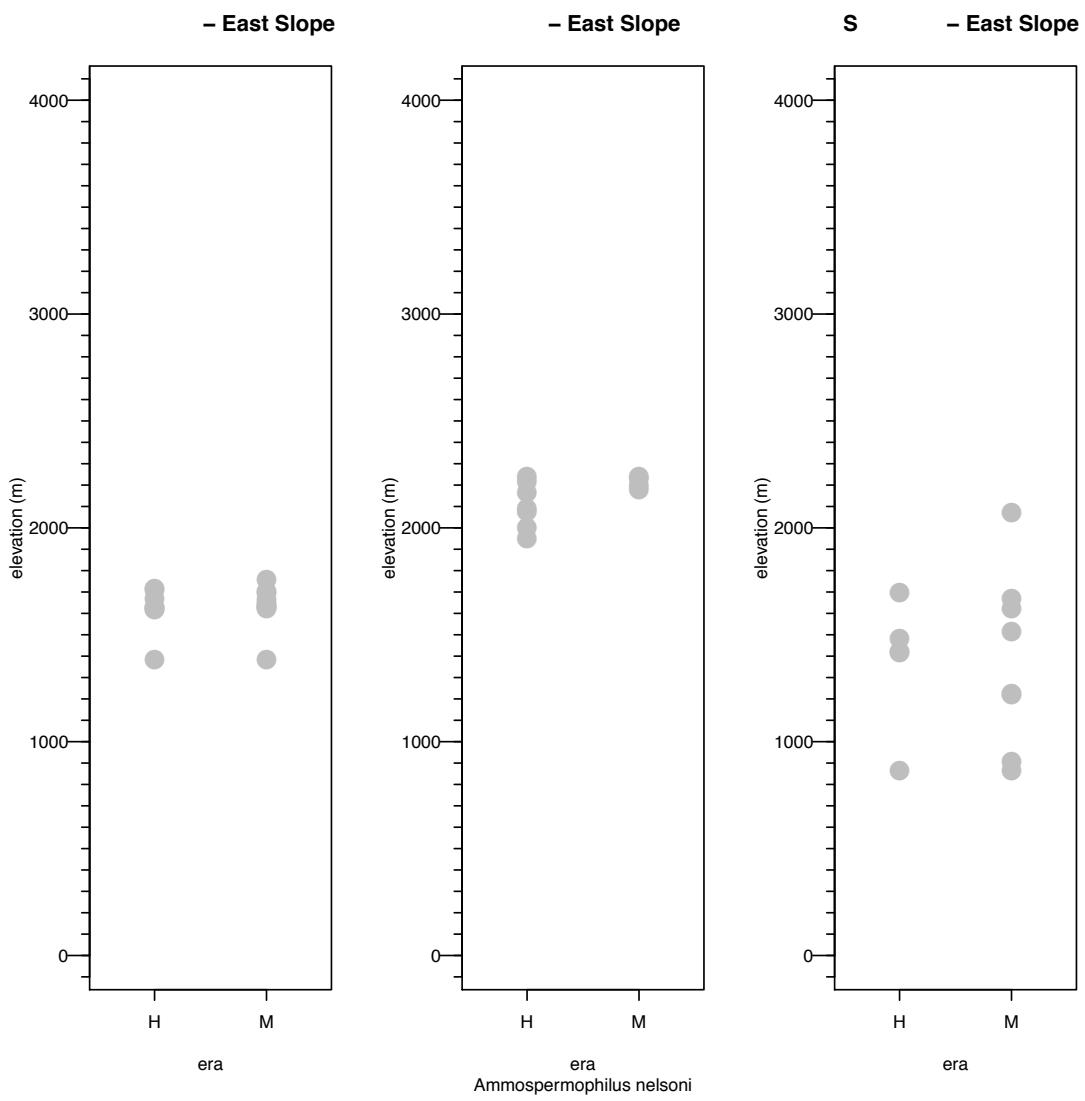


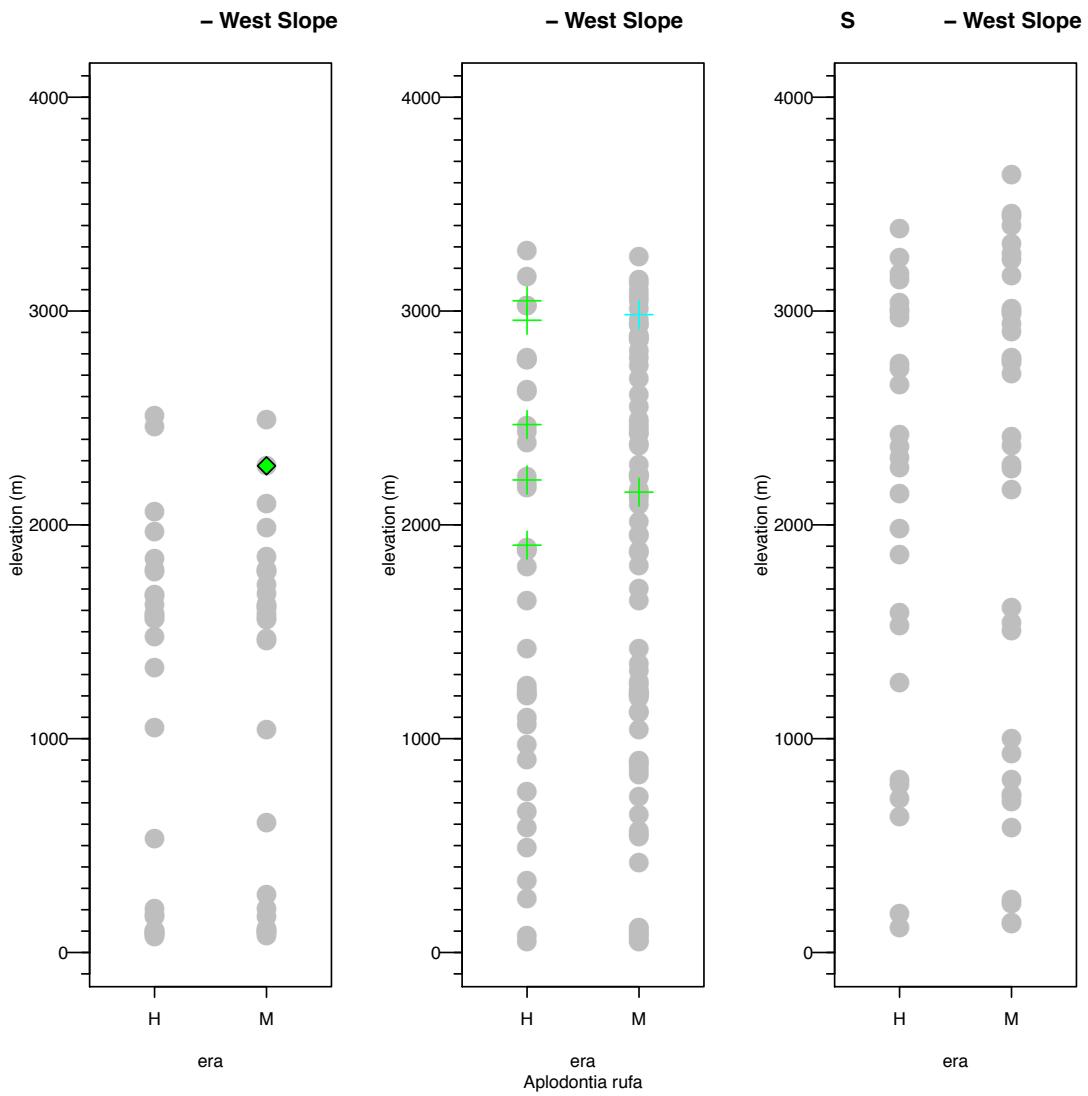
Supplementary Figure S2.

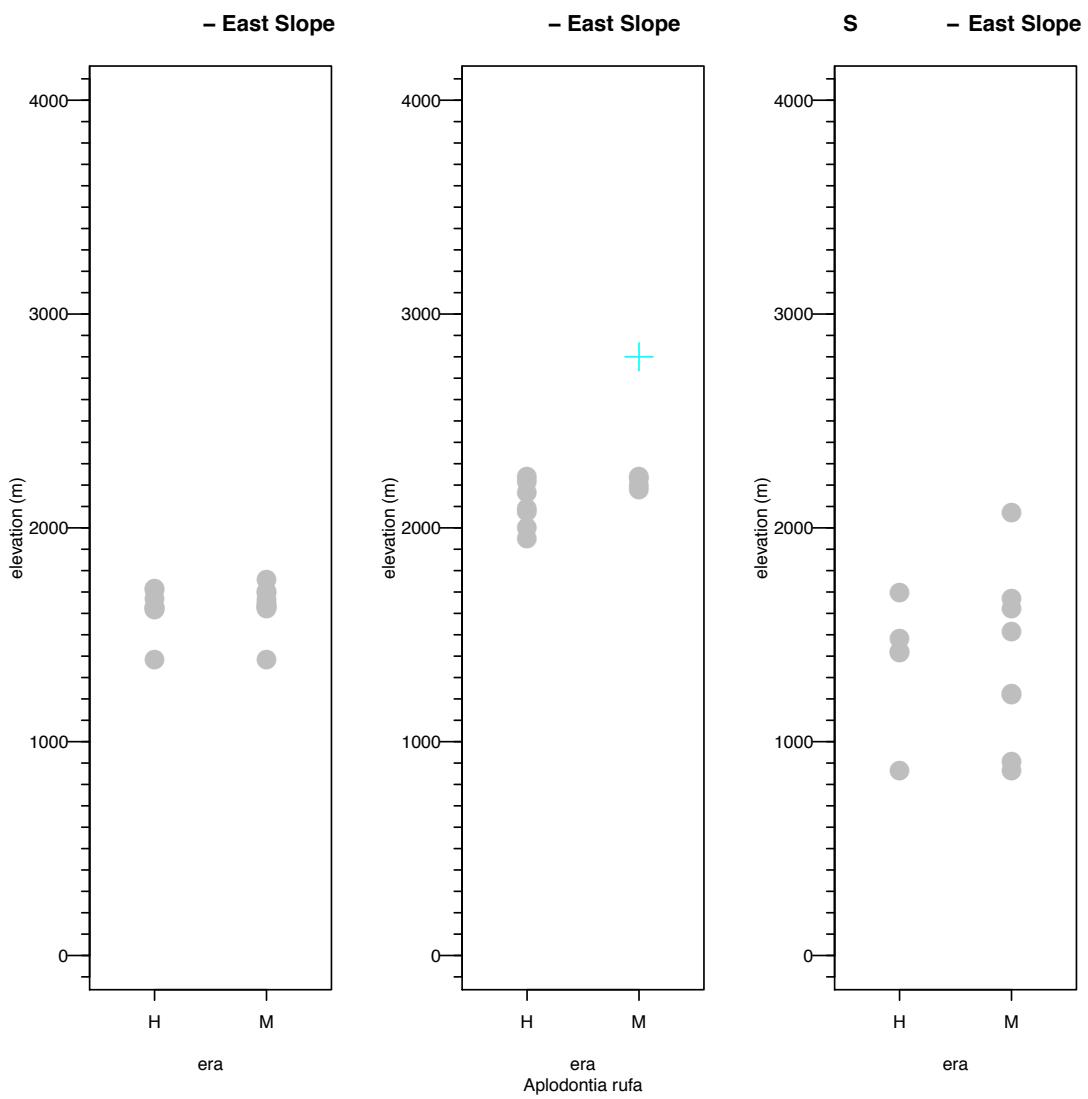


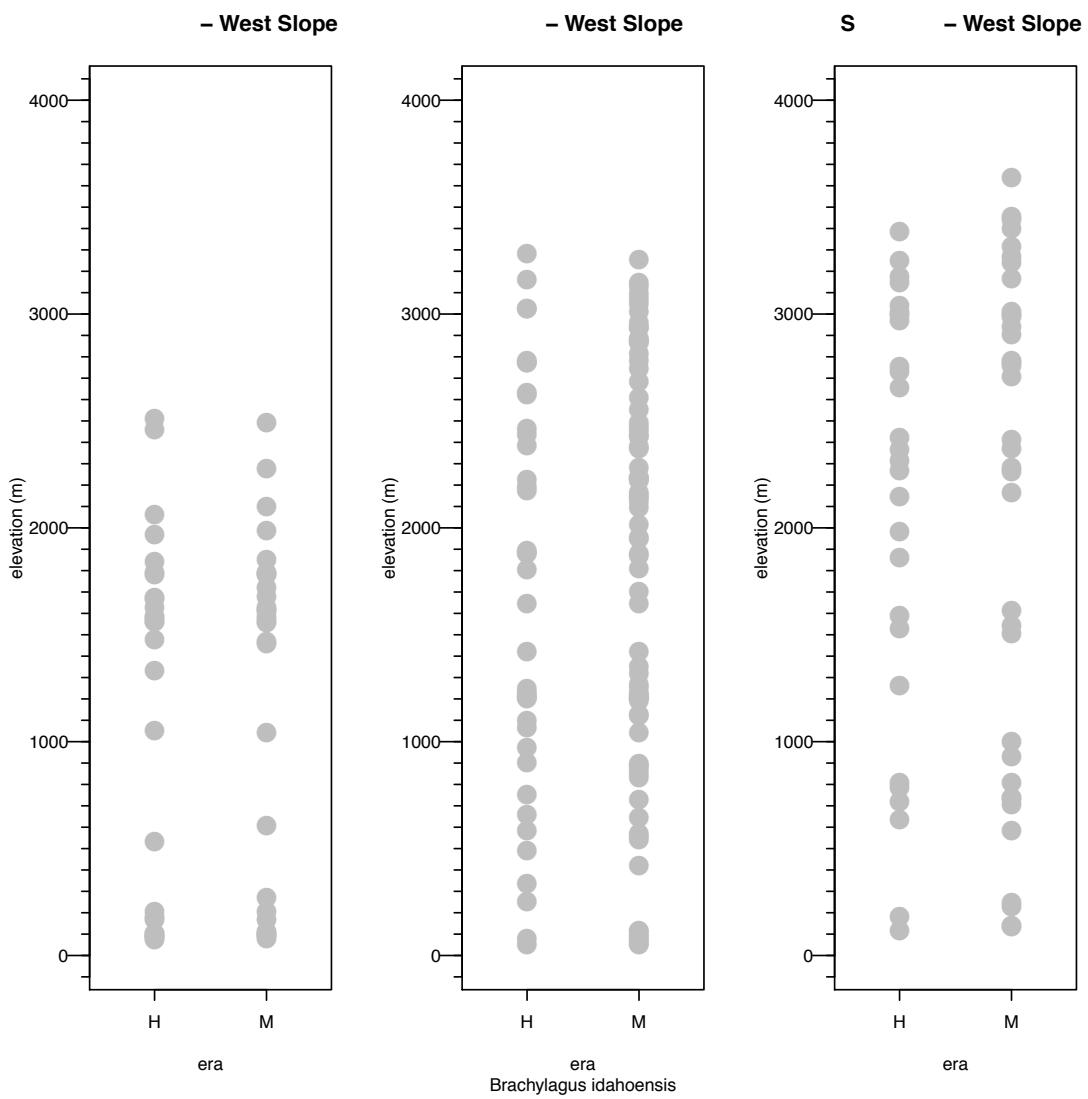


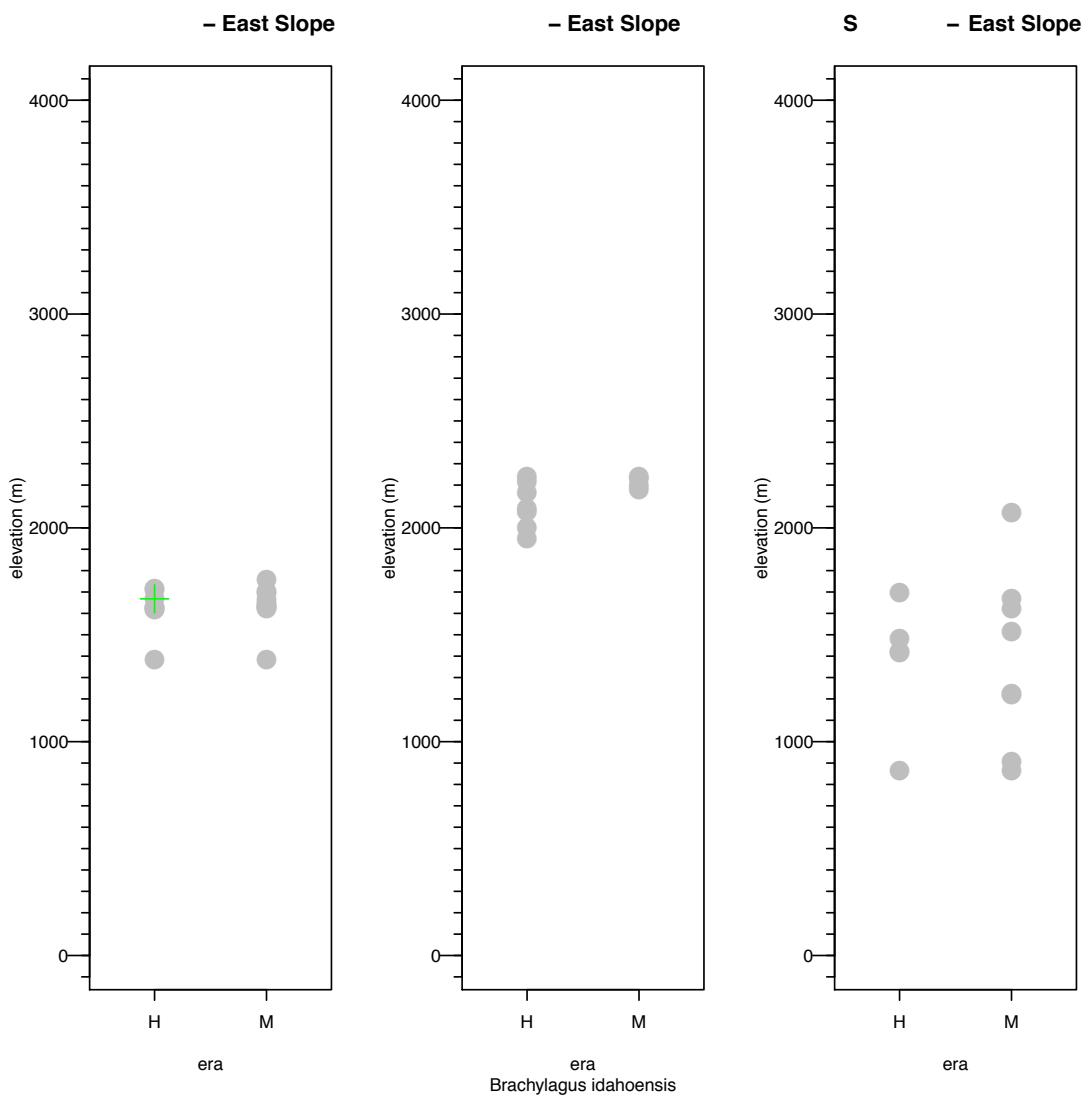


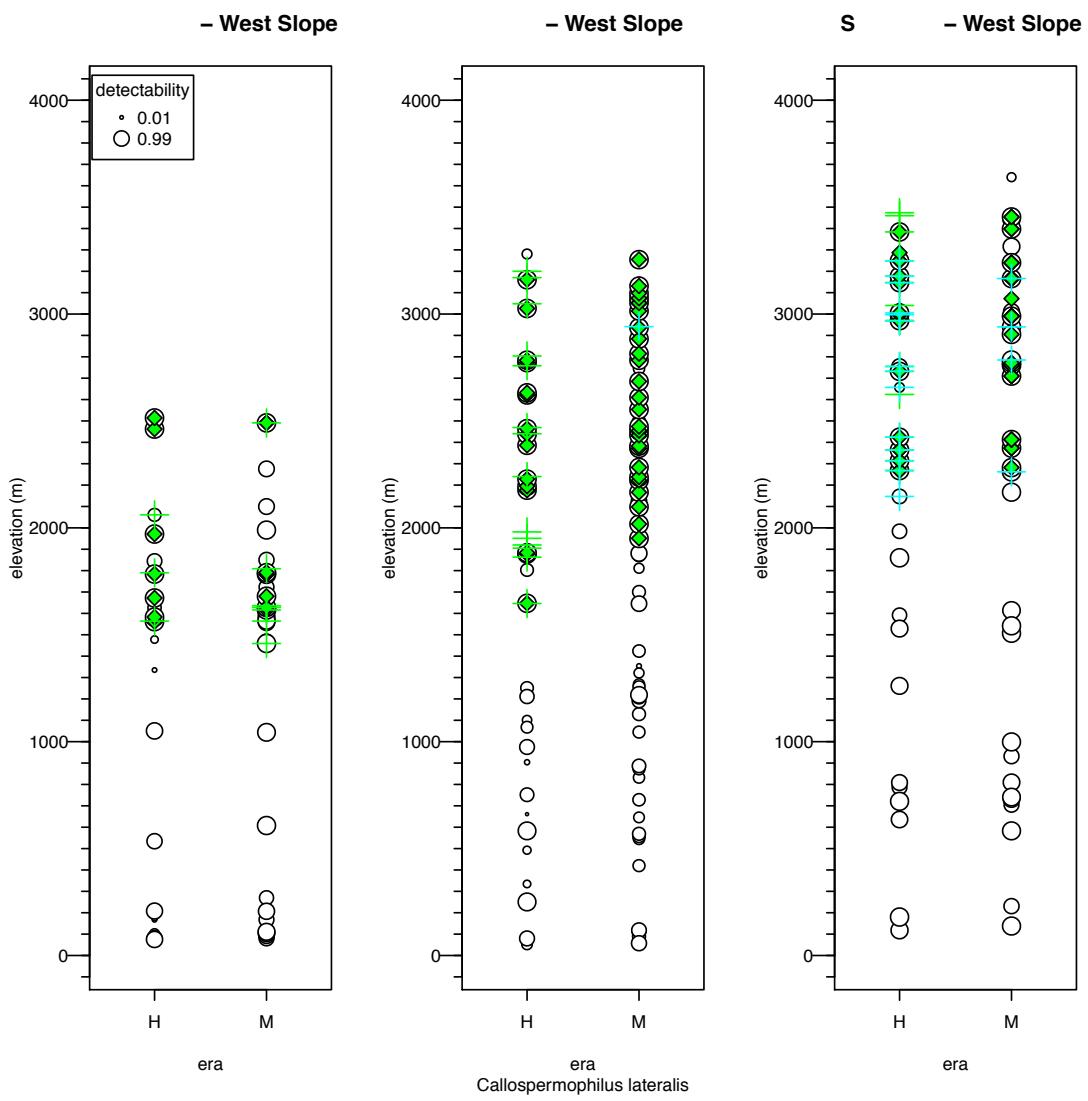


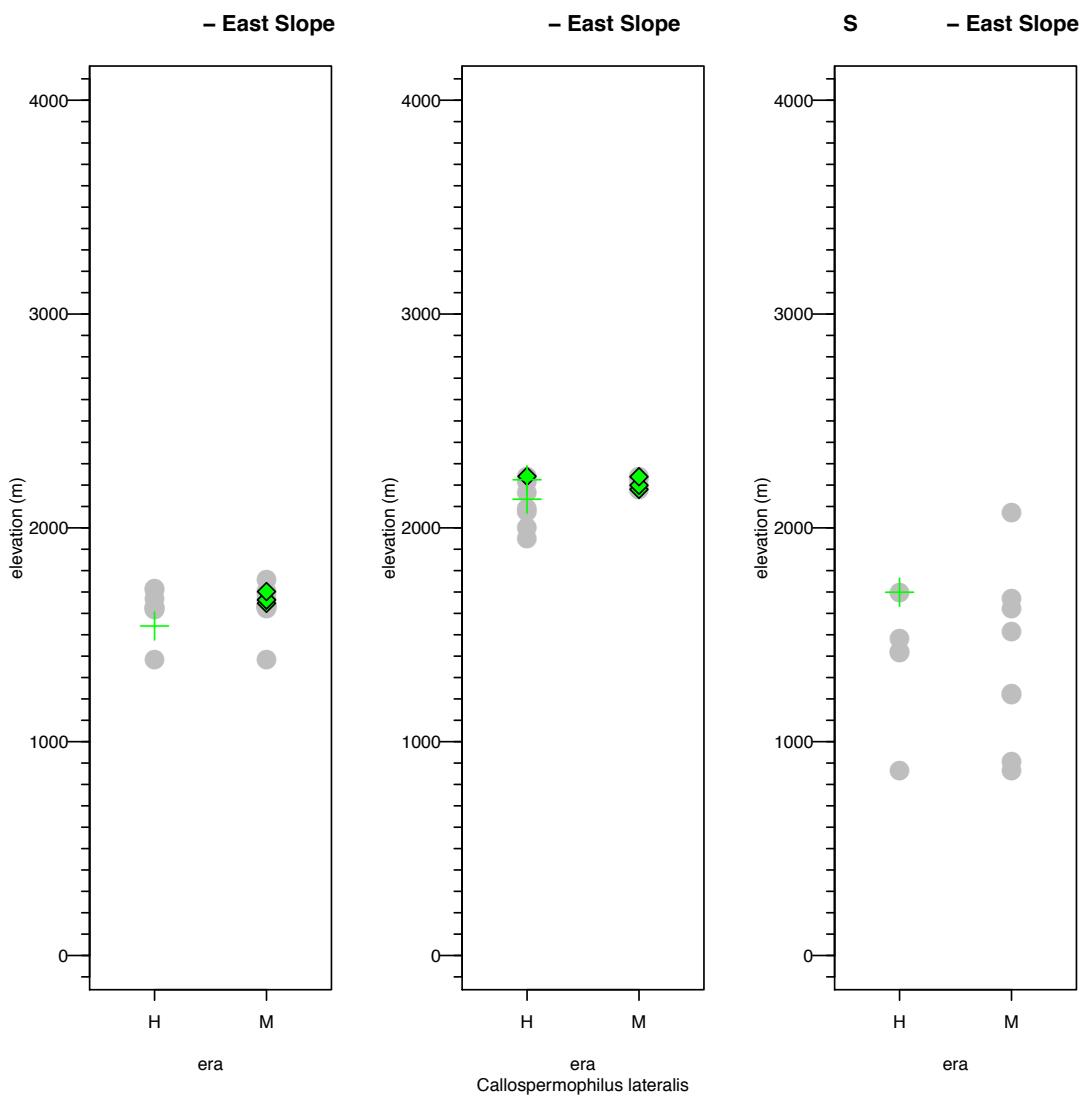


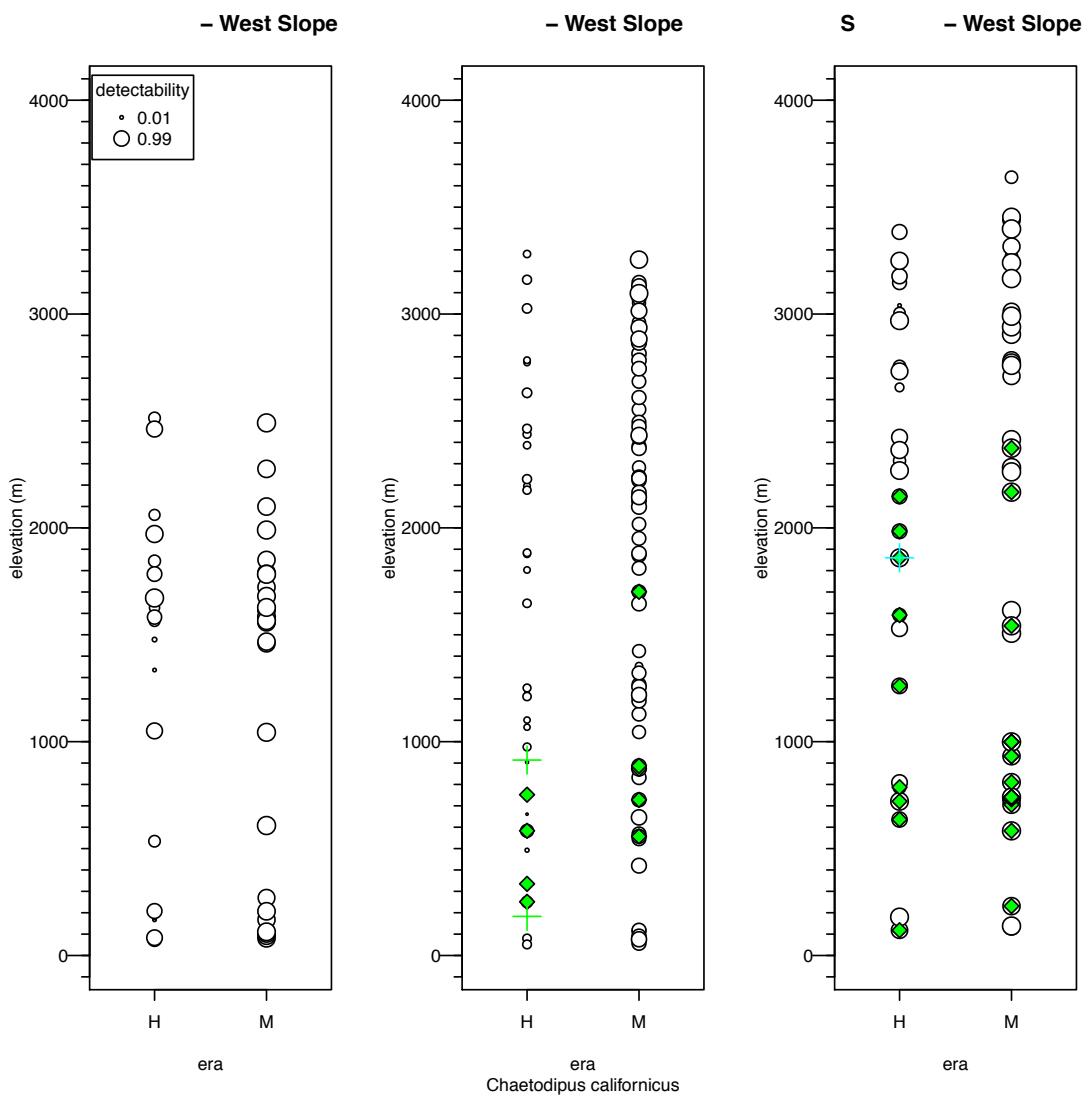


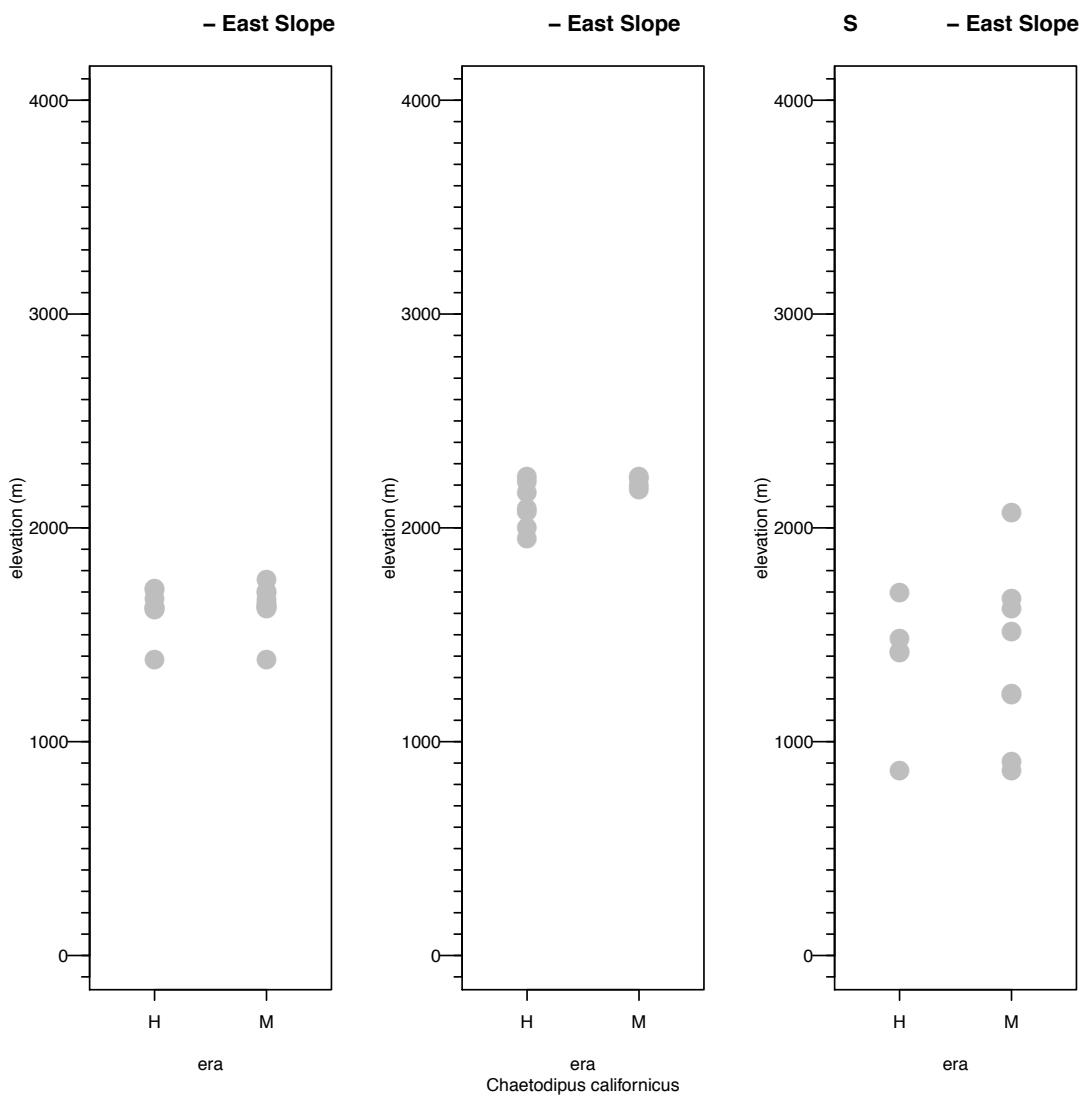


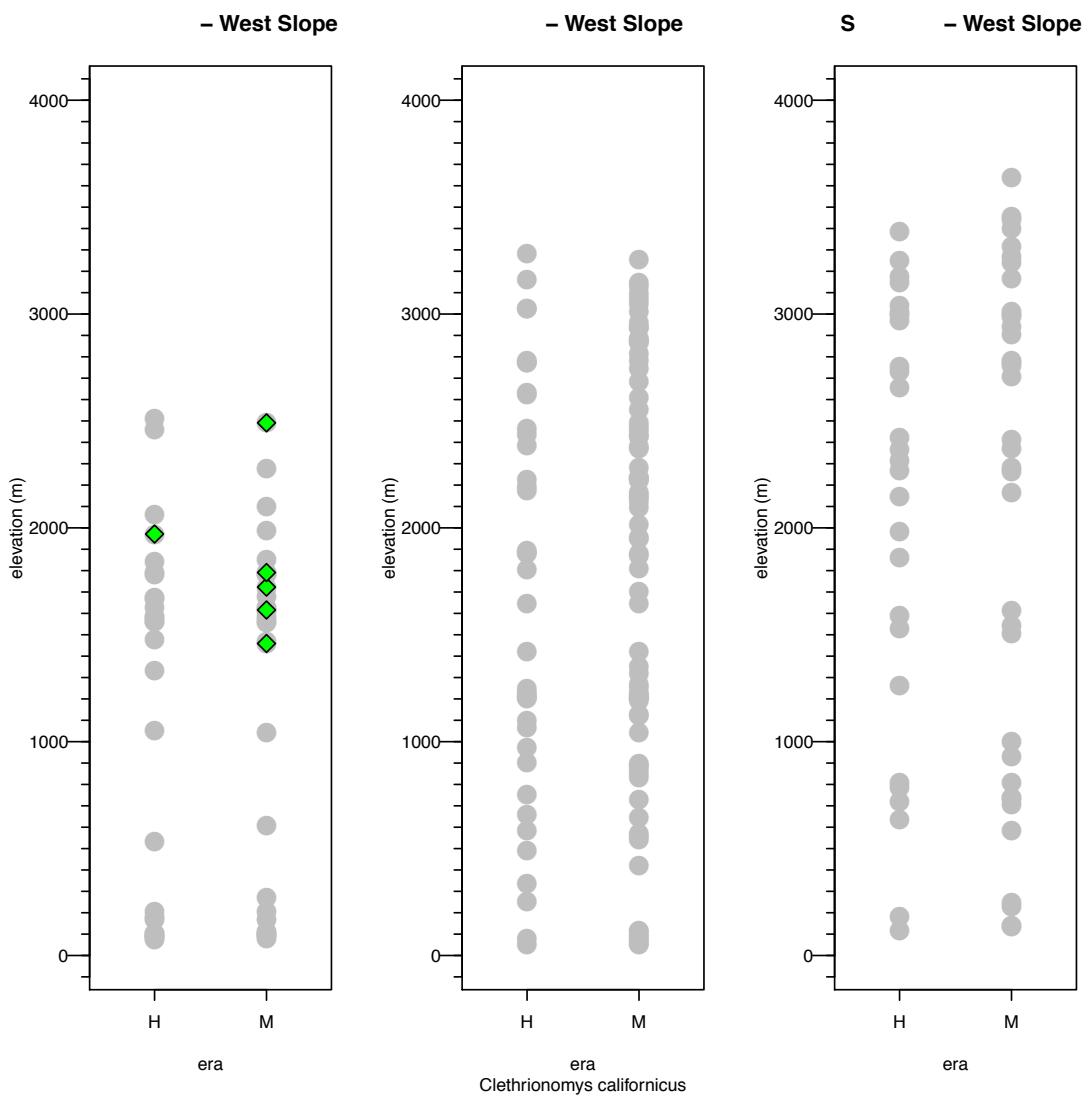


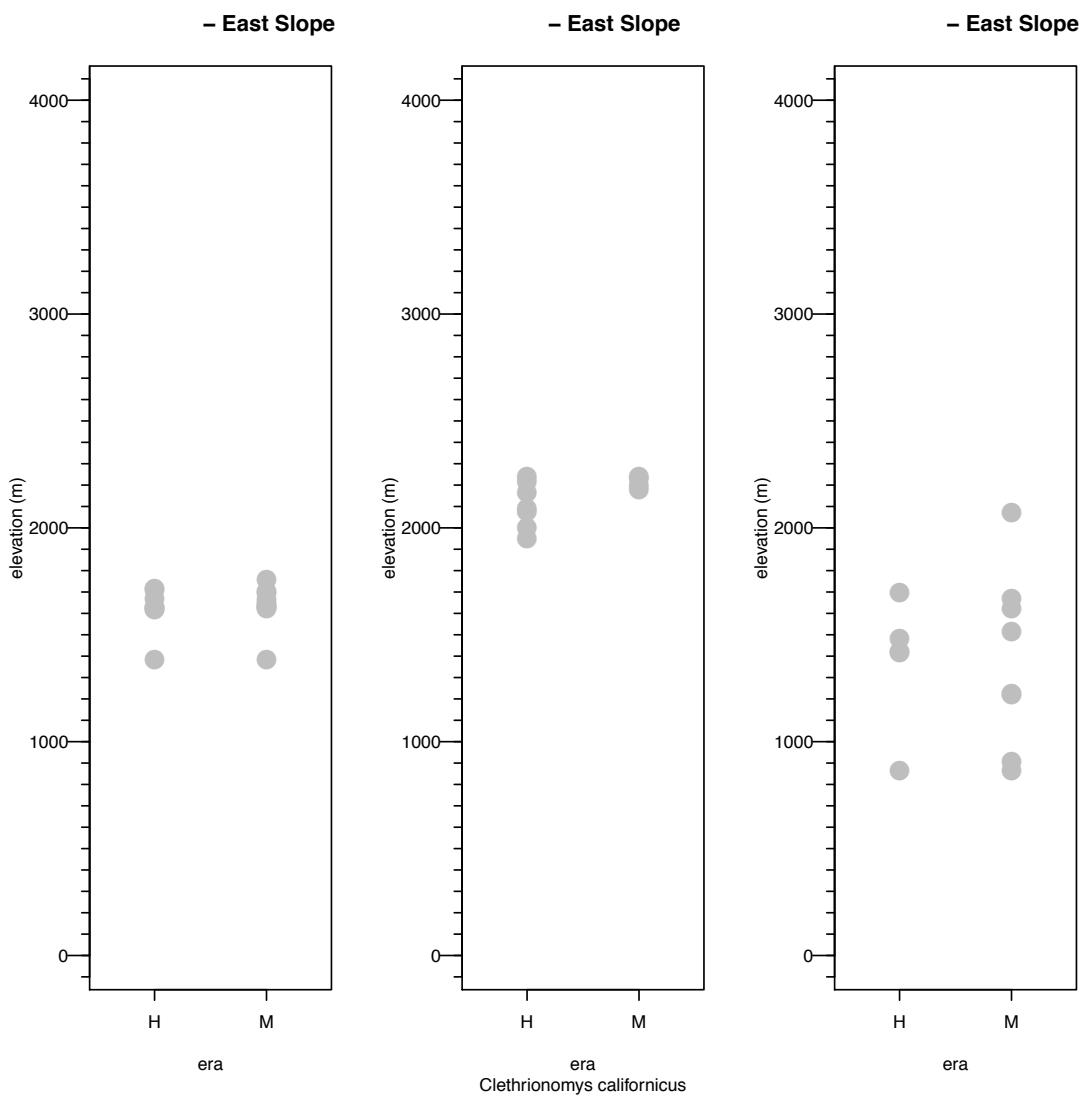


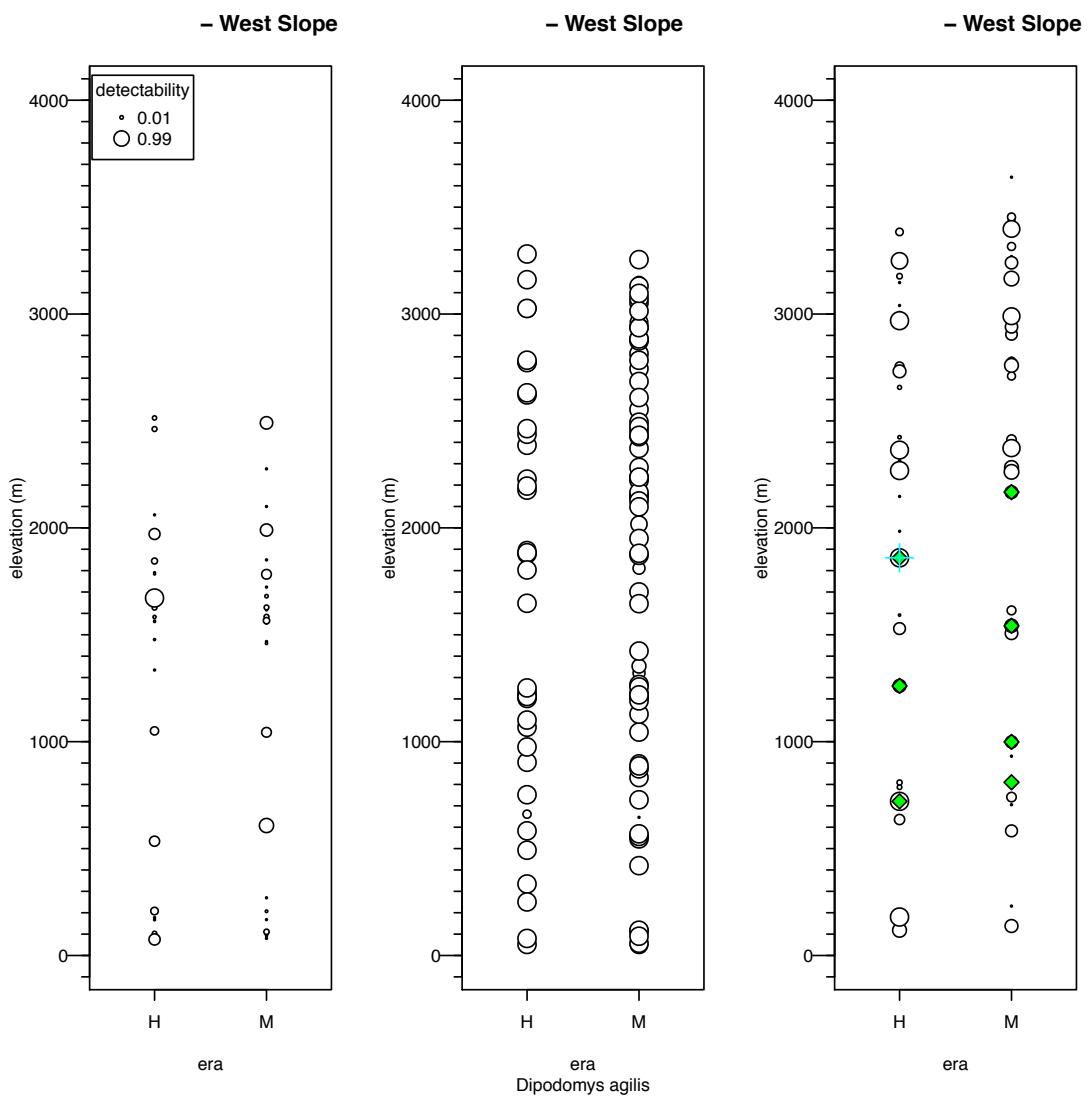


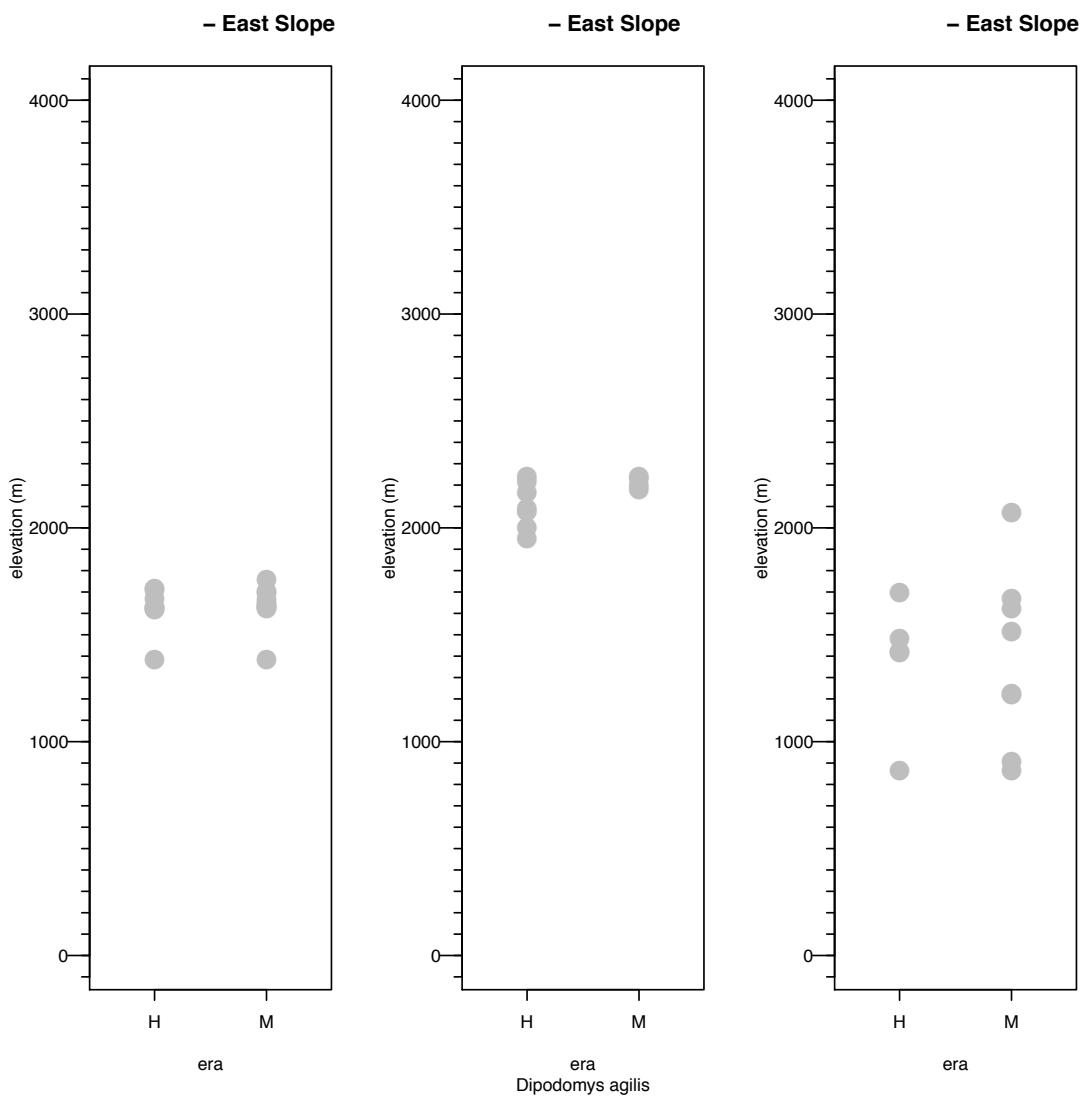


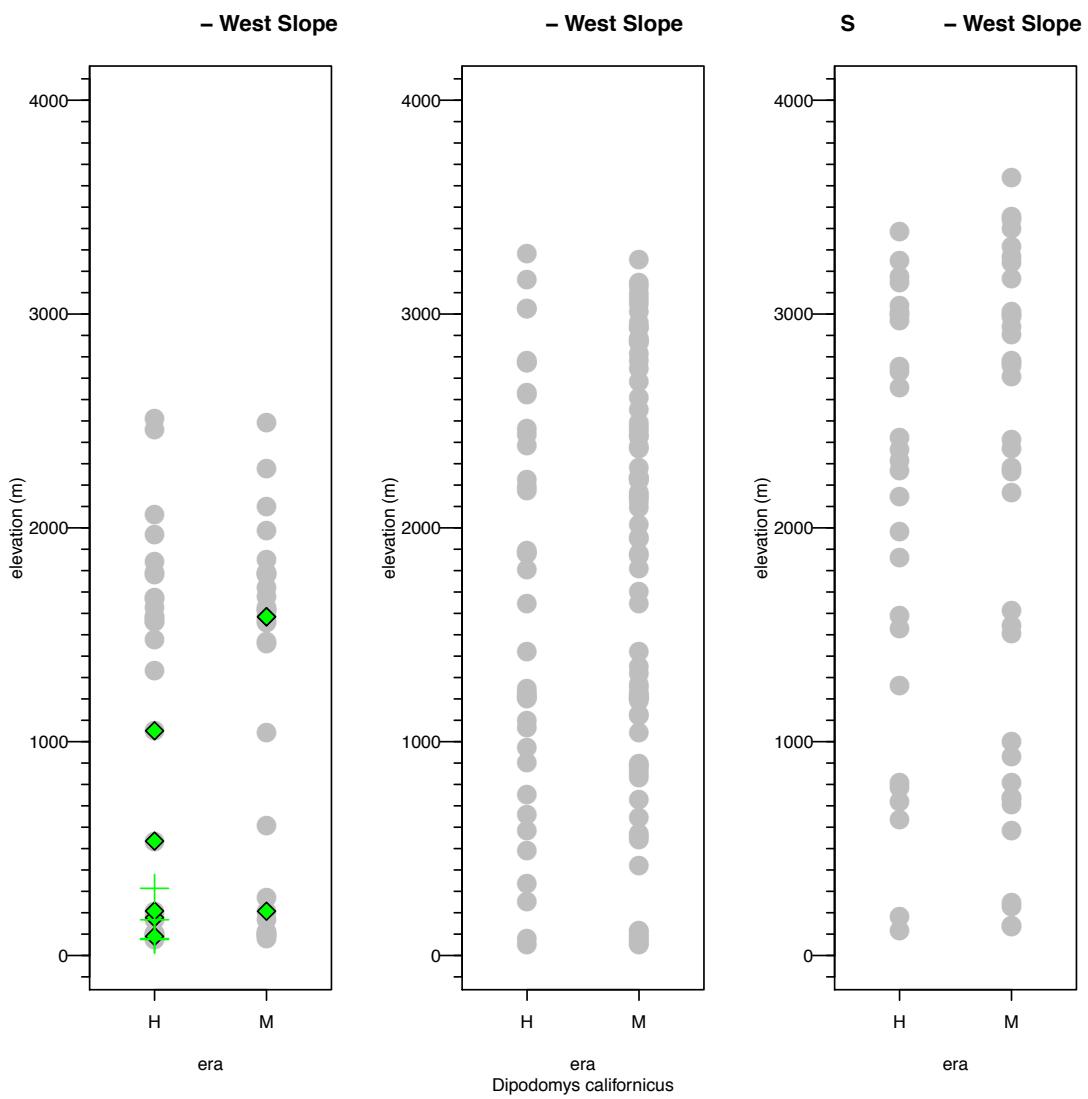


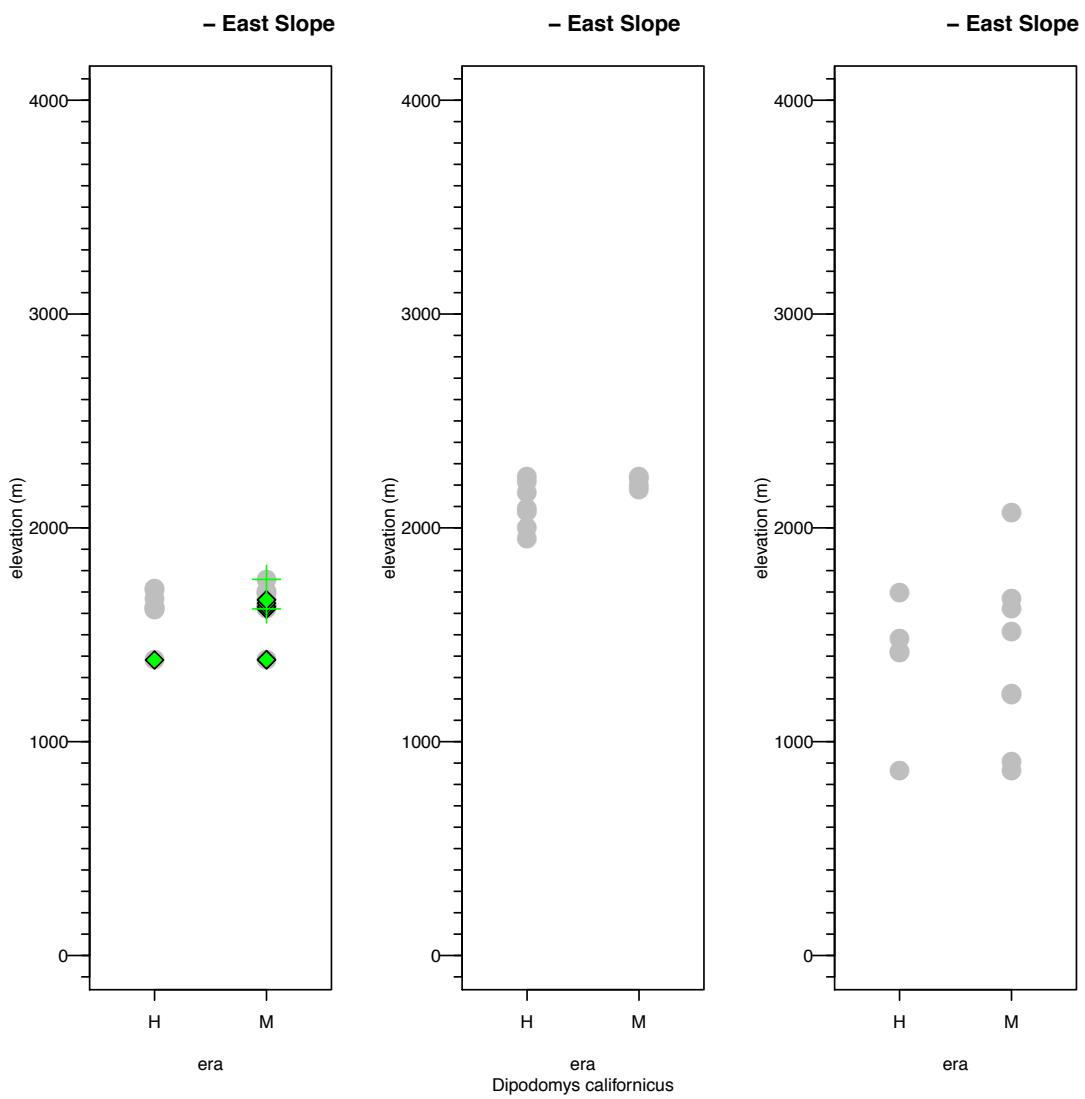


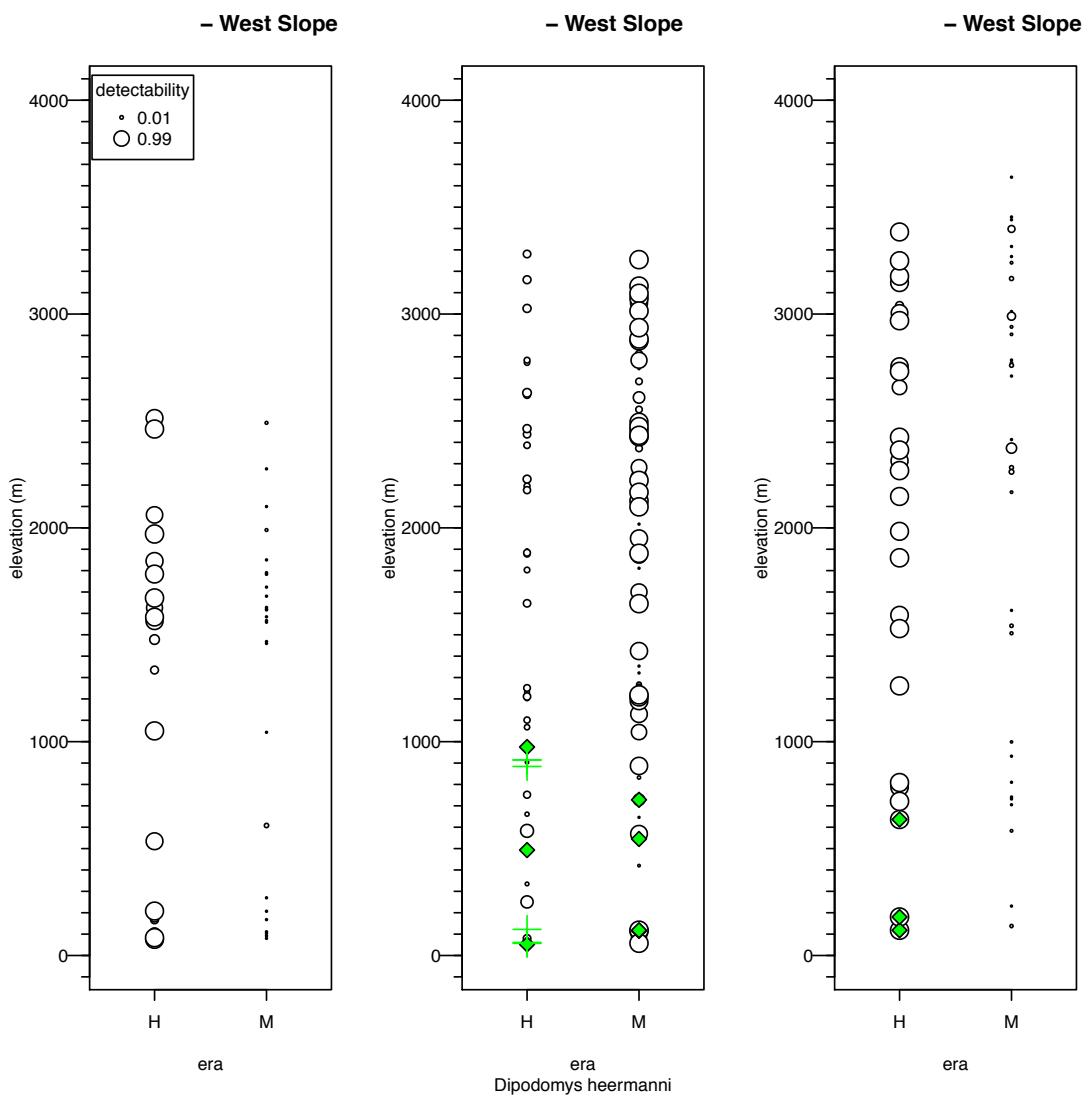


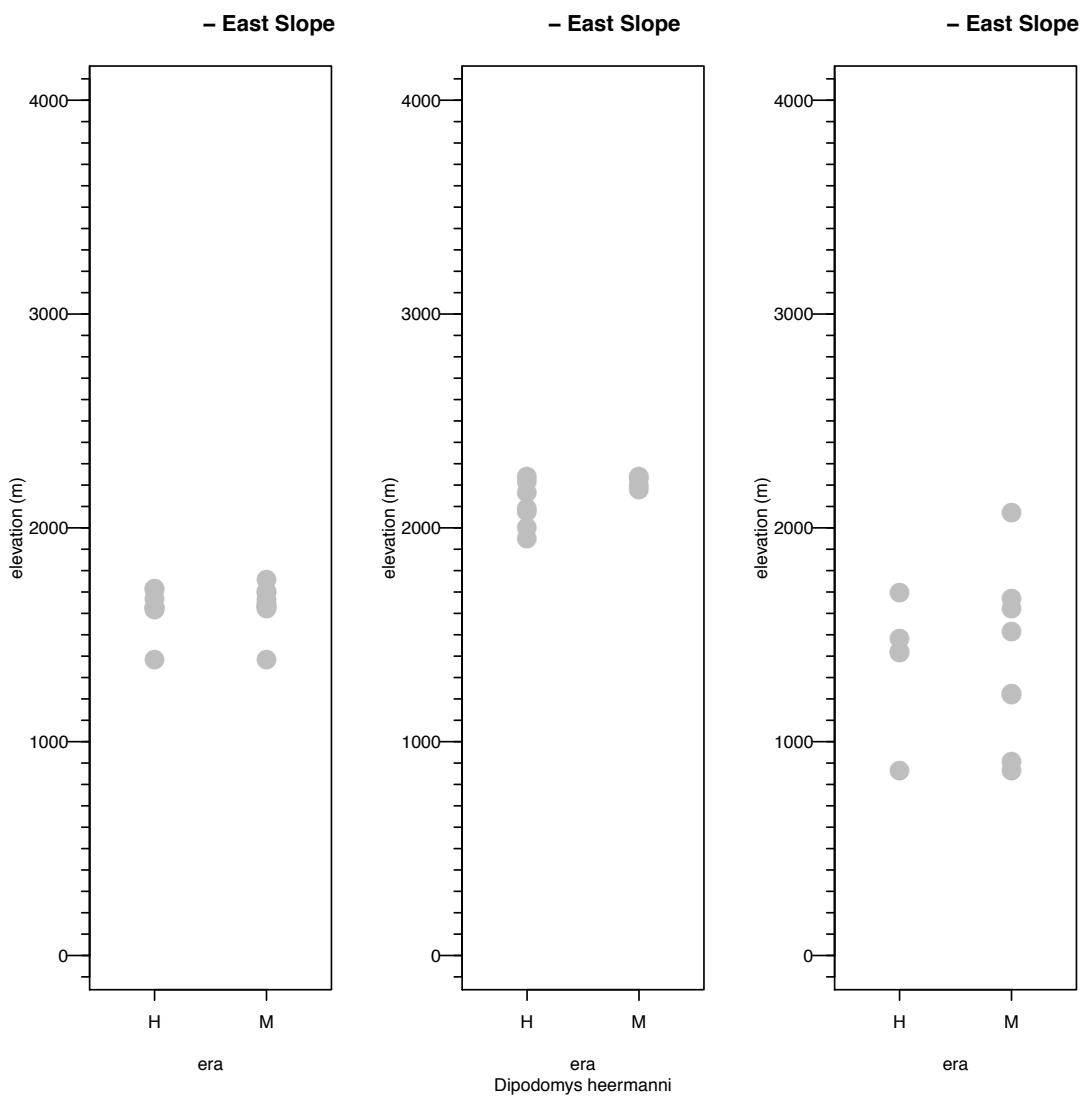


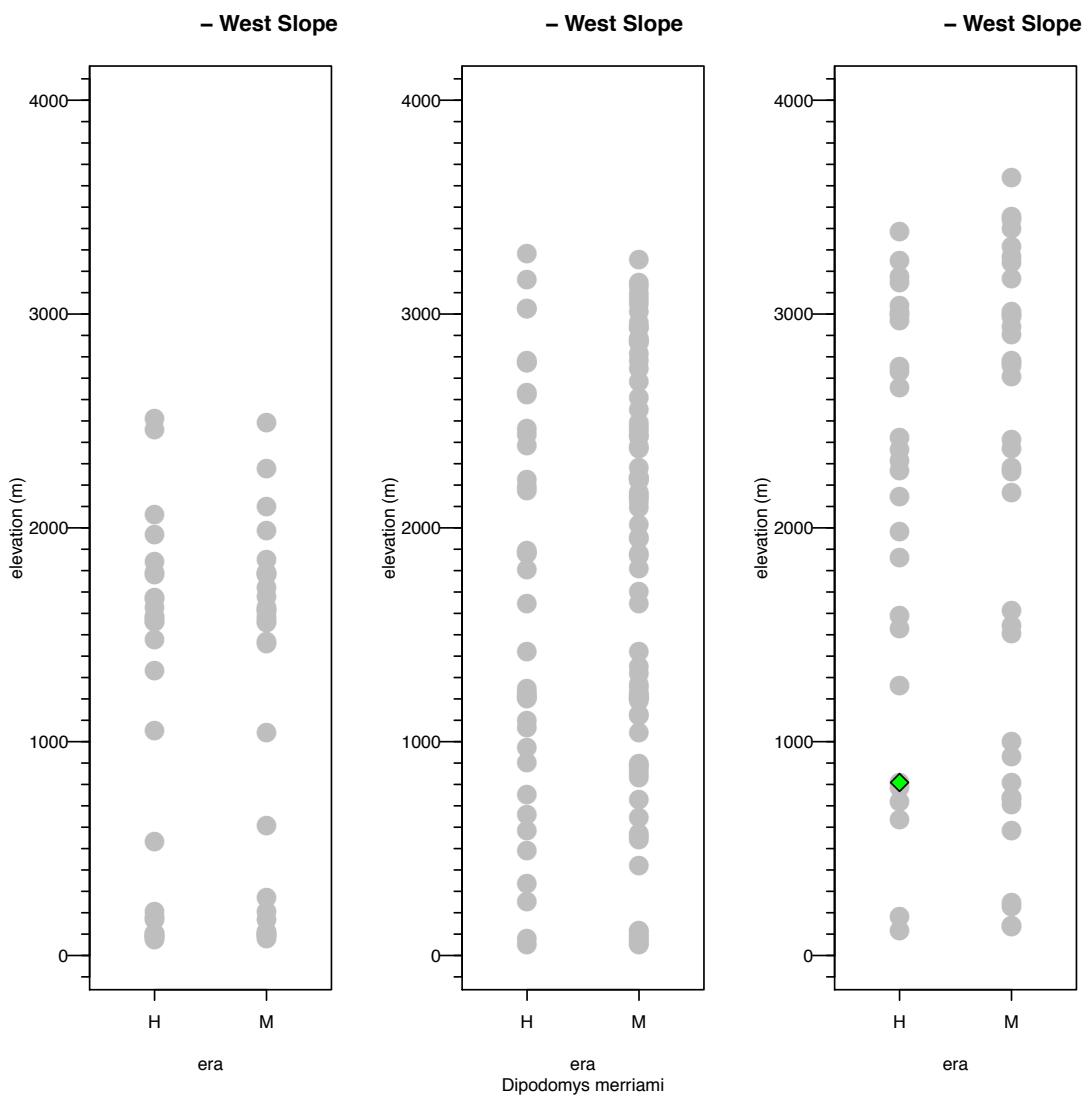


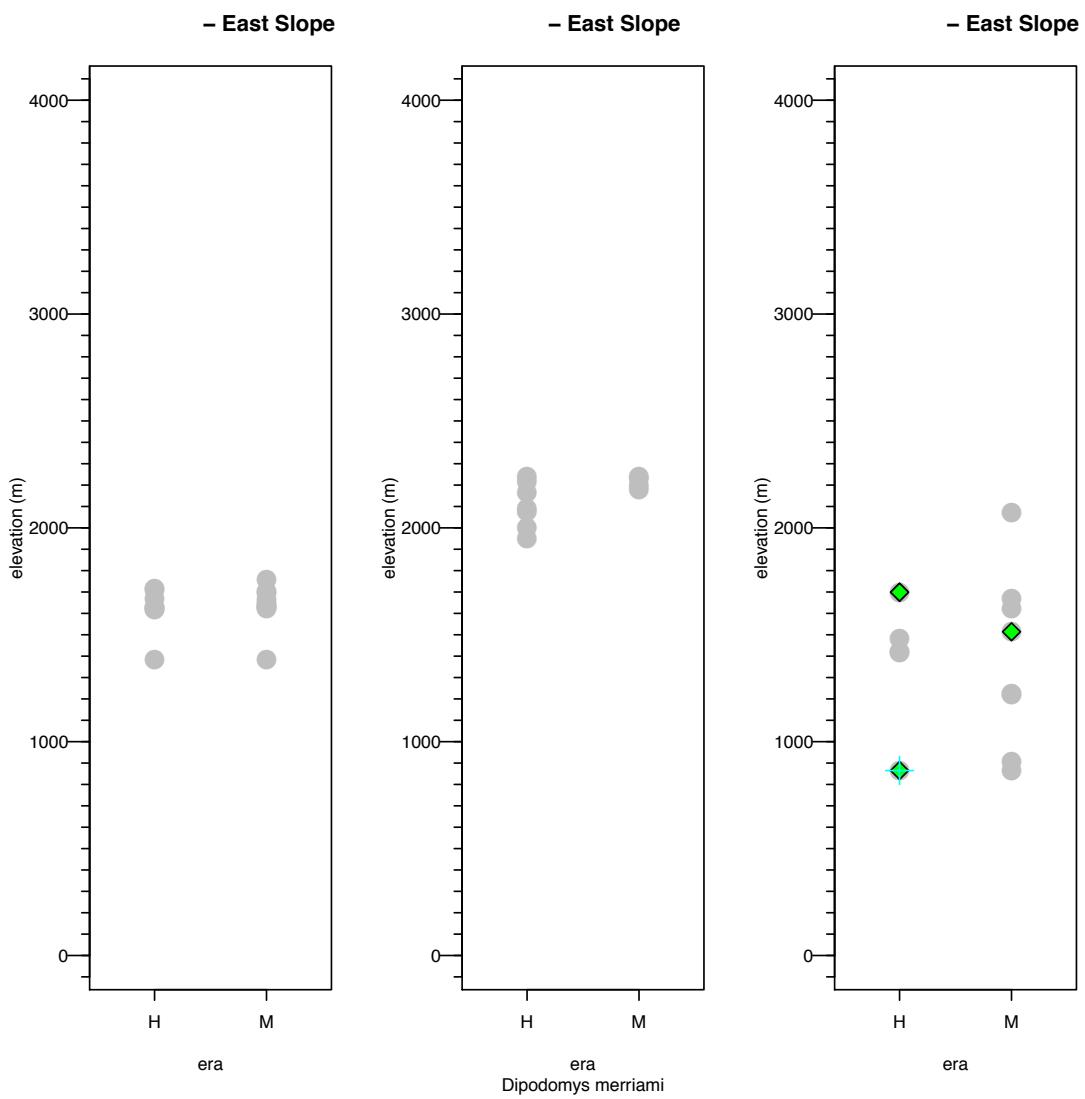


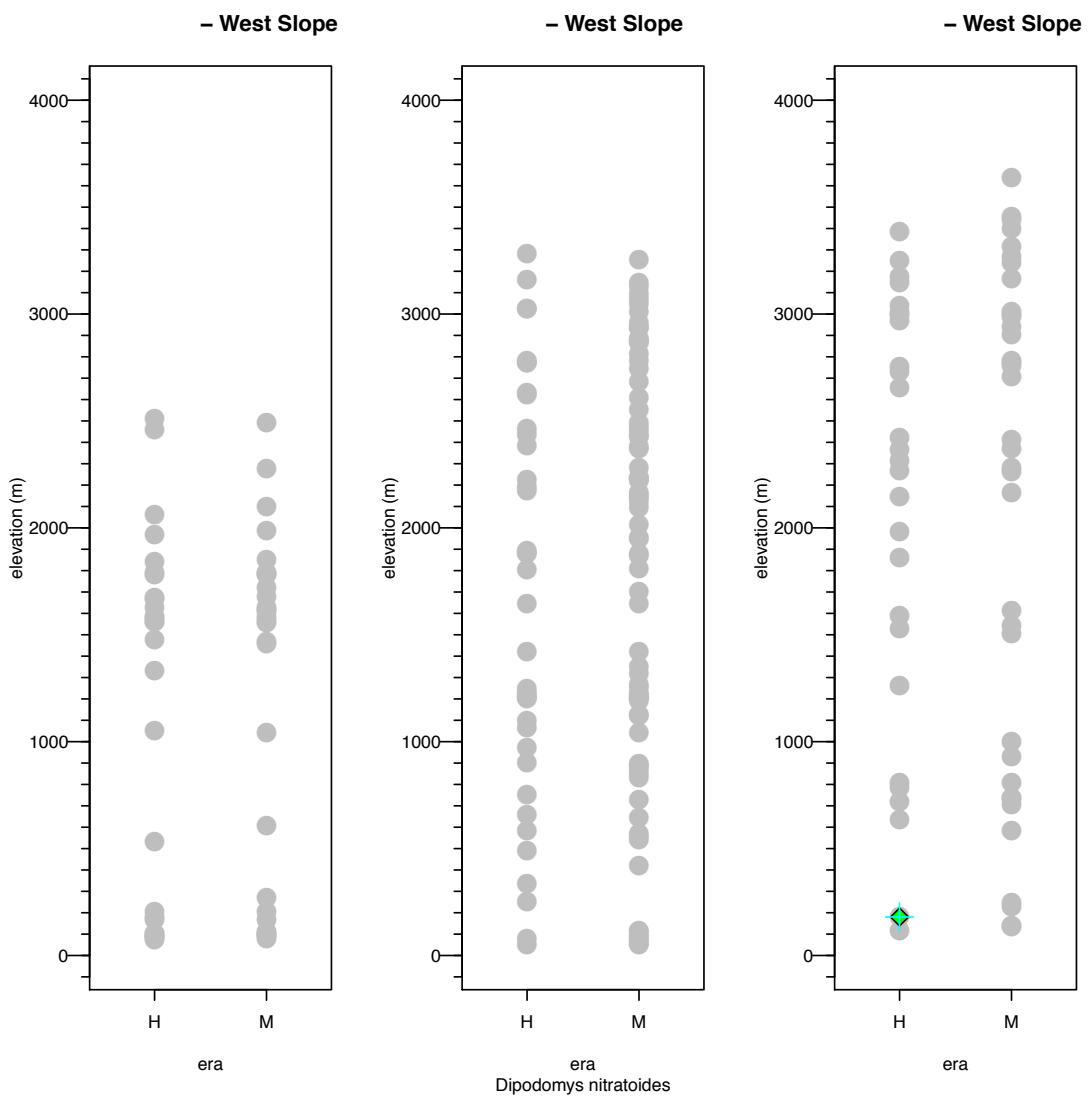


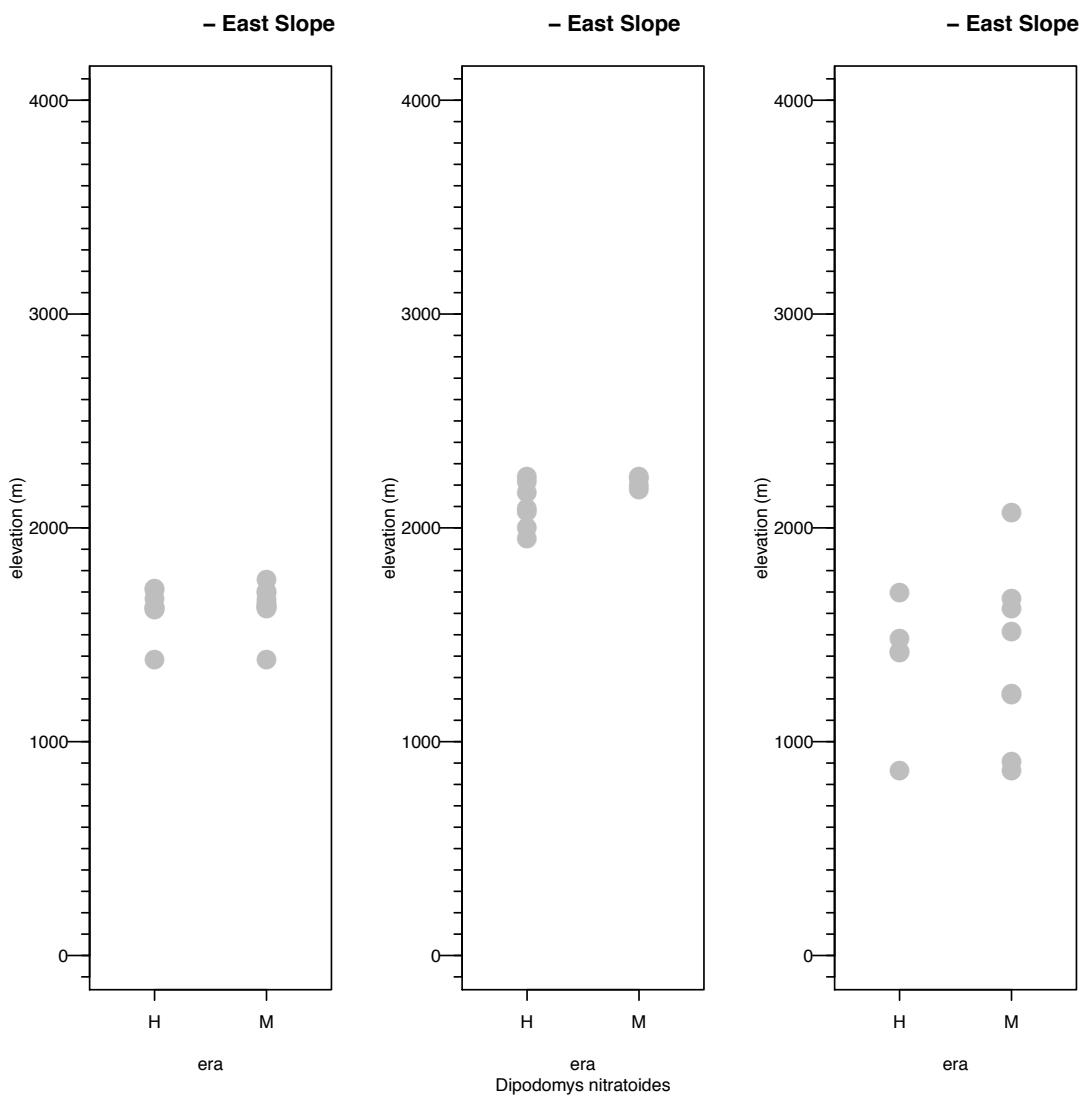


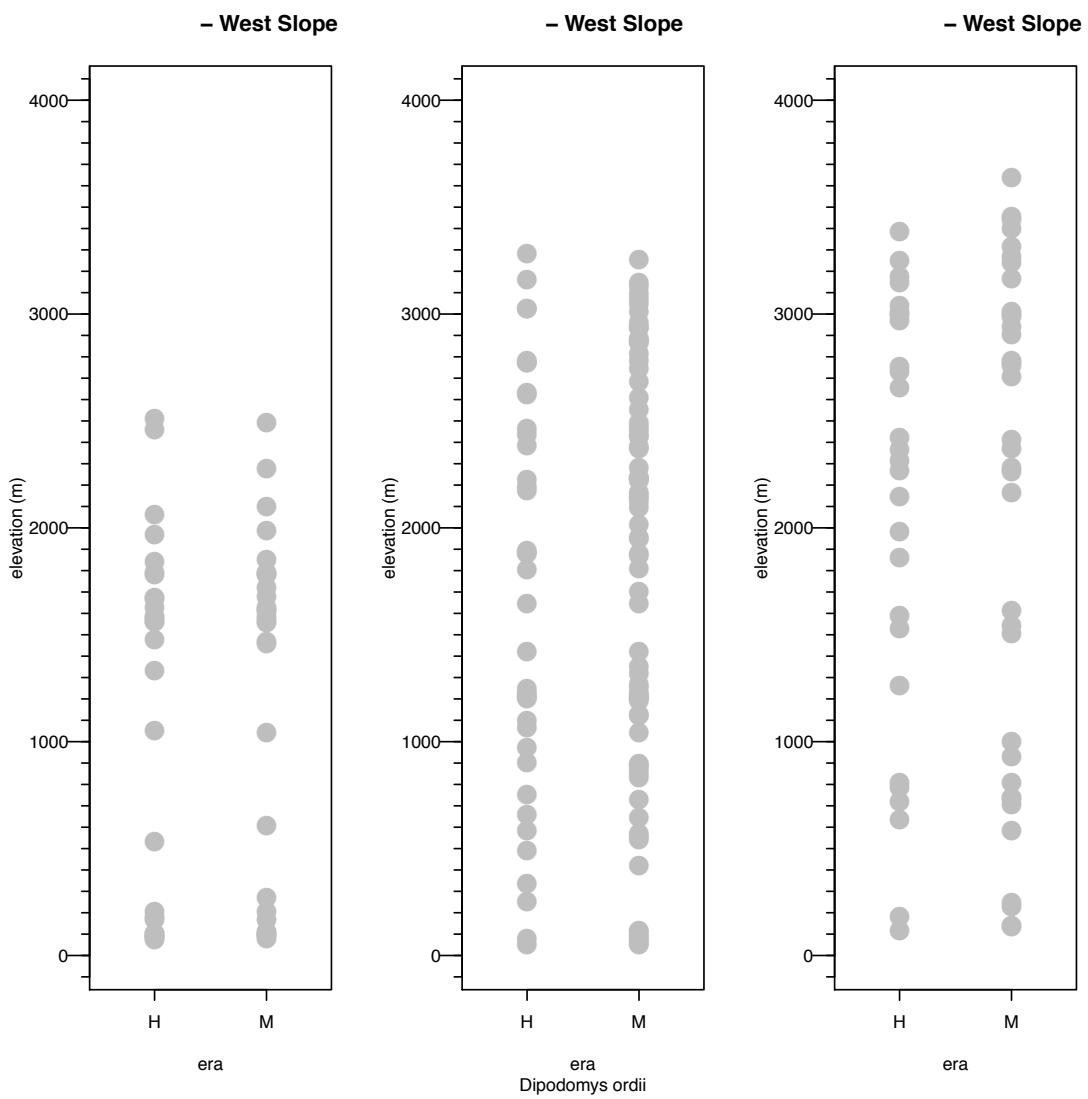


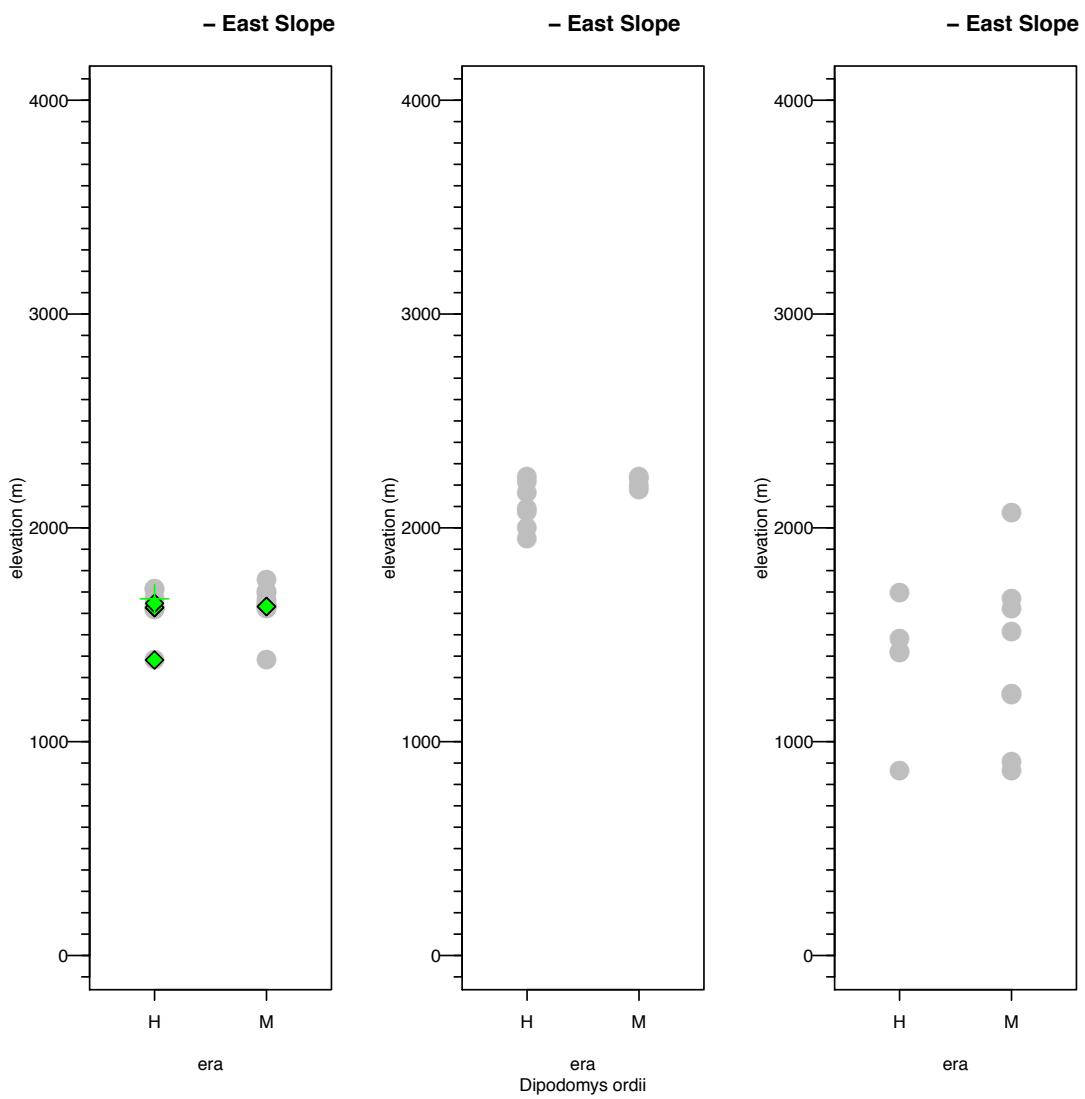


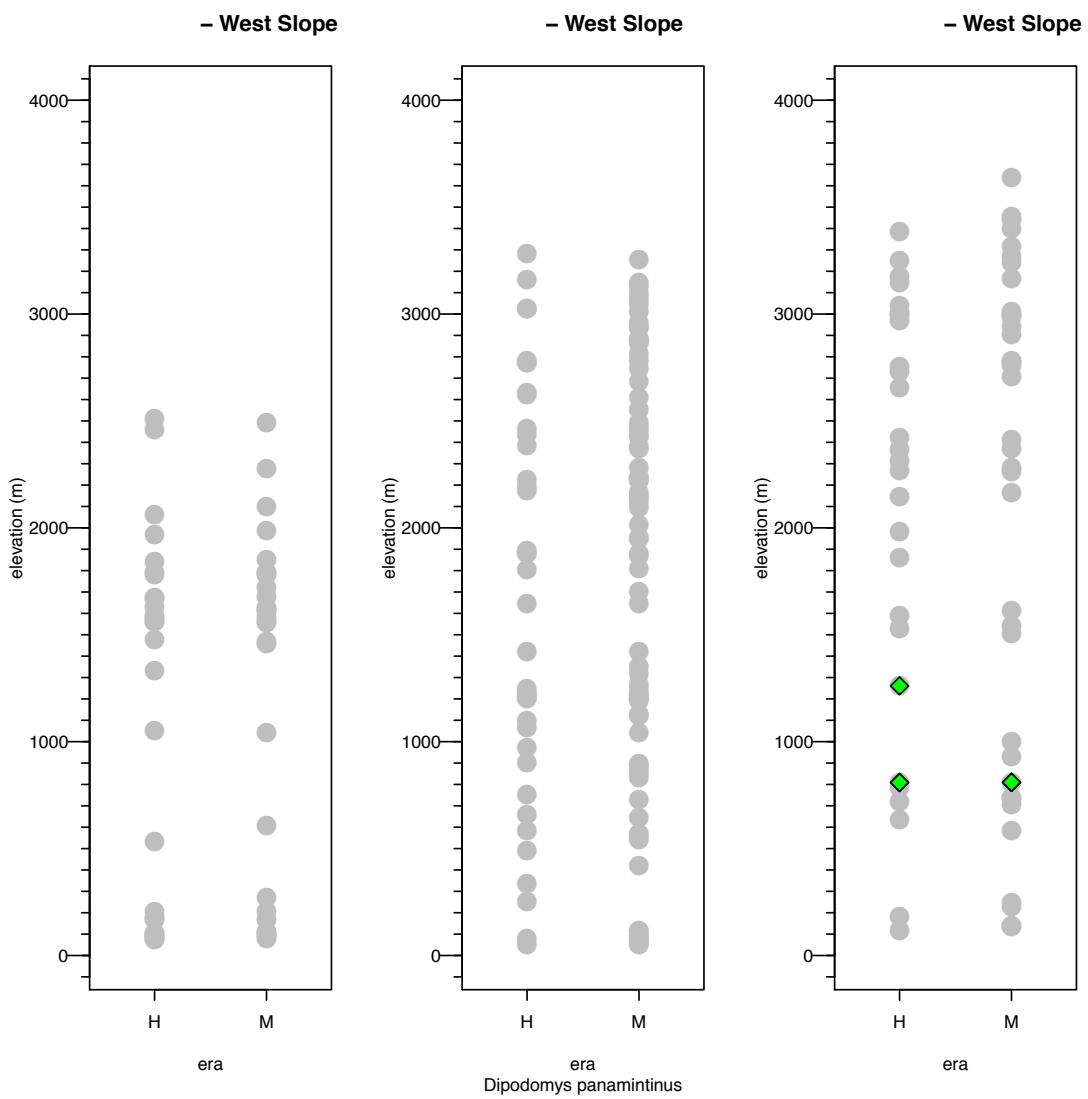


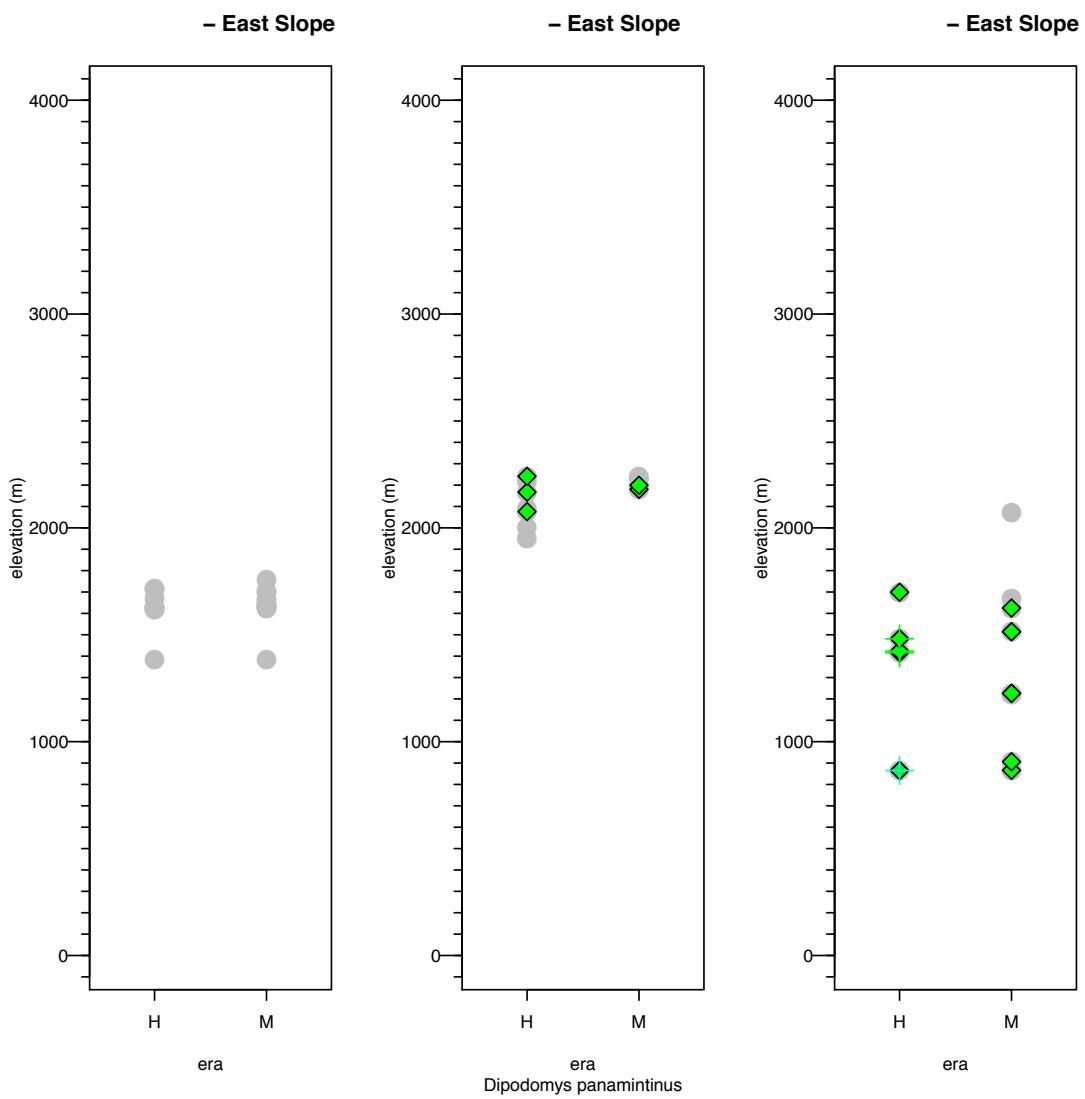


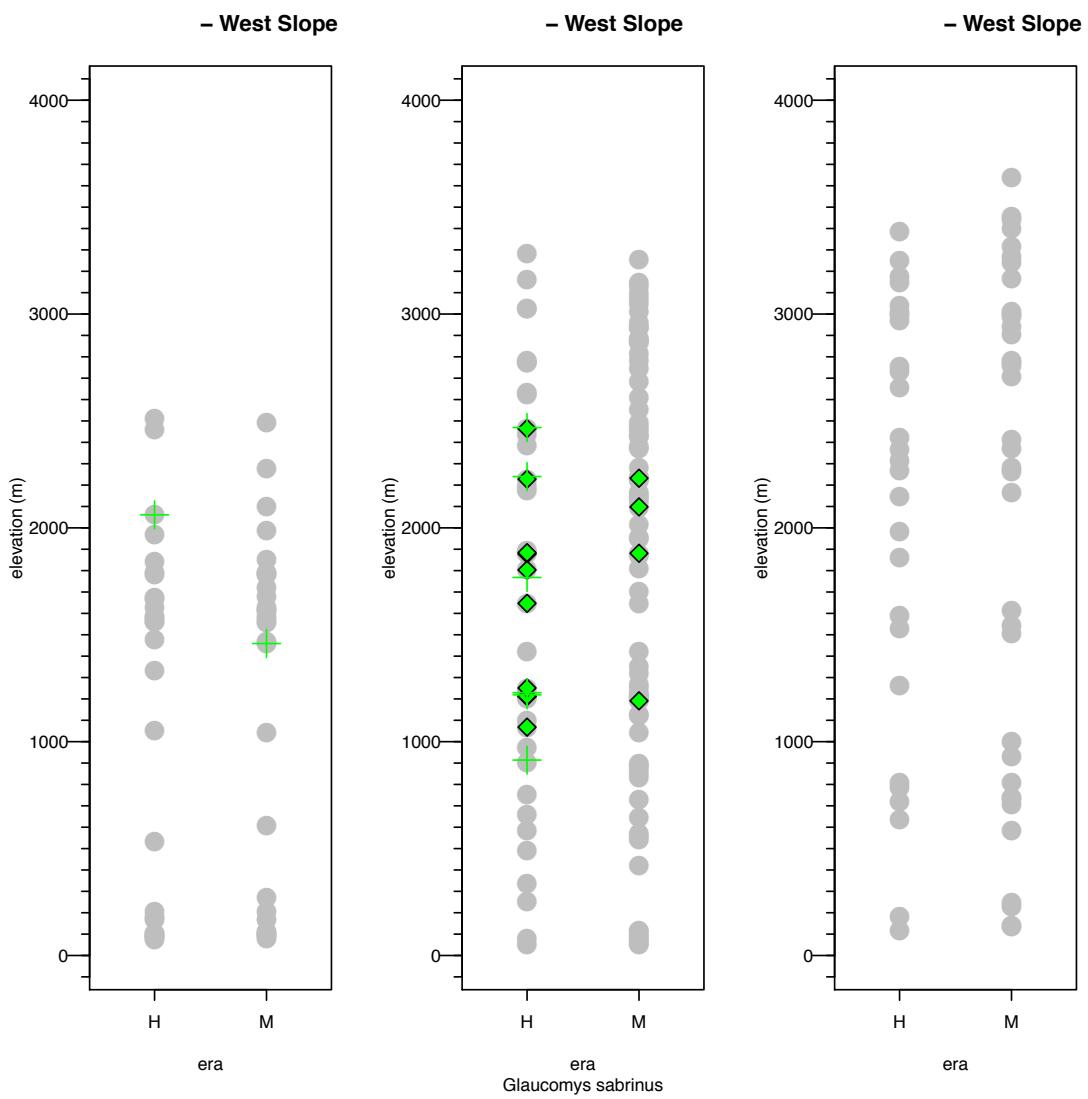


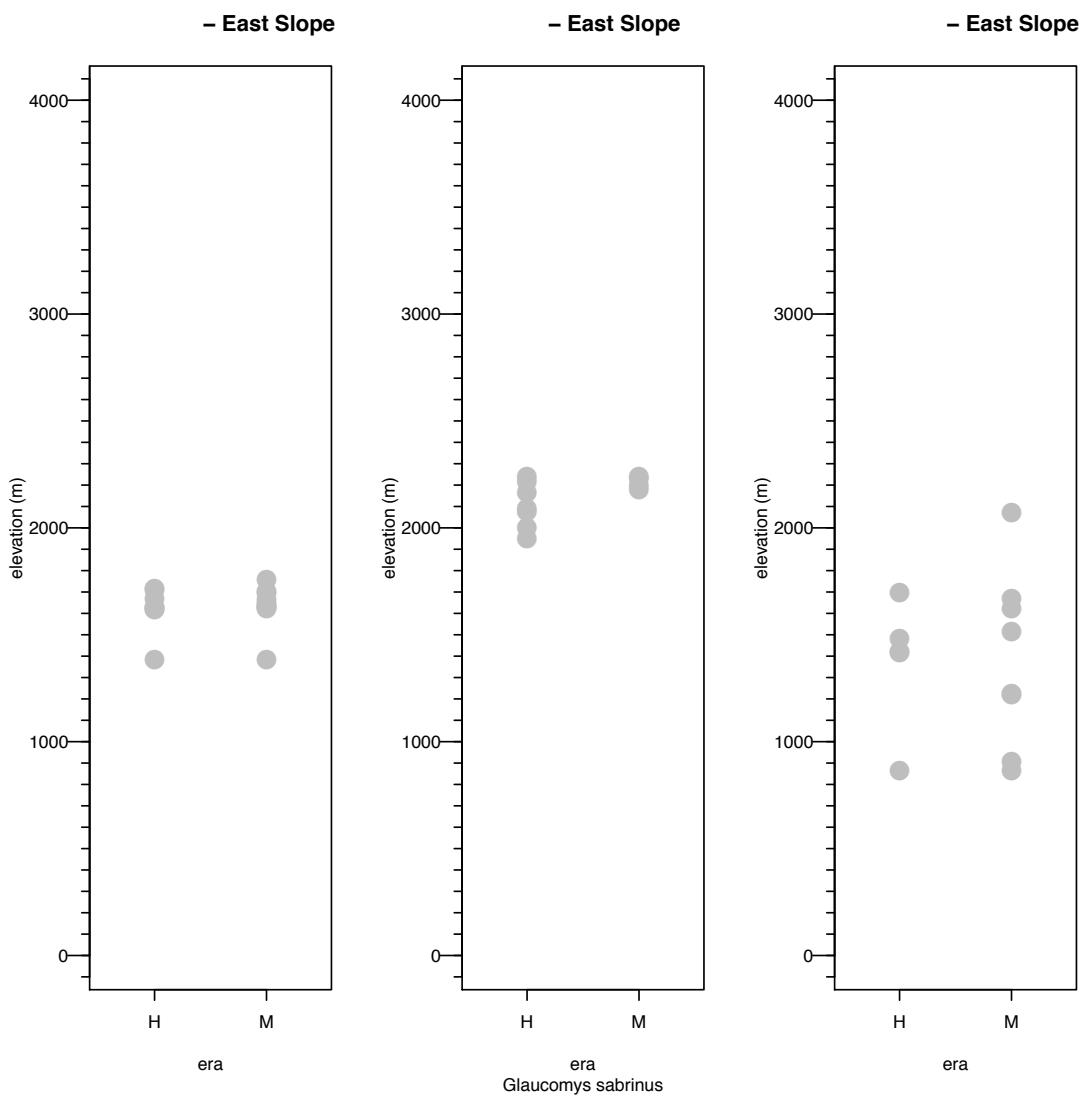


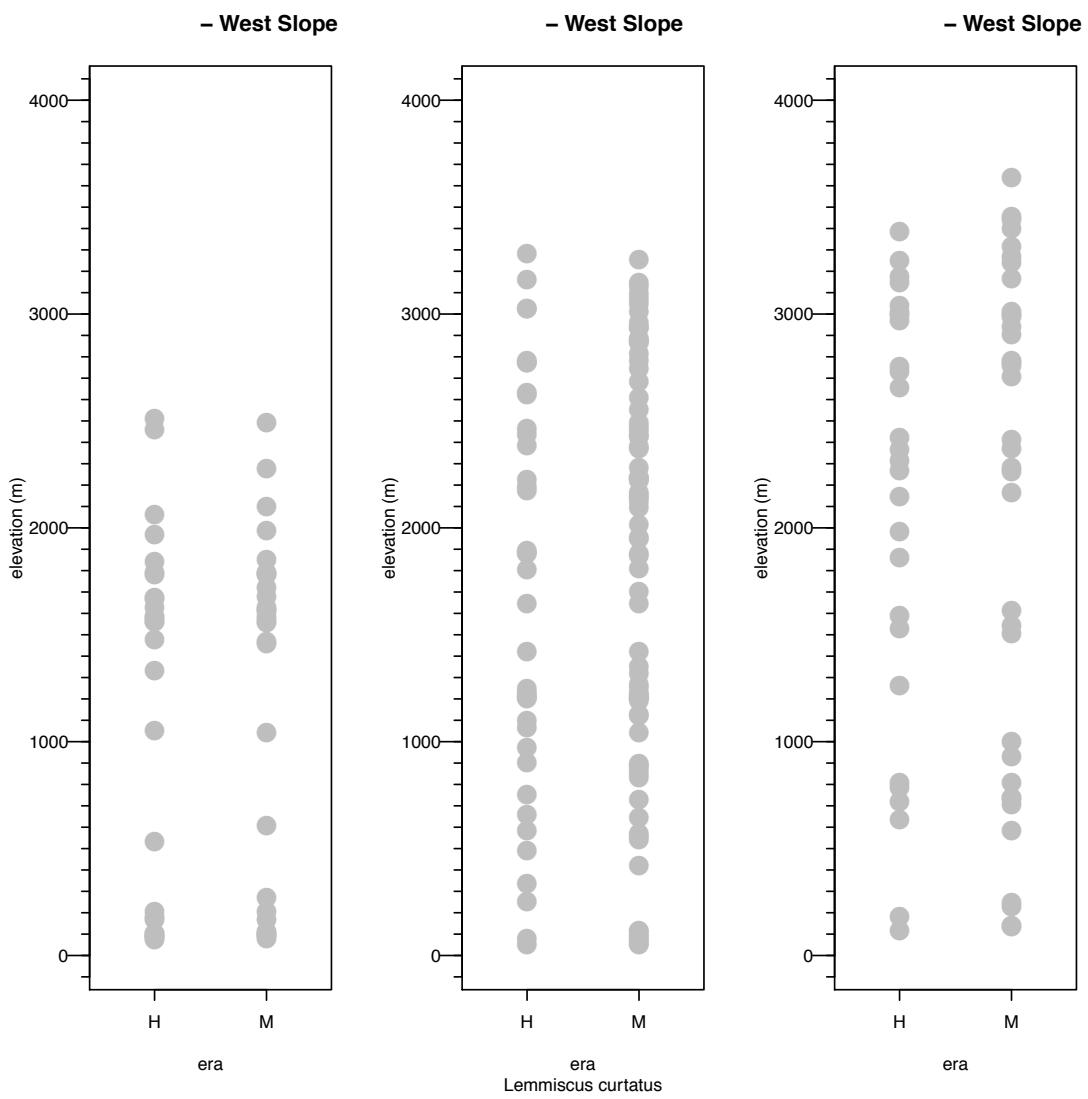


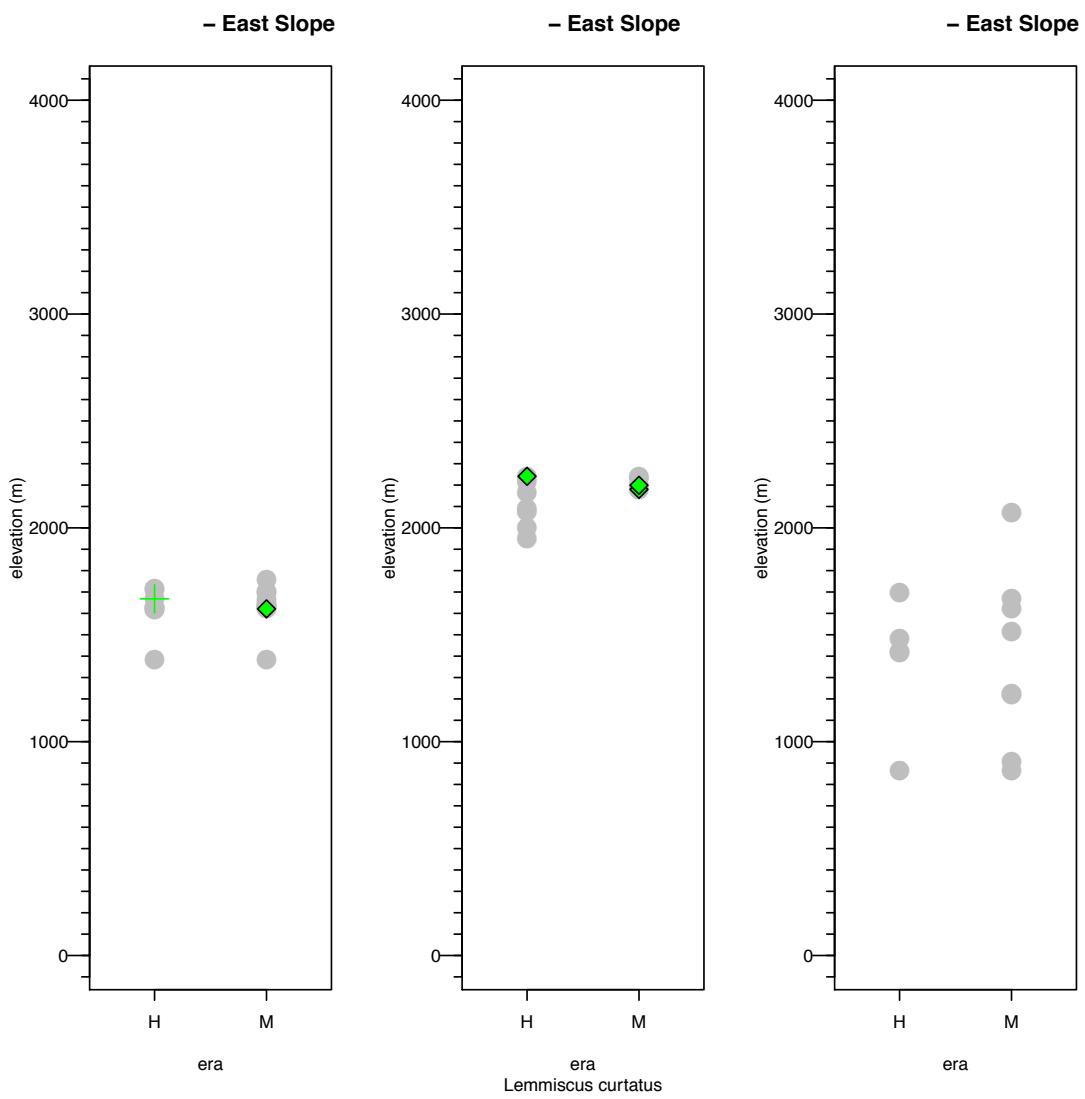


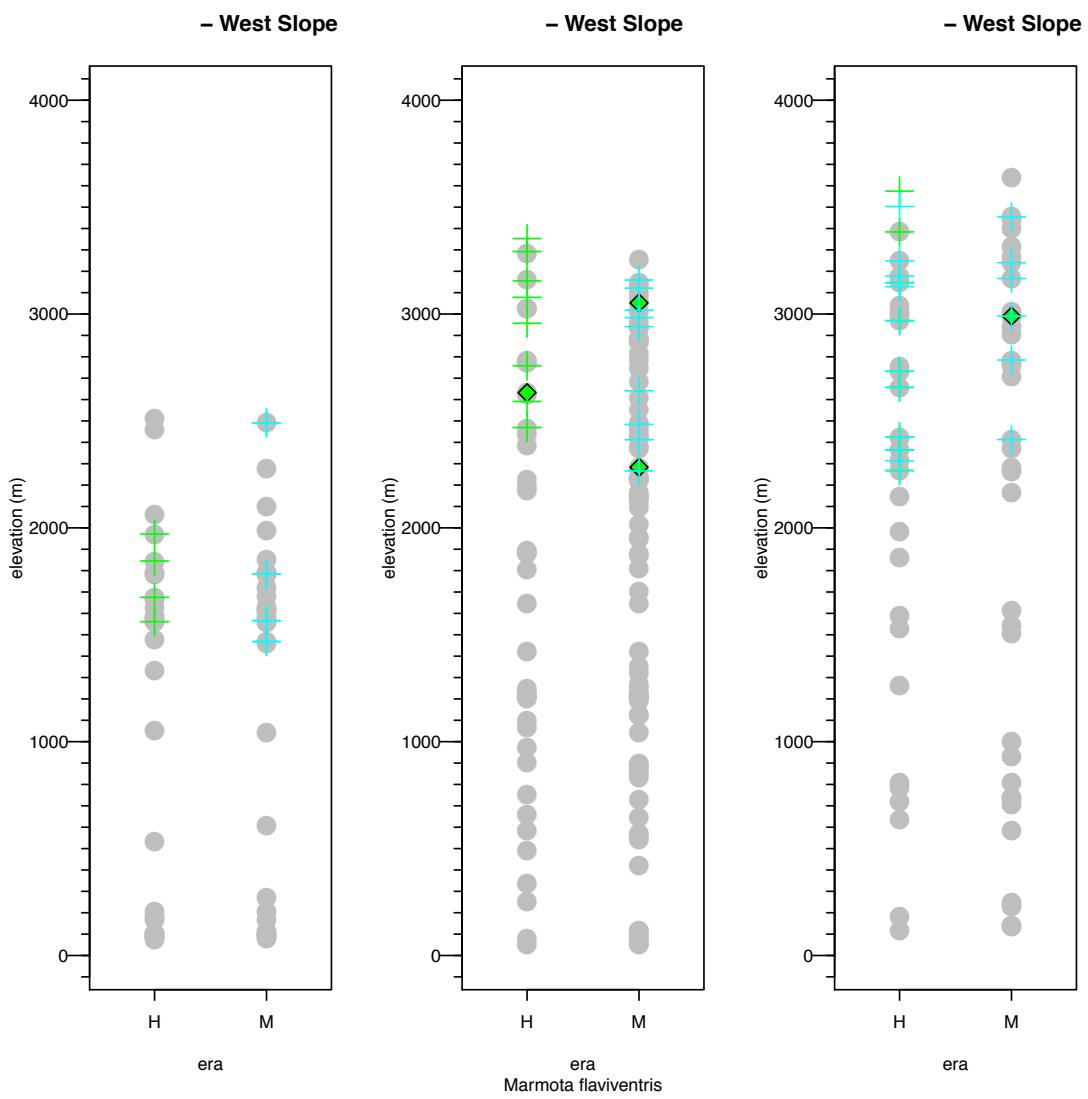


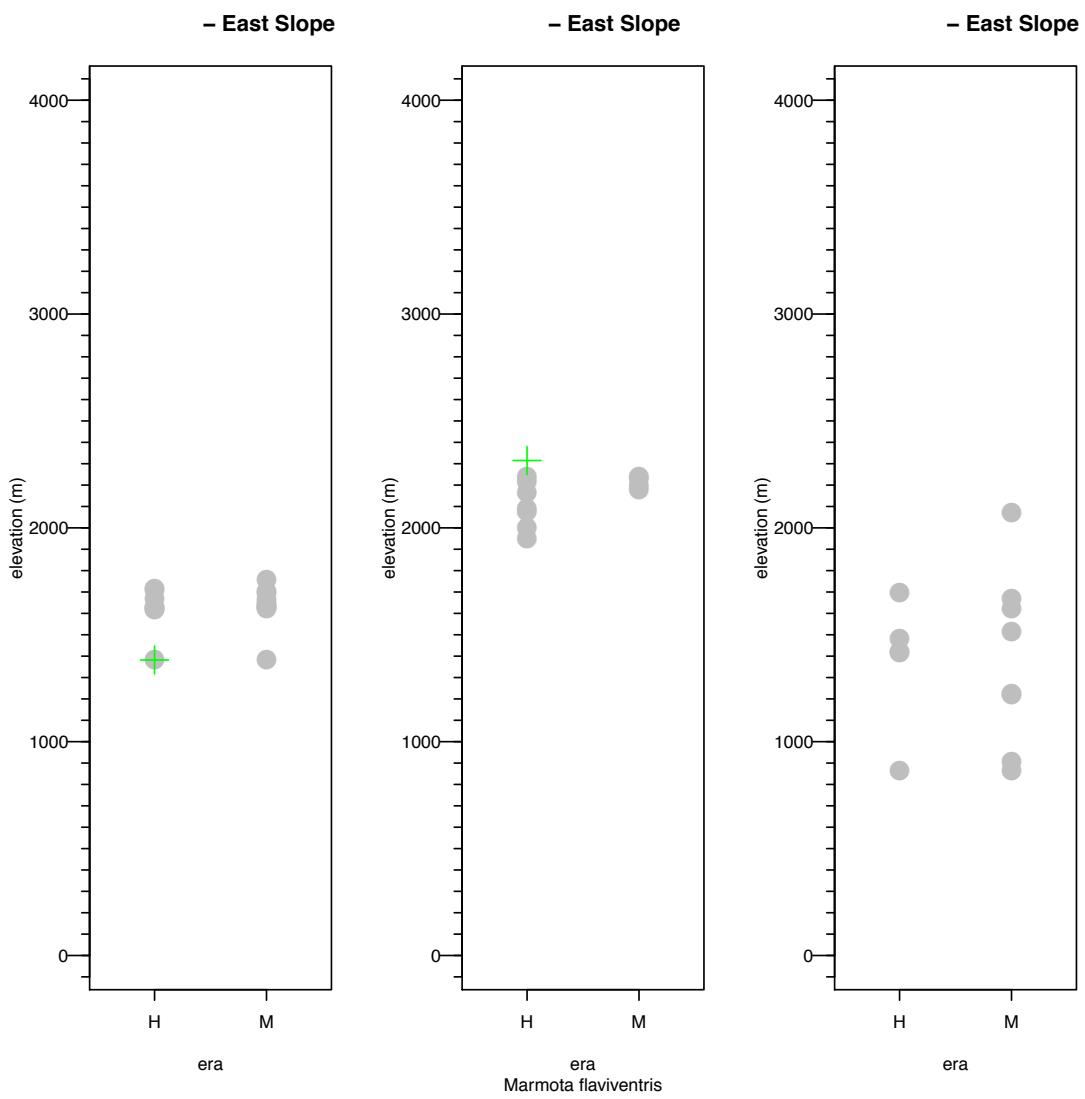


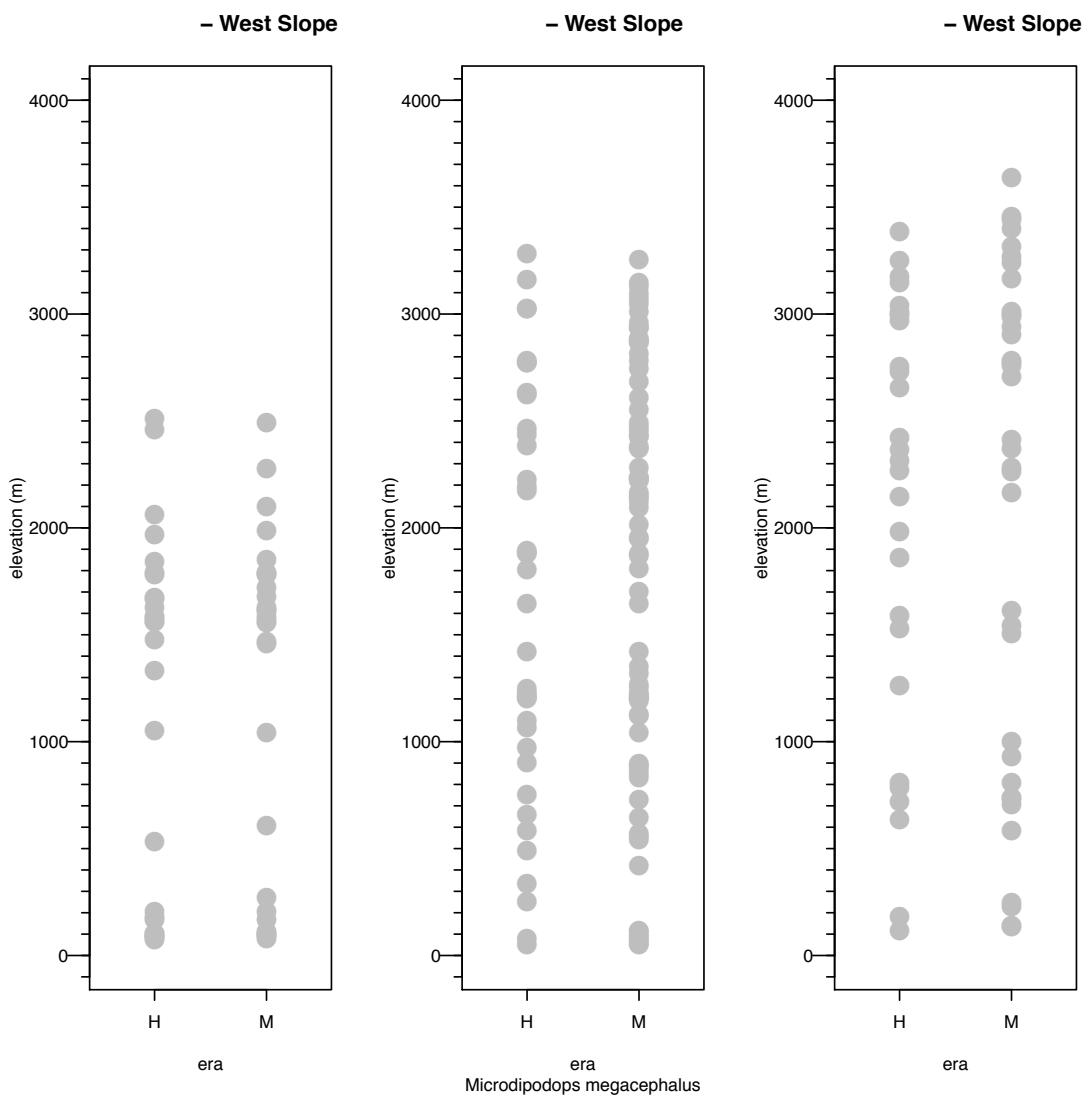


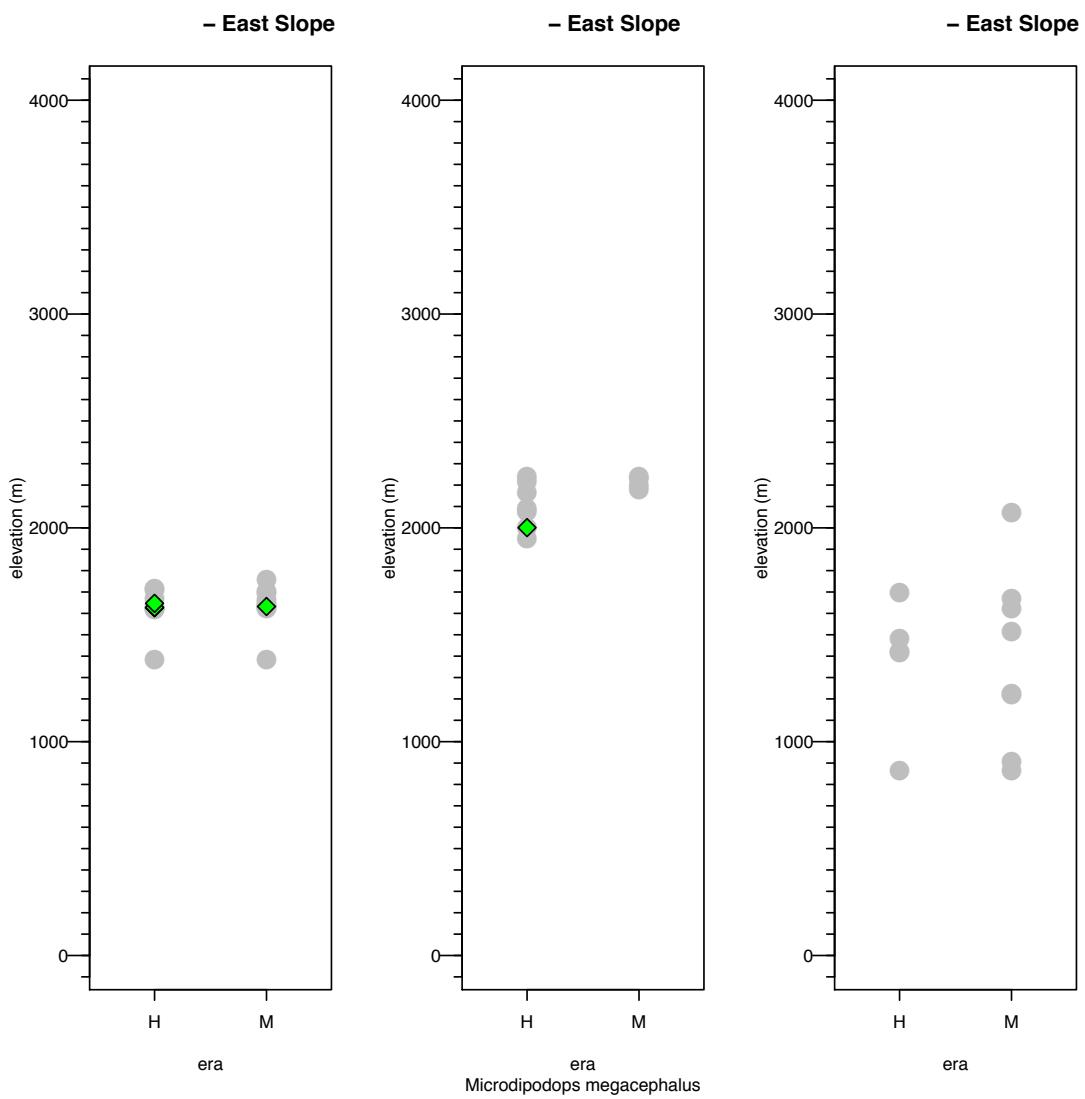


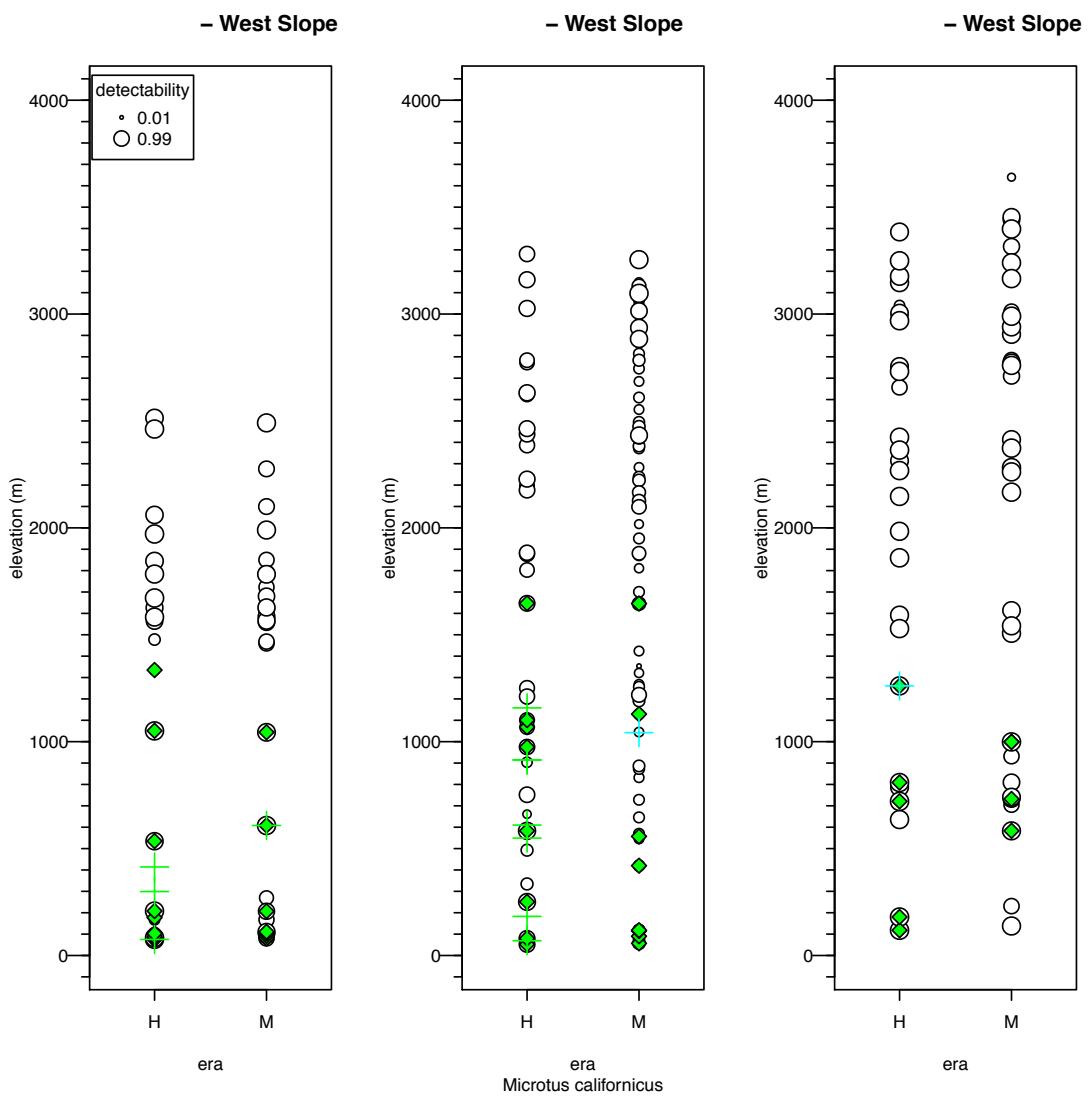


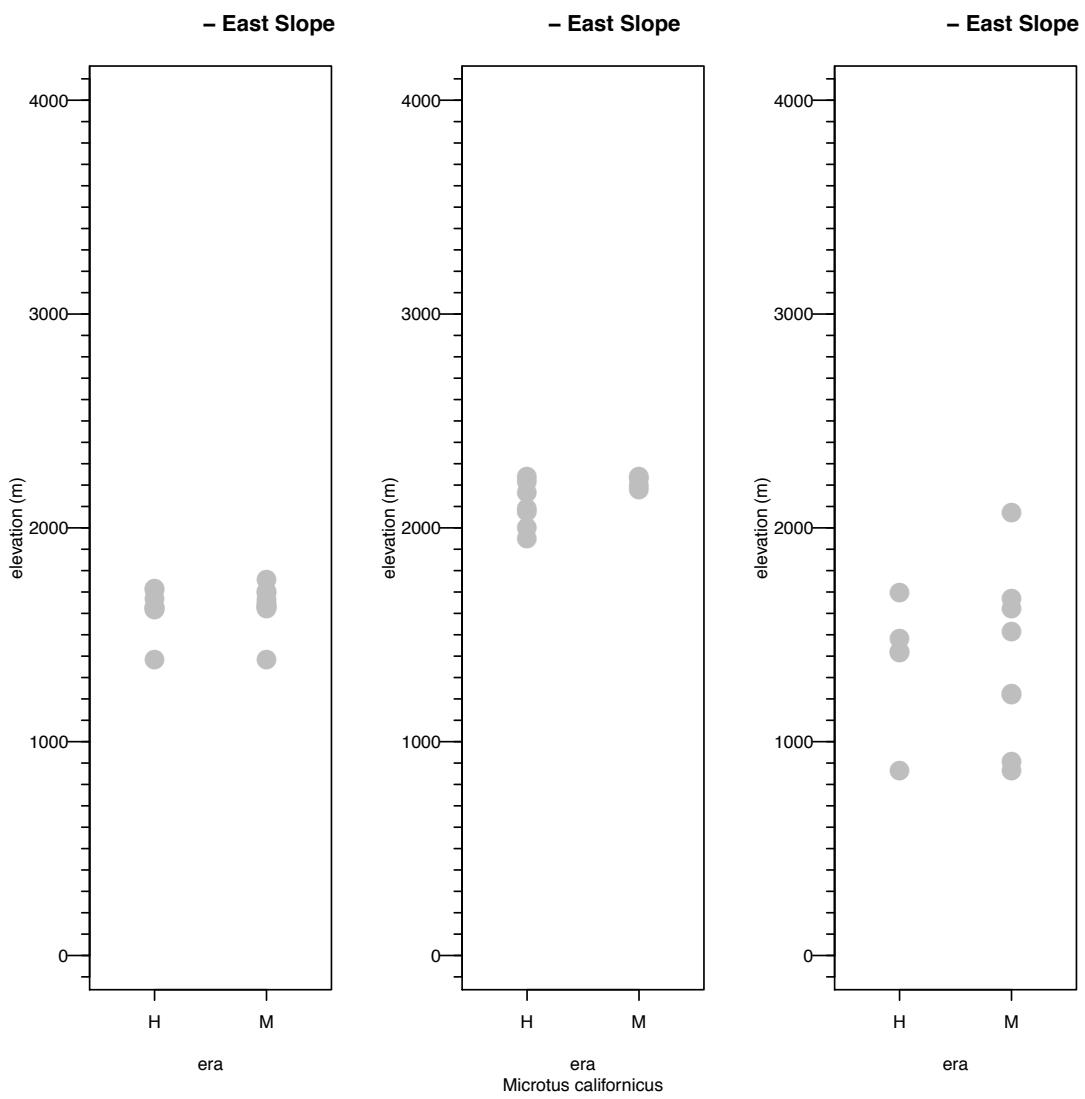


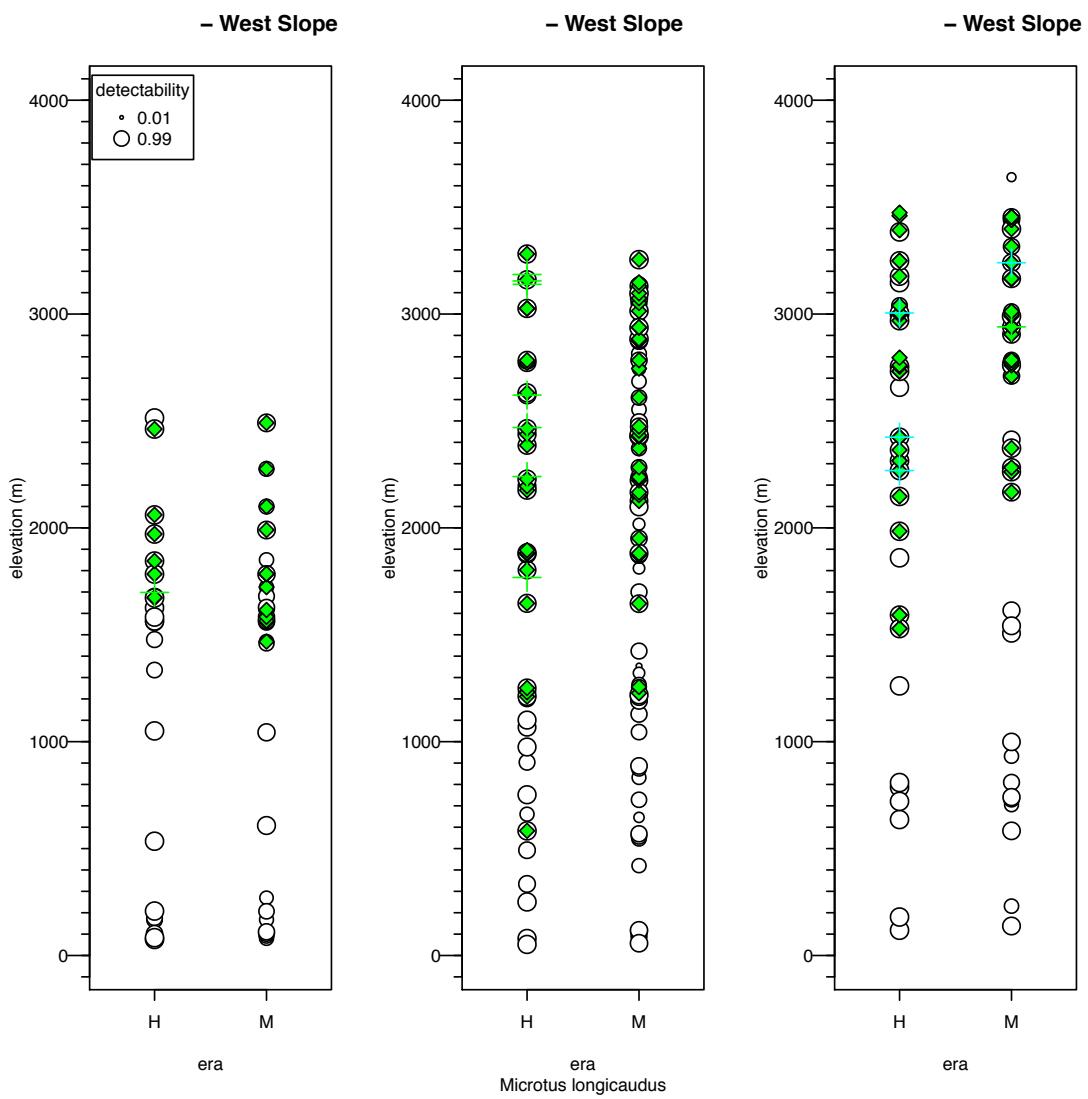


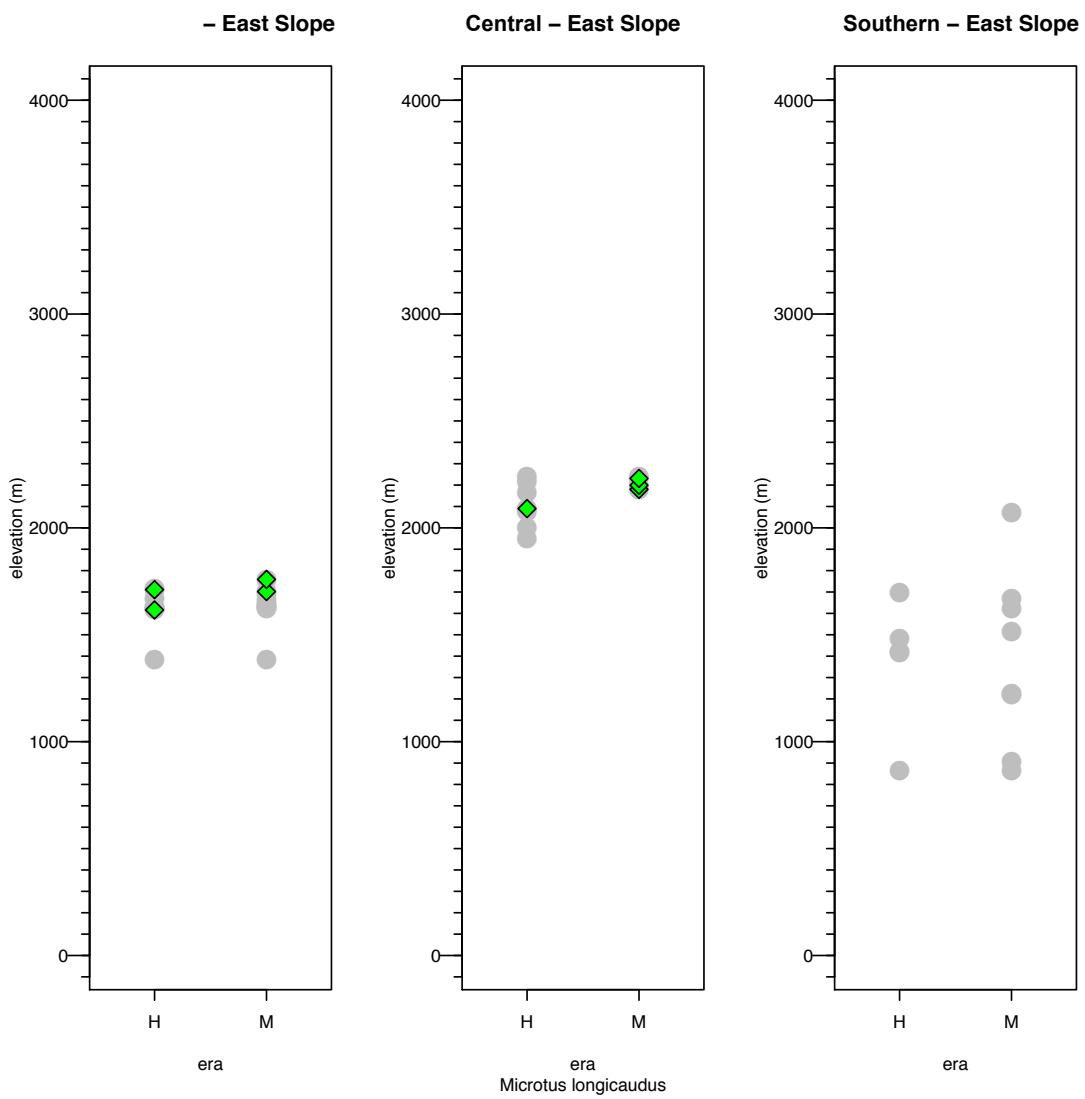


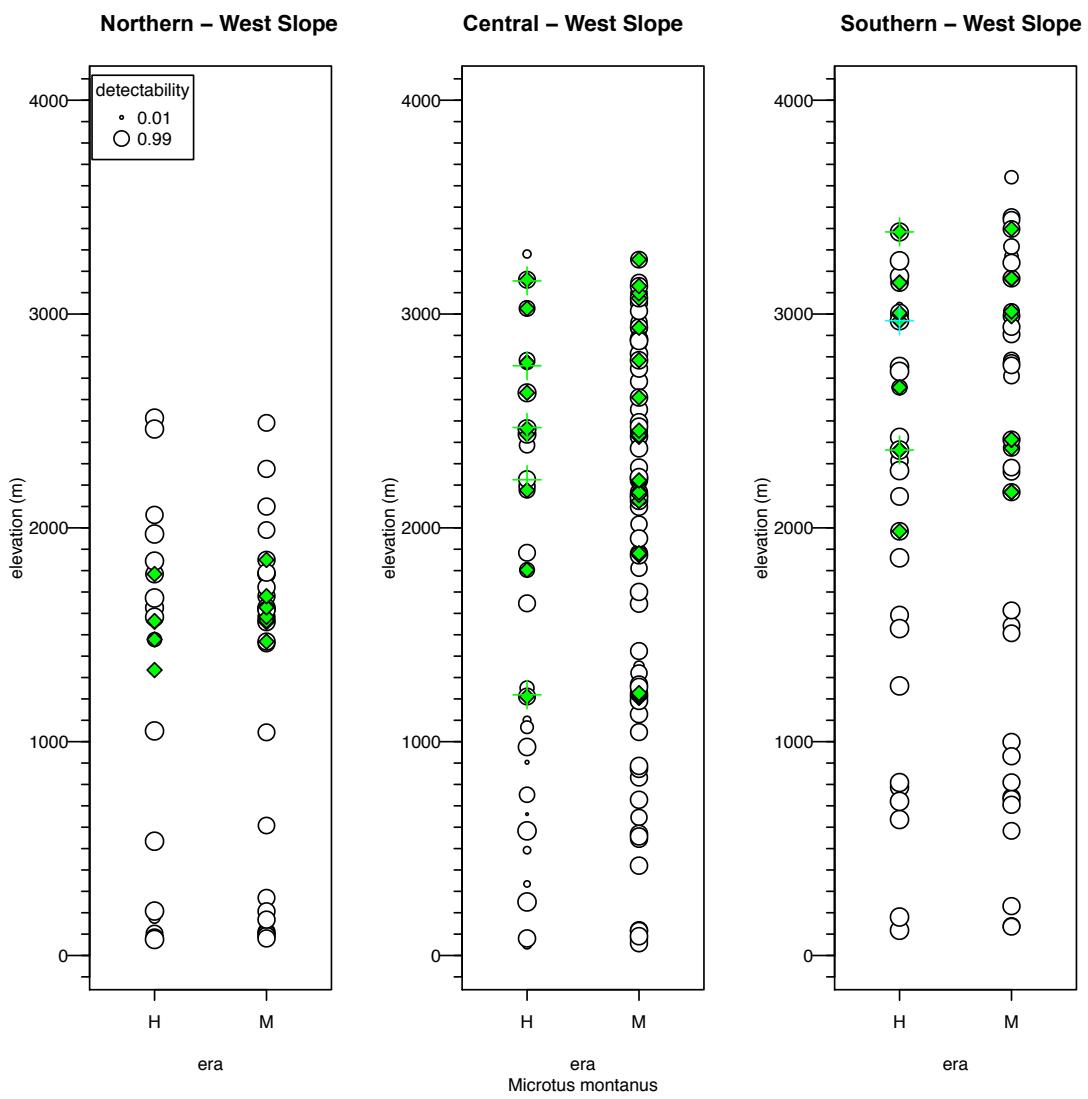


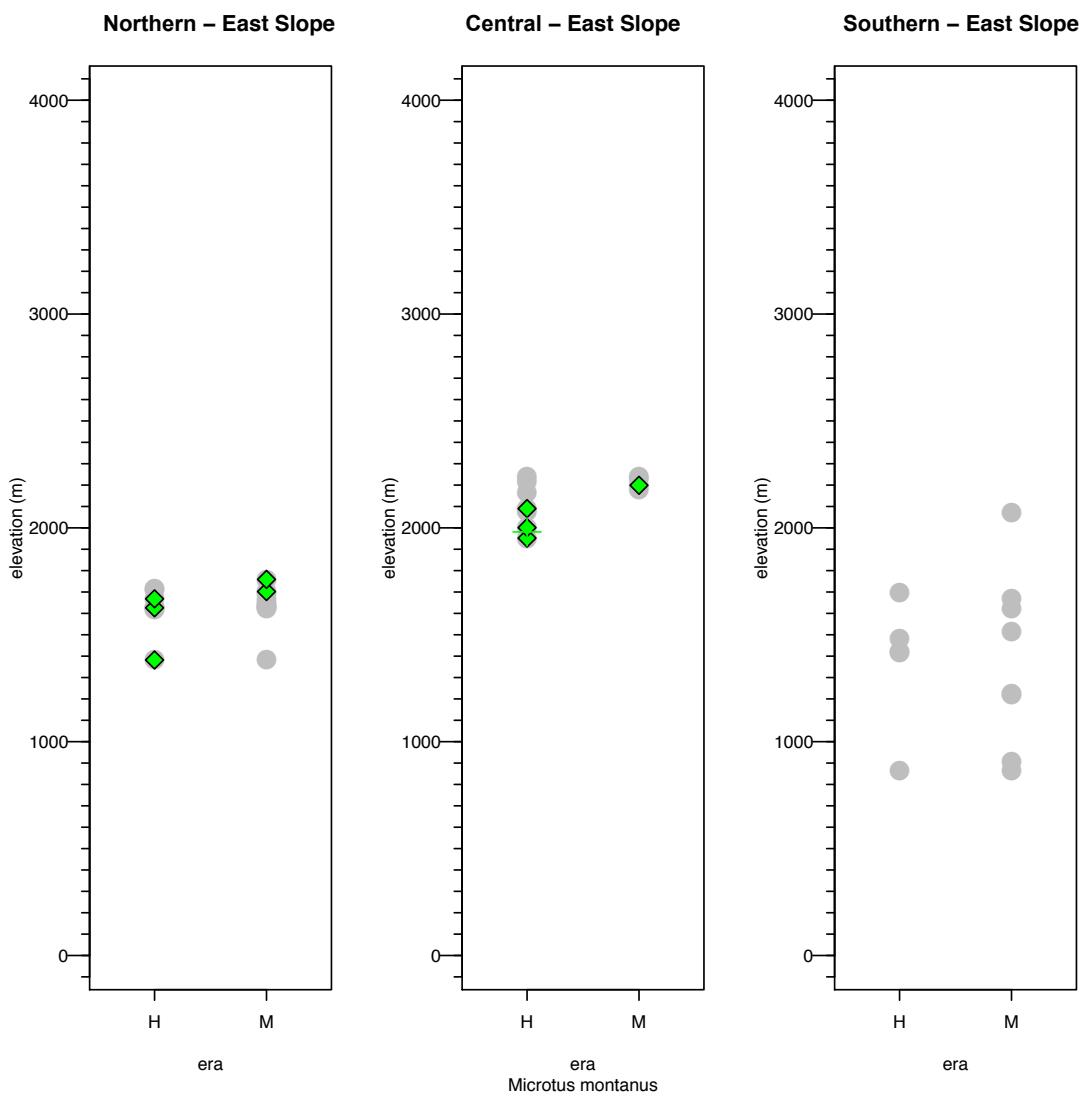


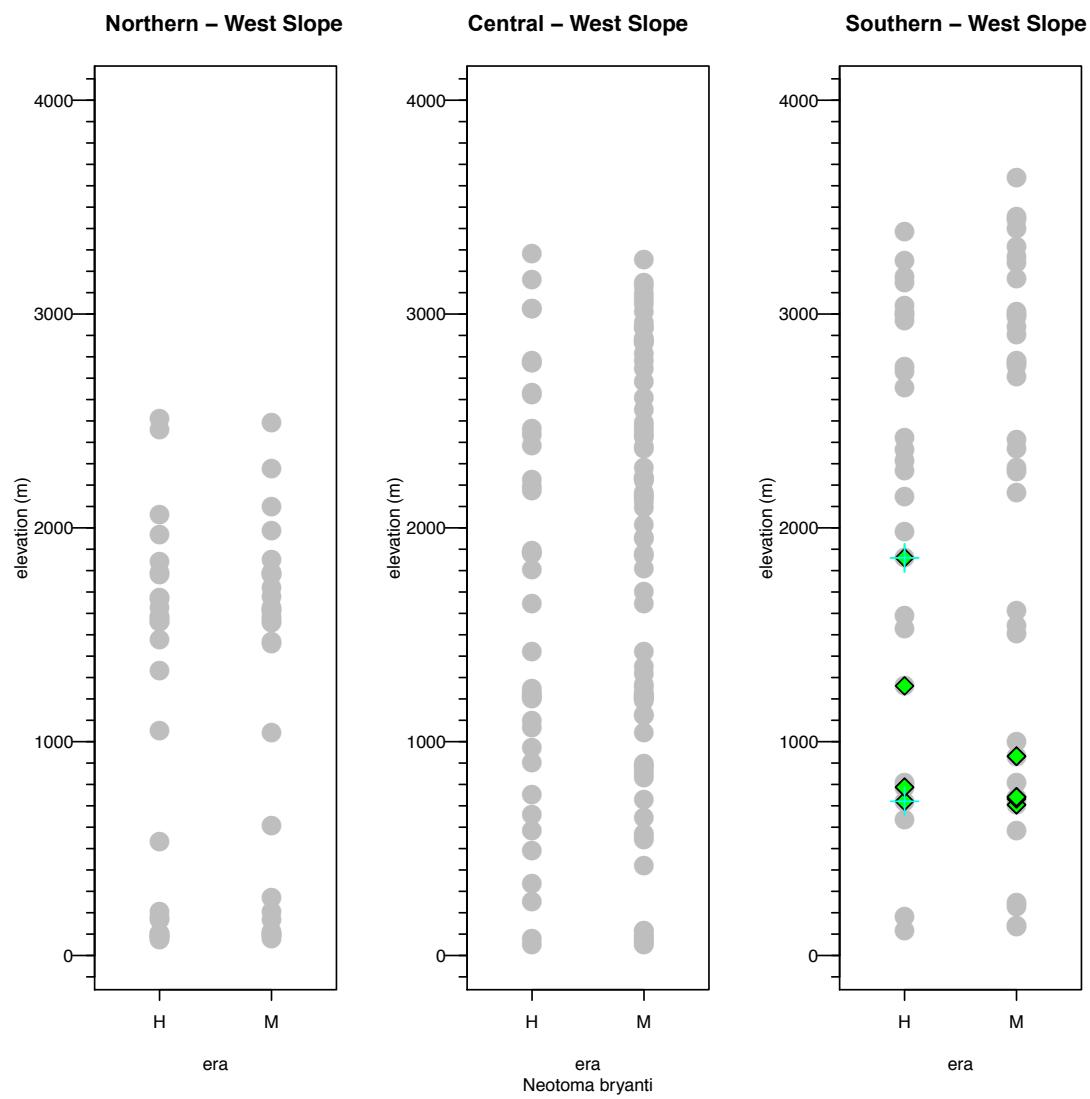


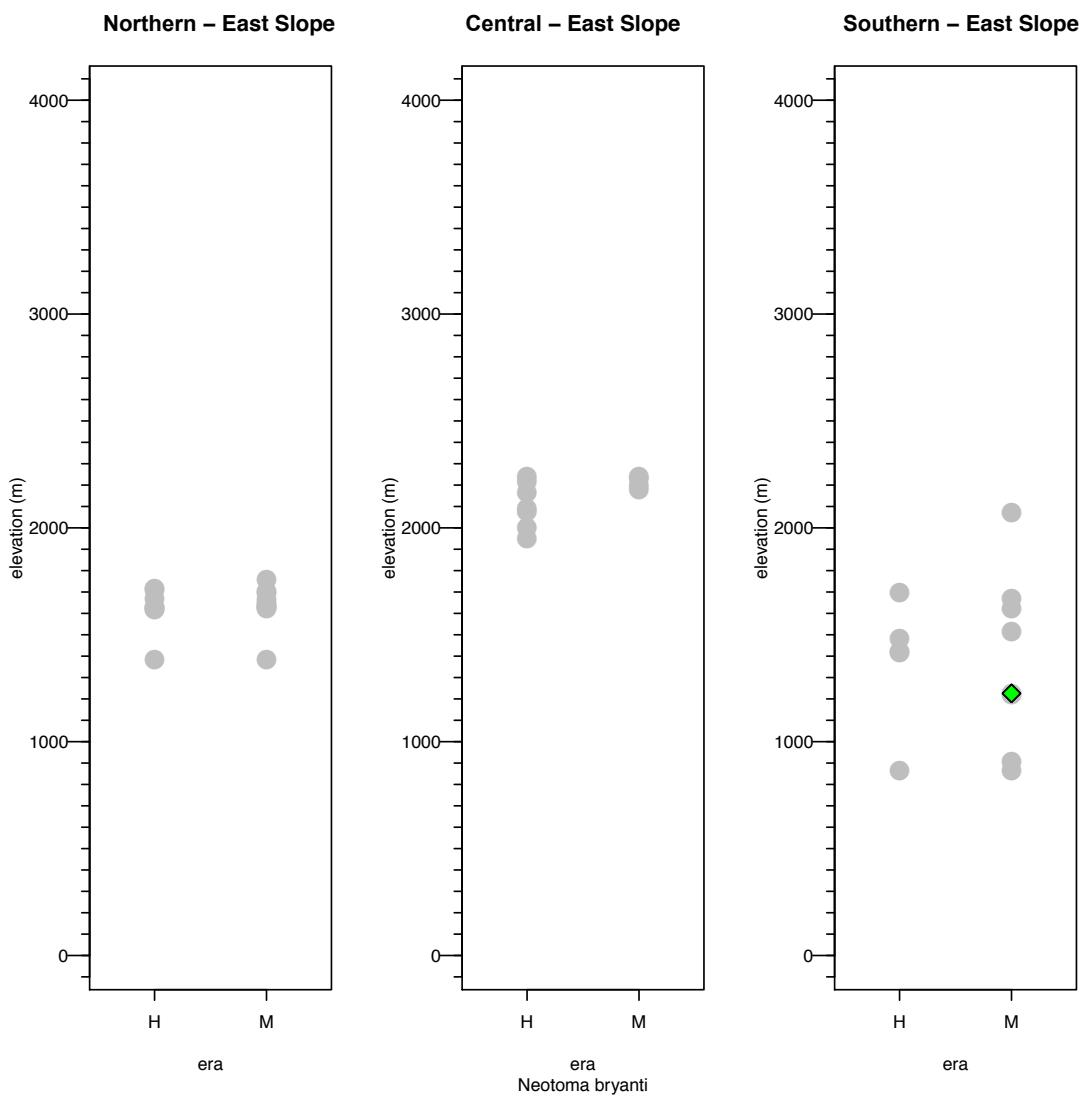


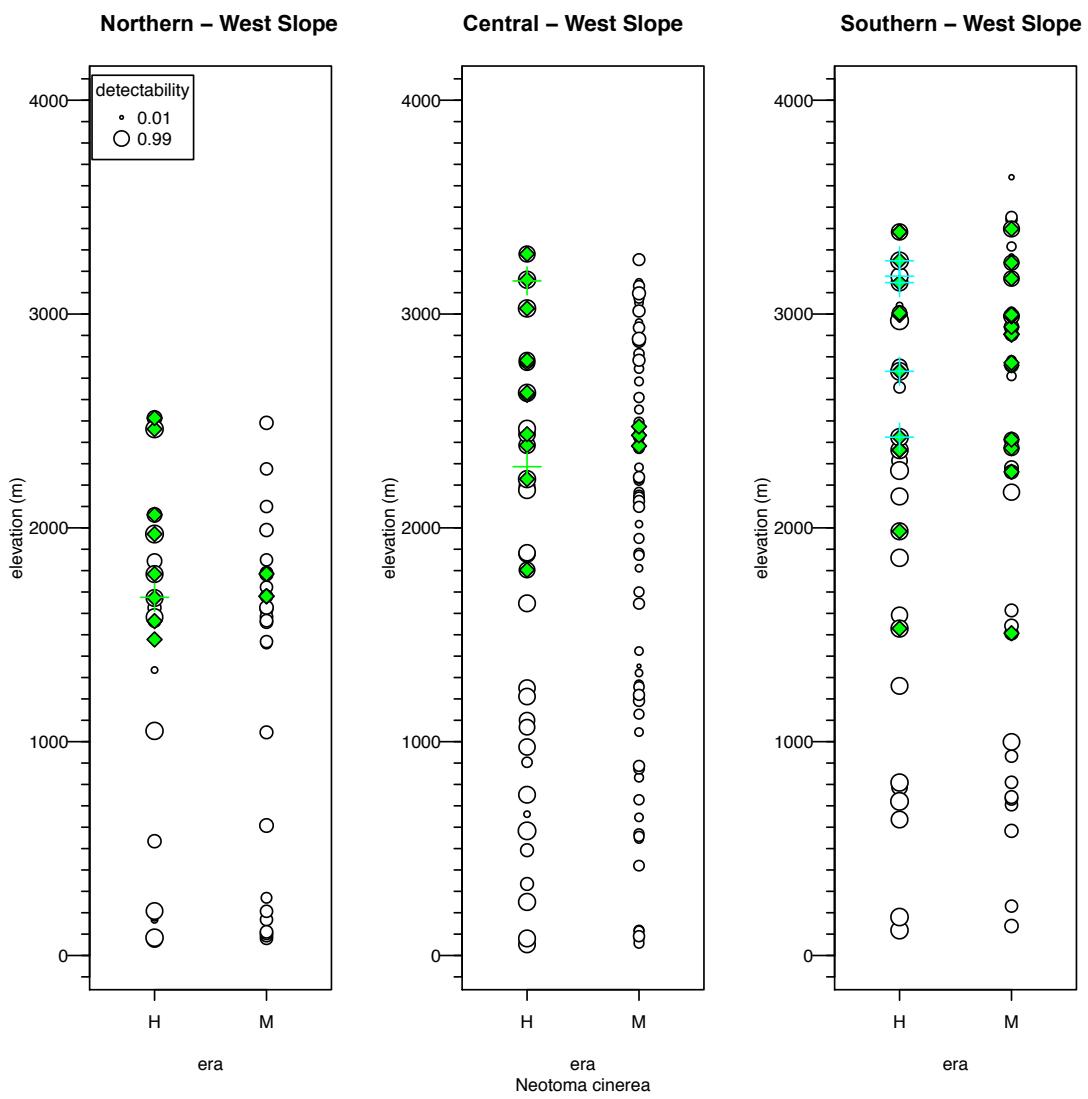


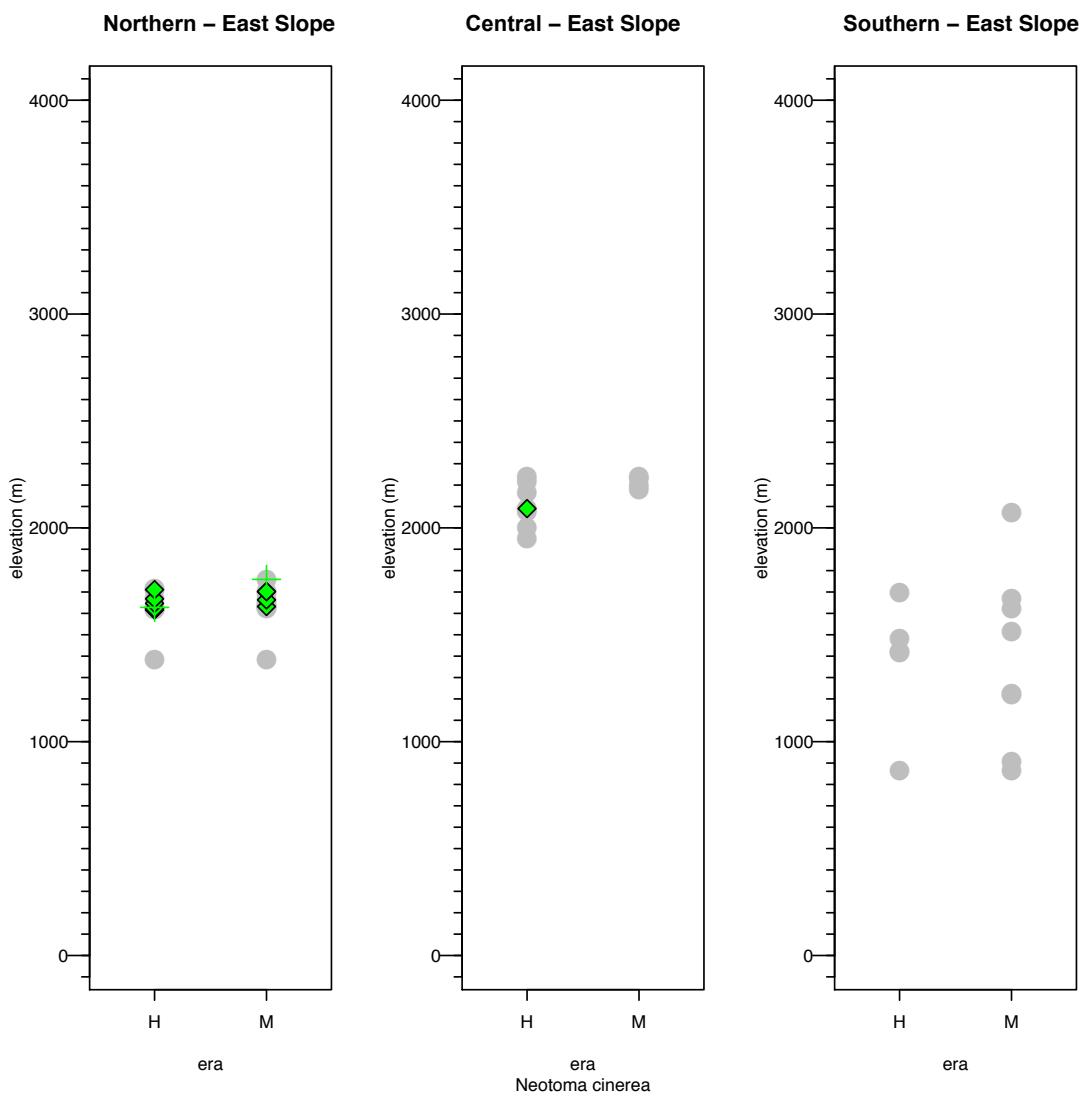


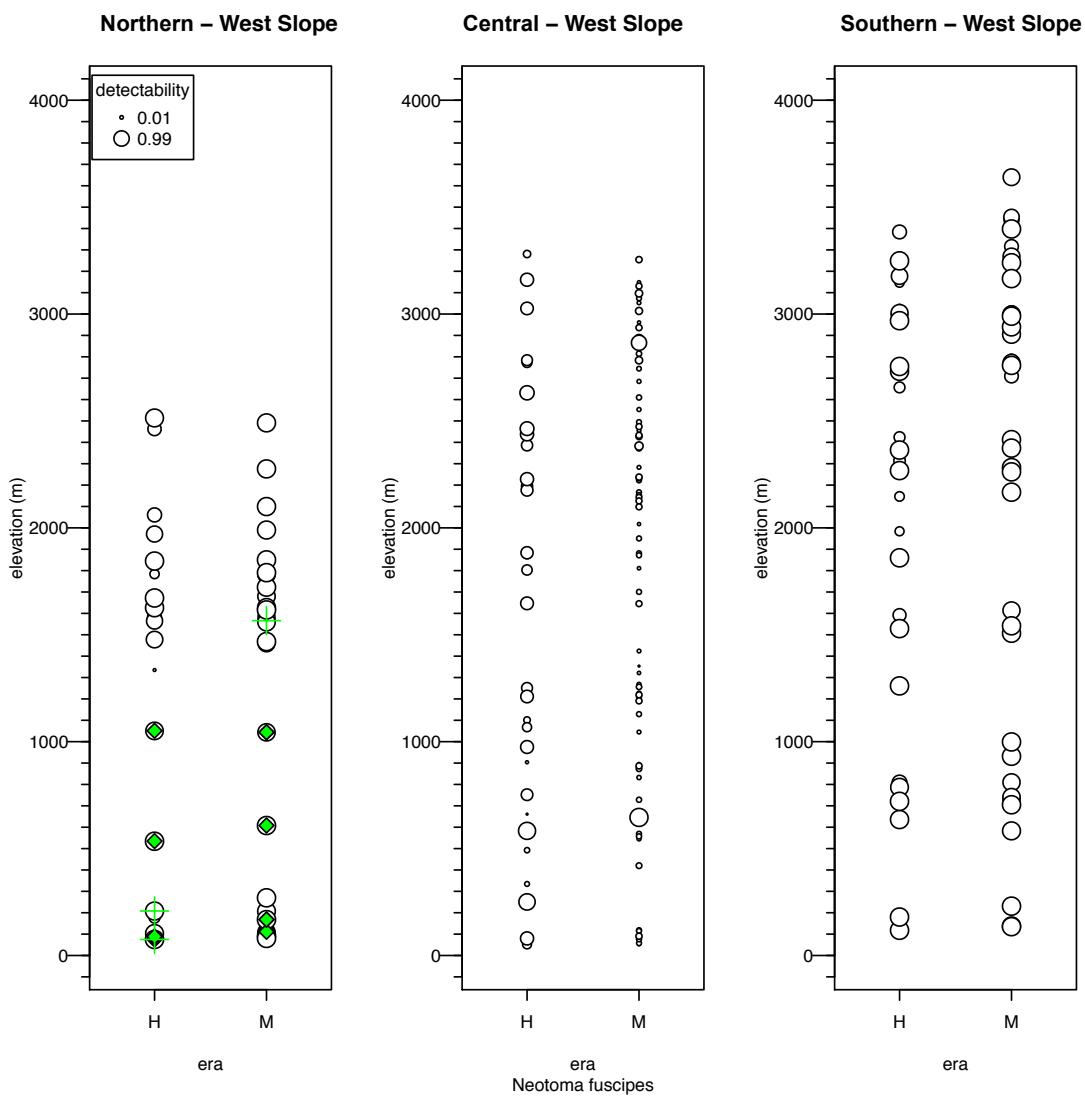


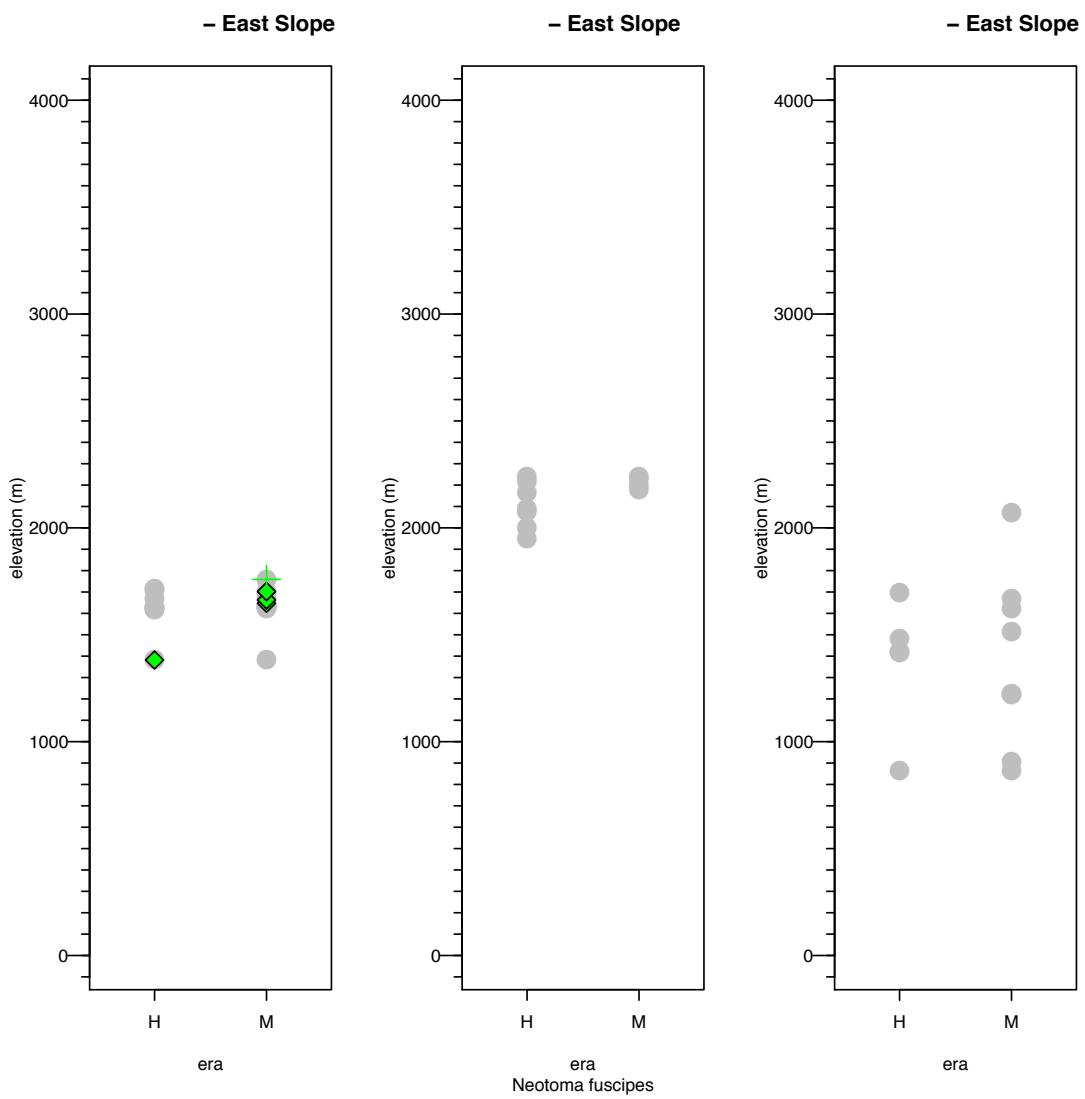


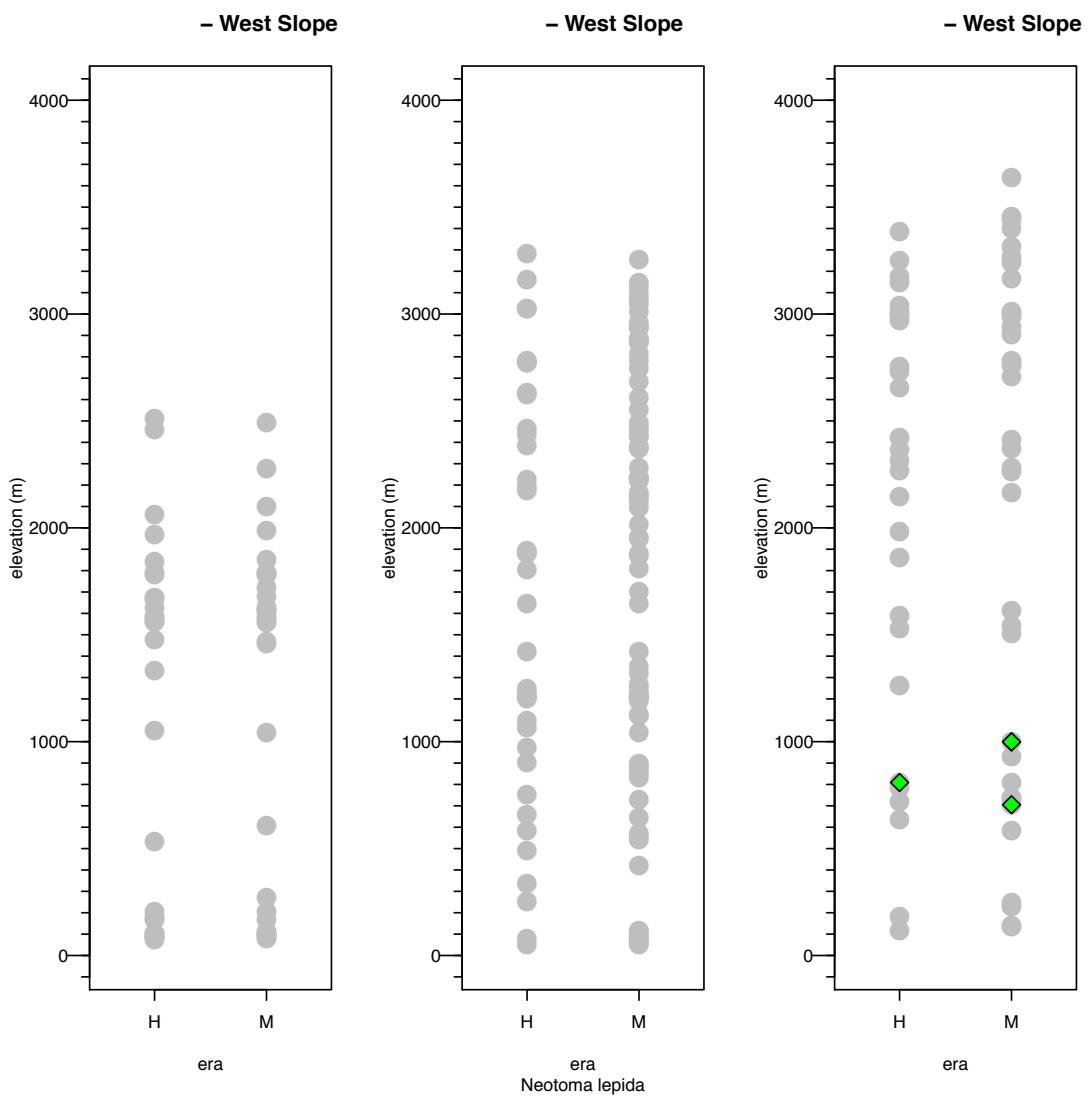


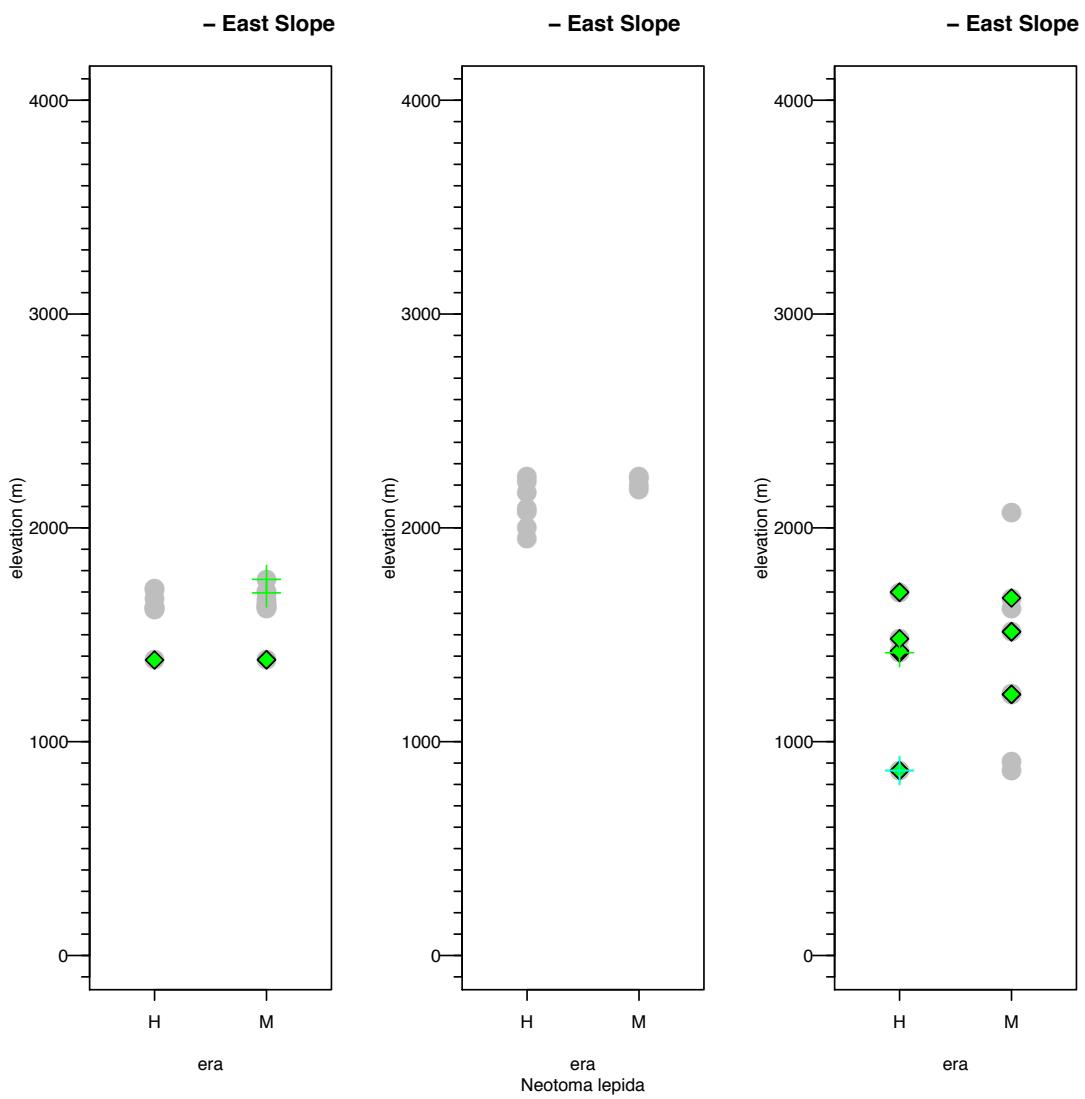


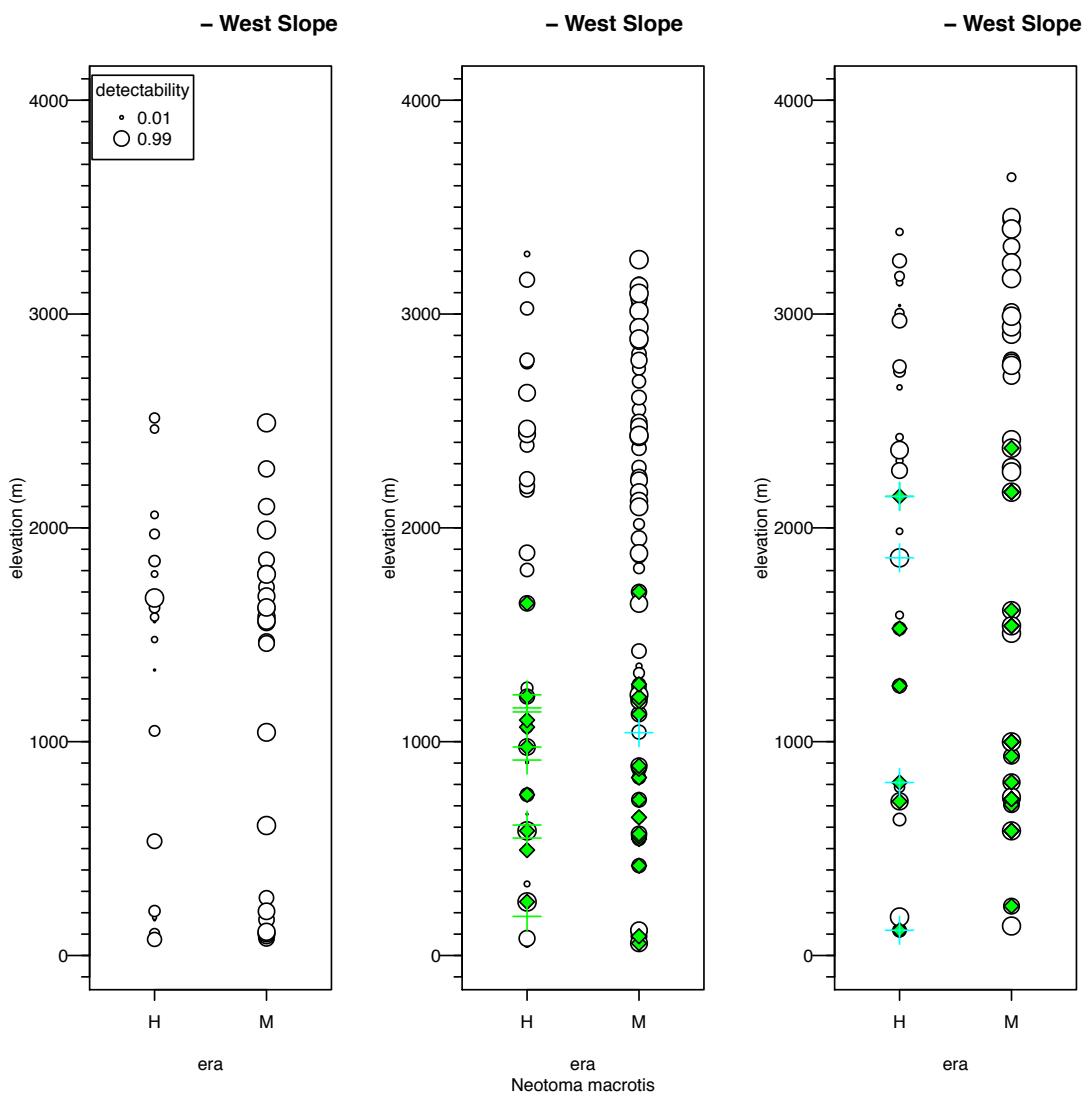


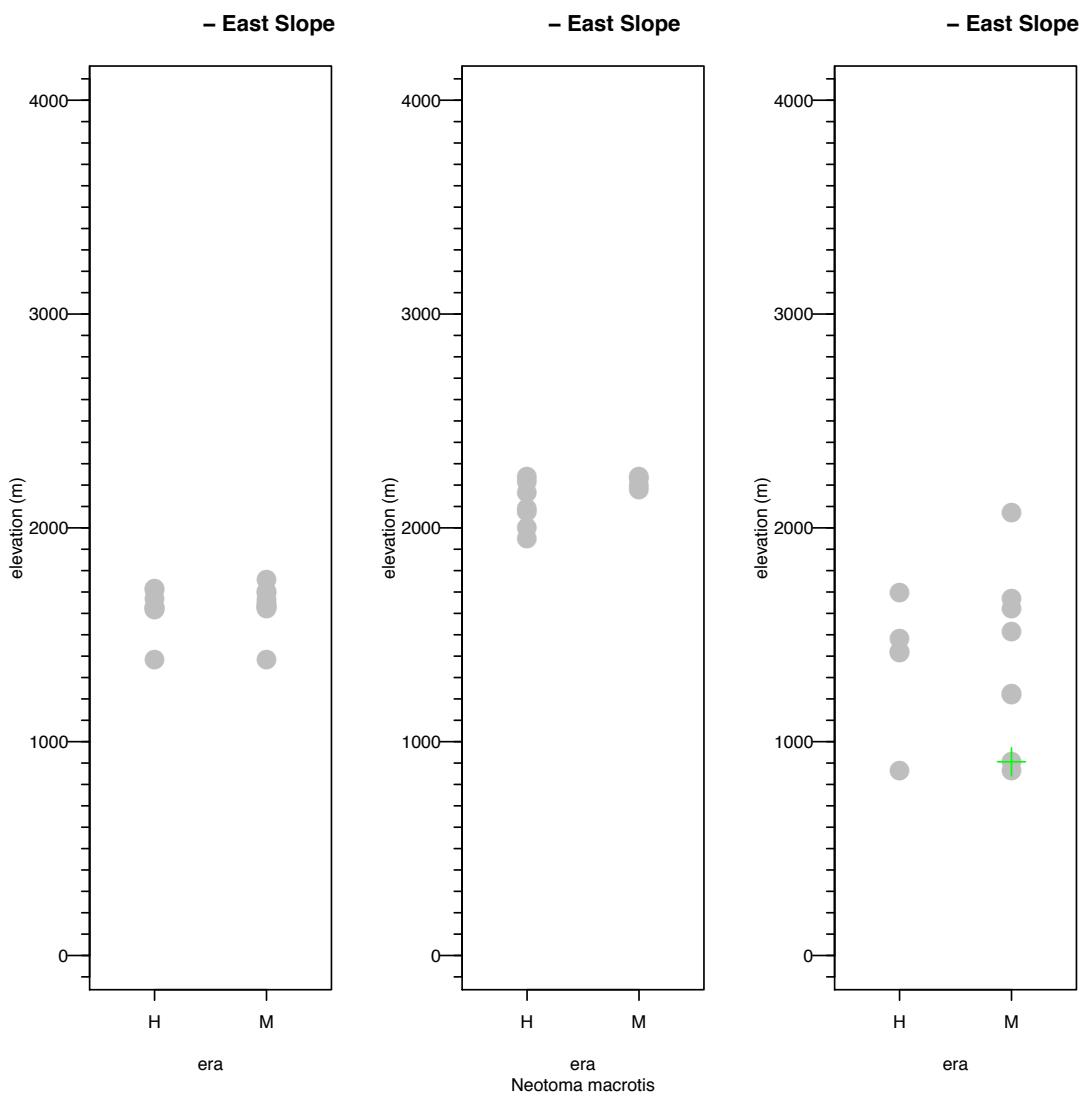


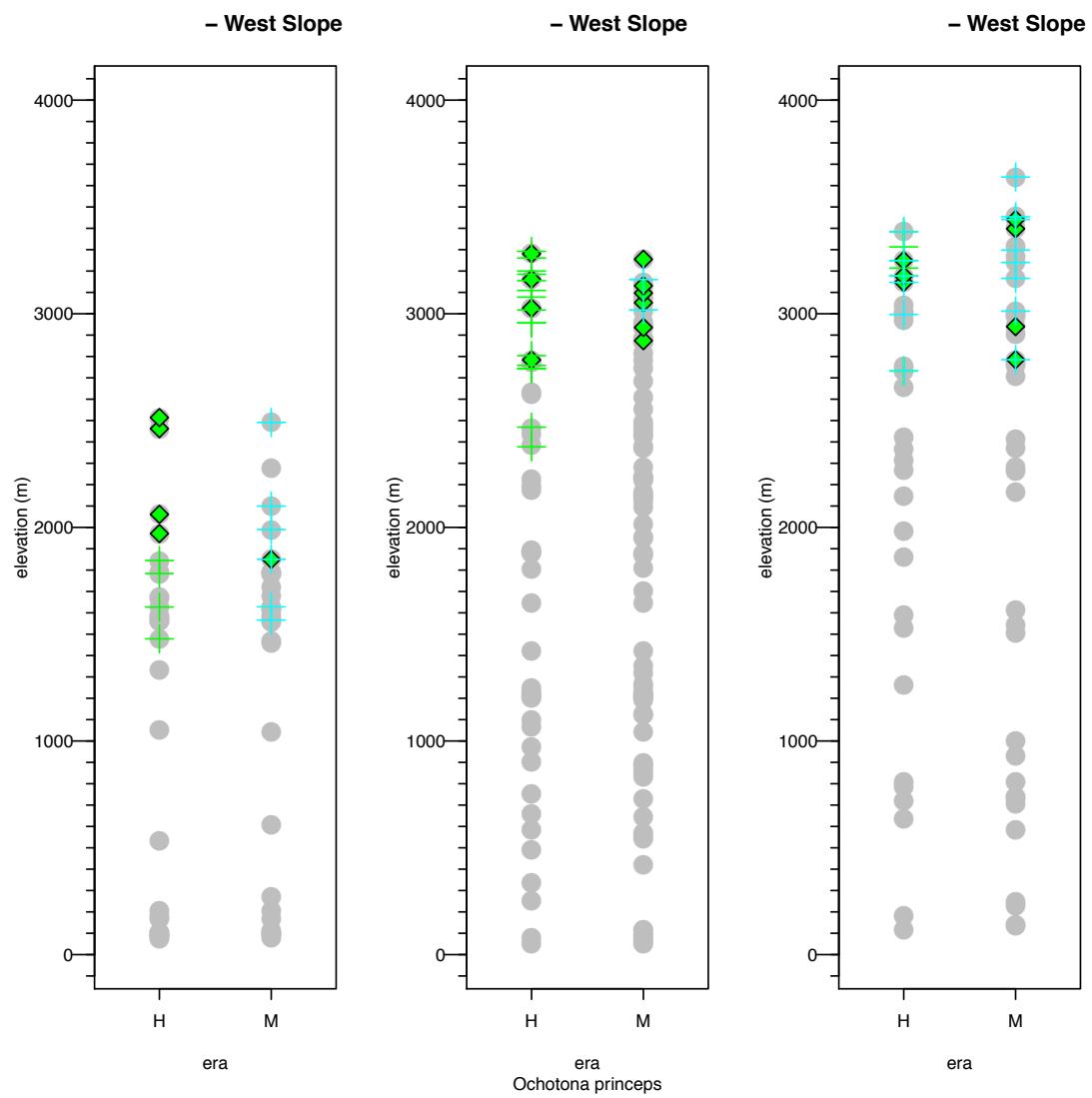


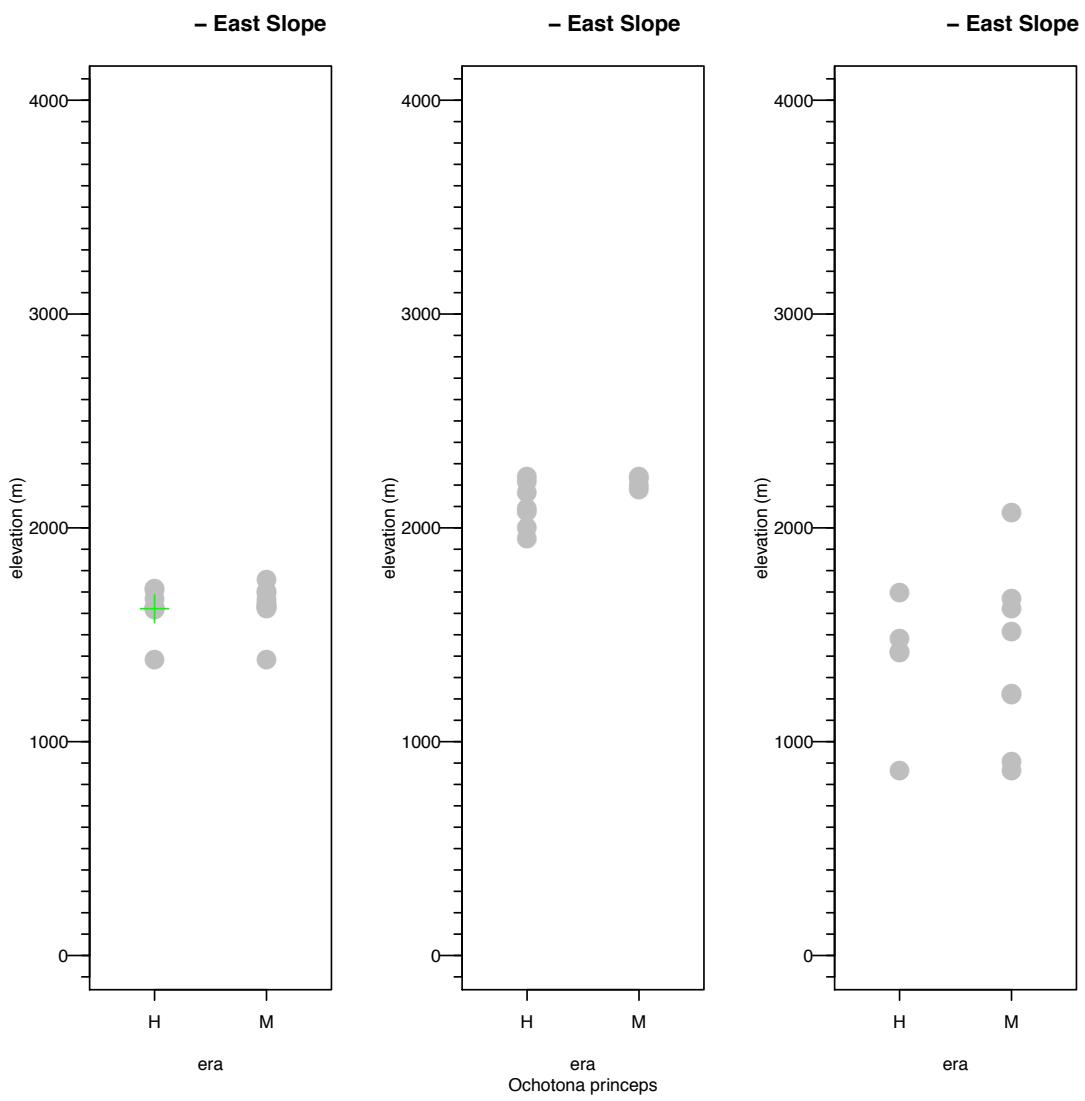


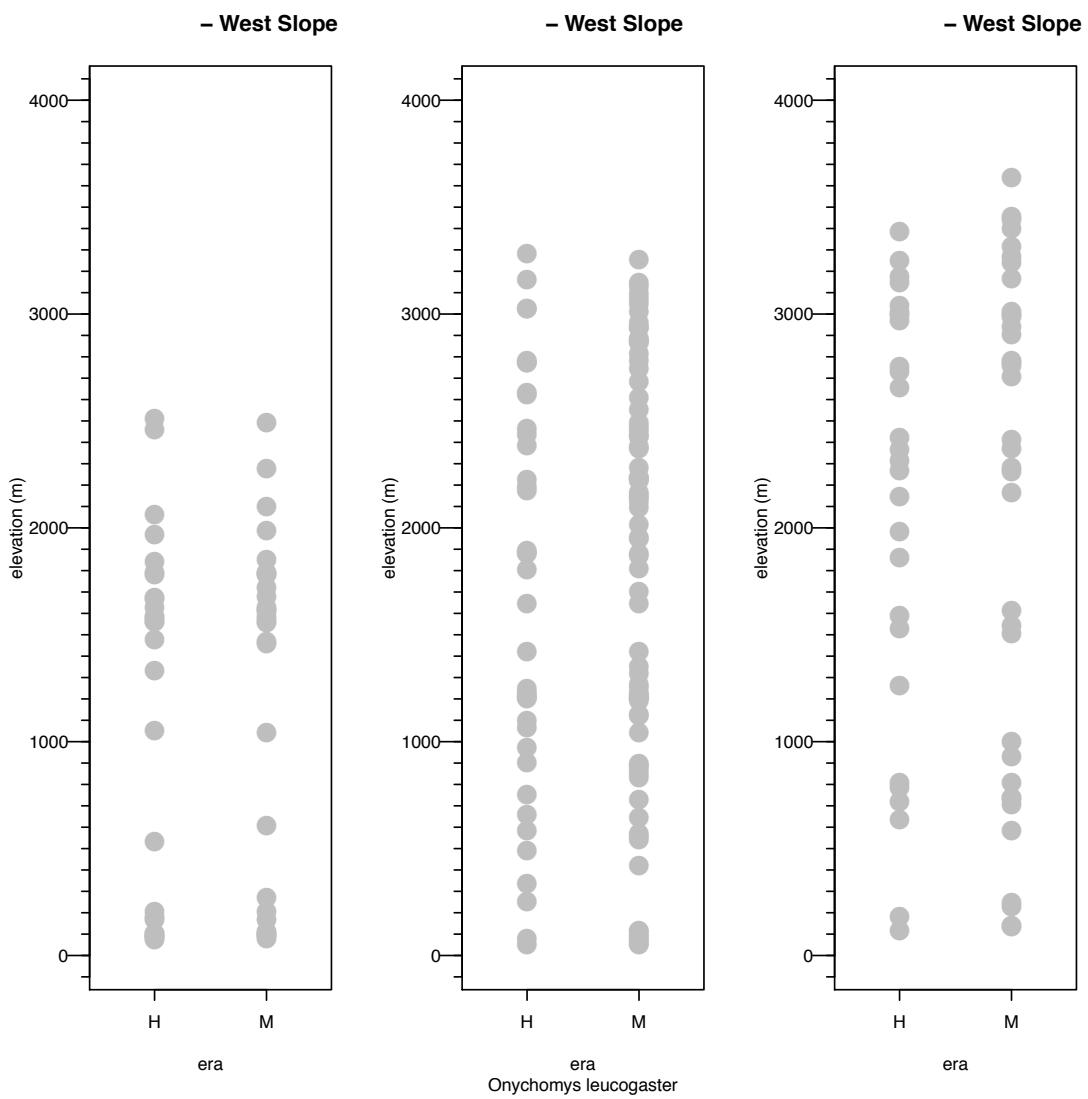


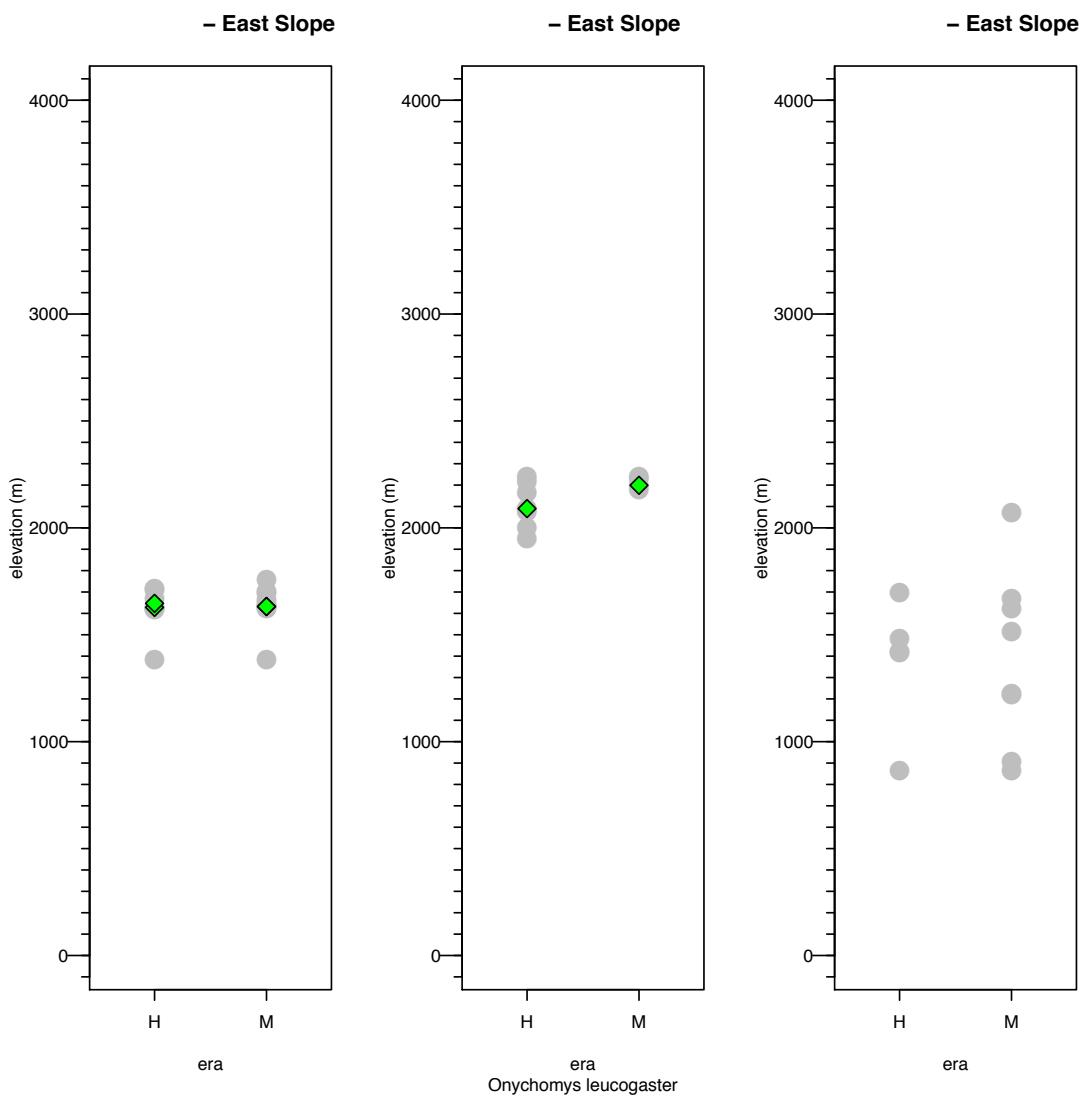


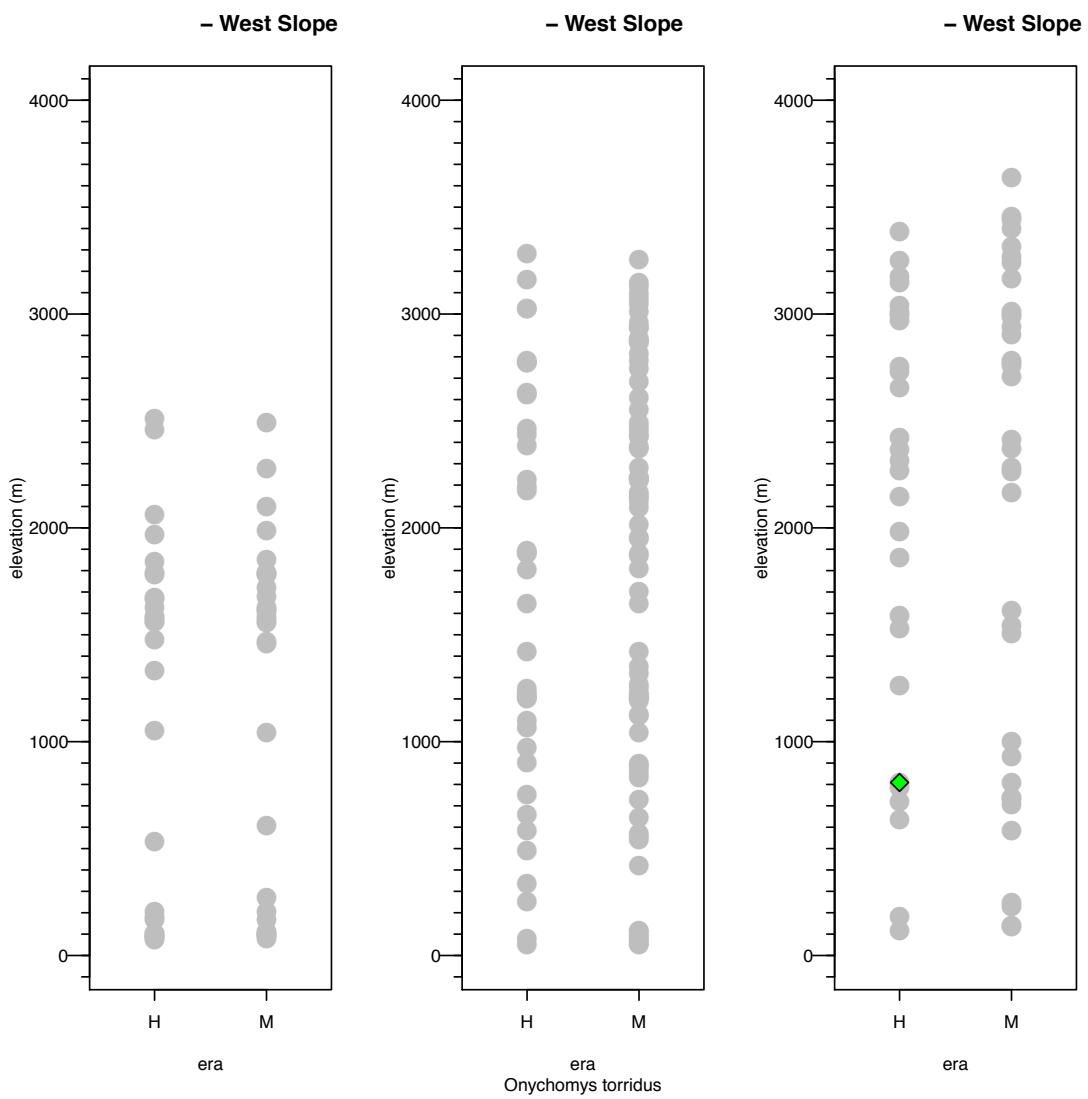


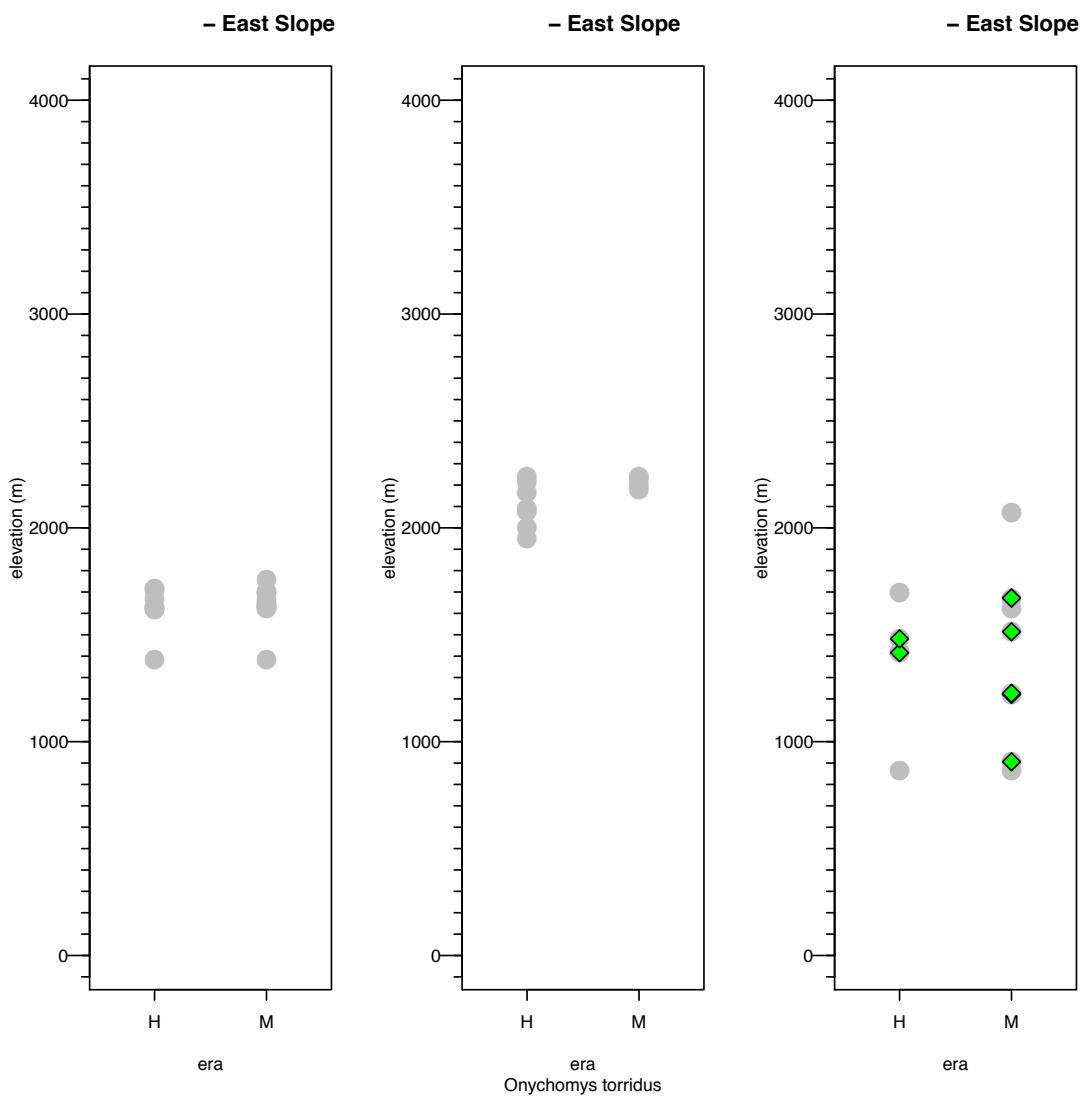


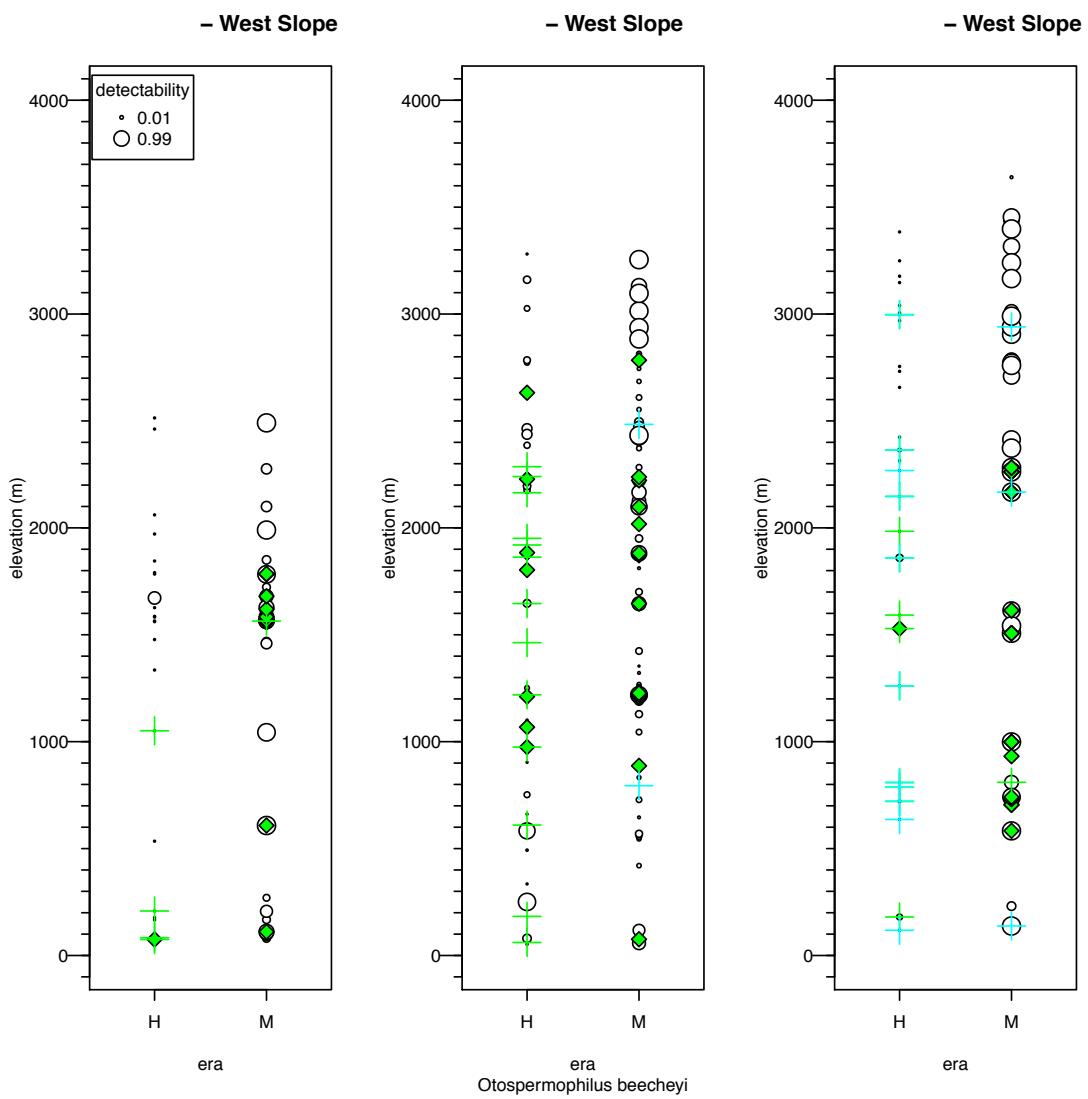


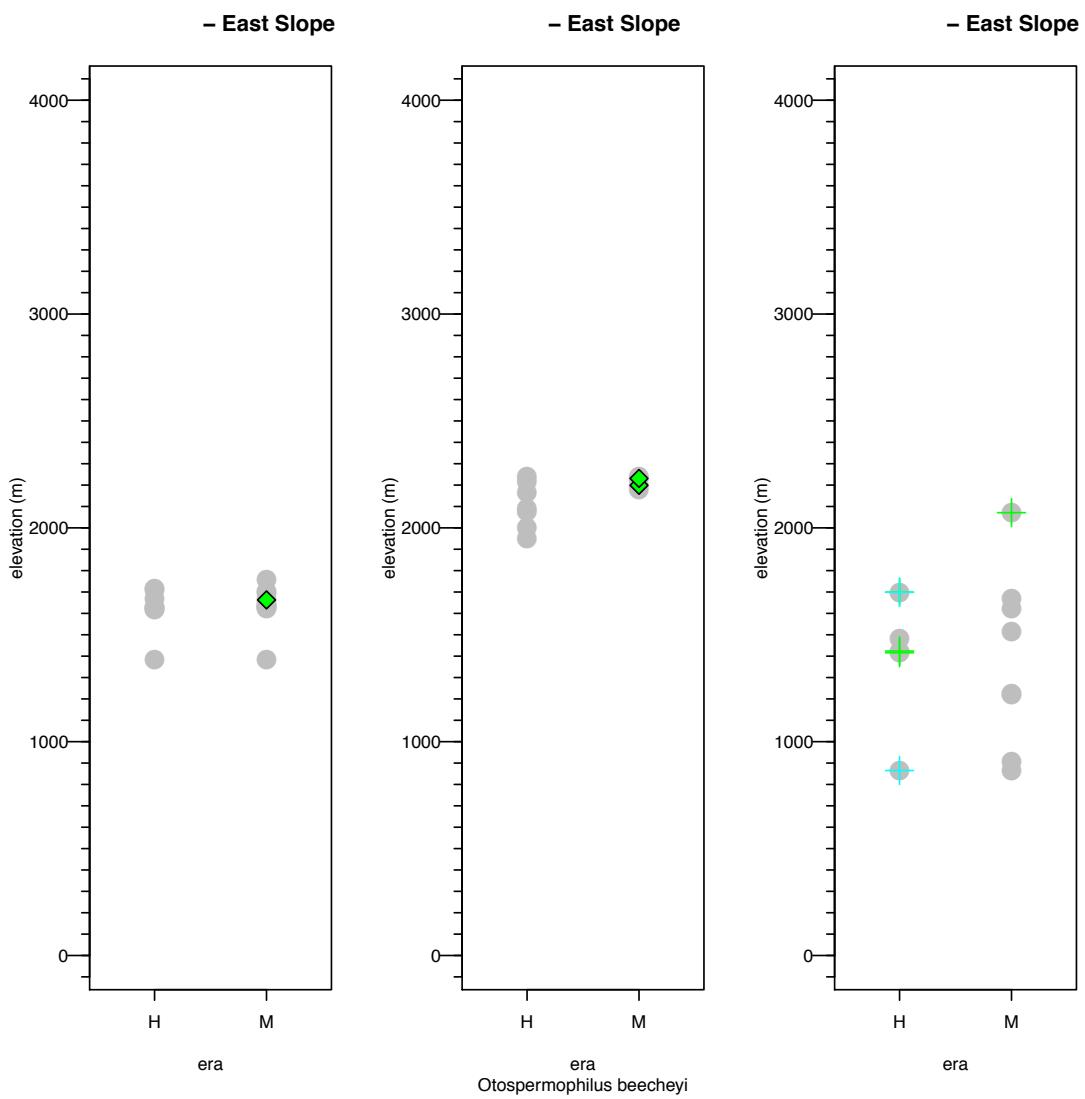


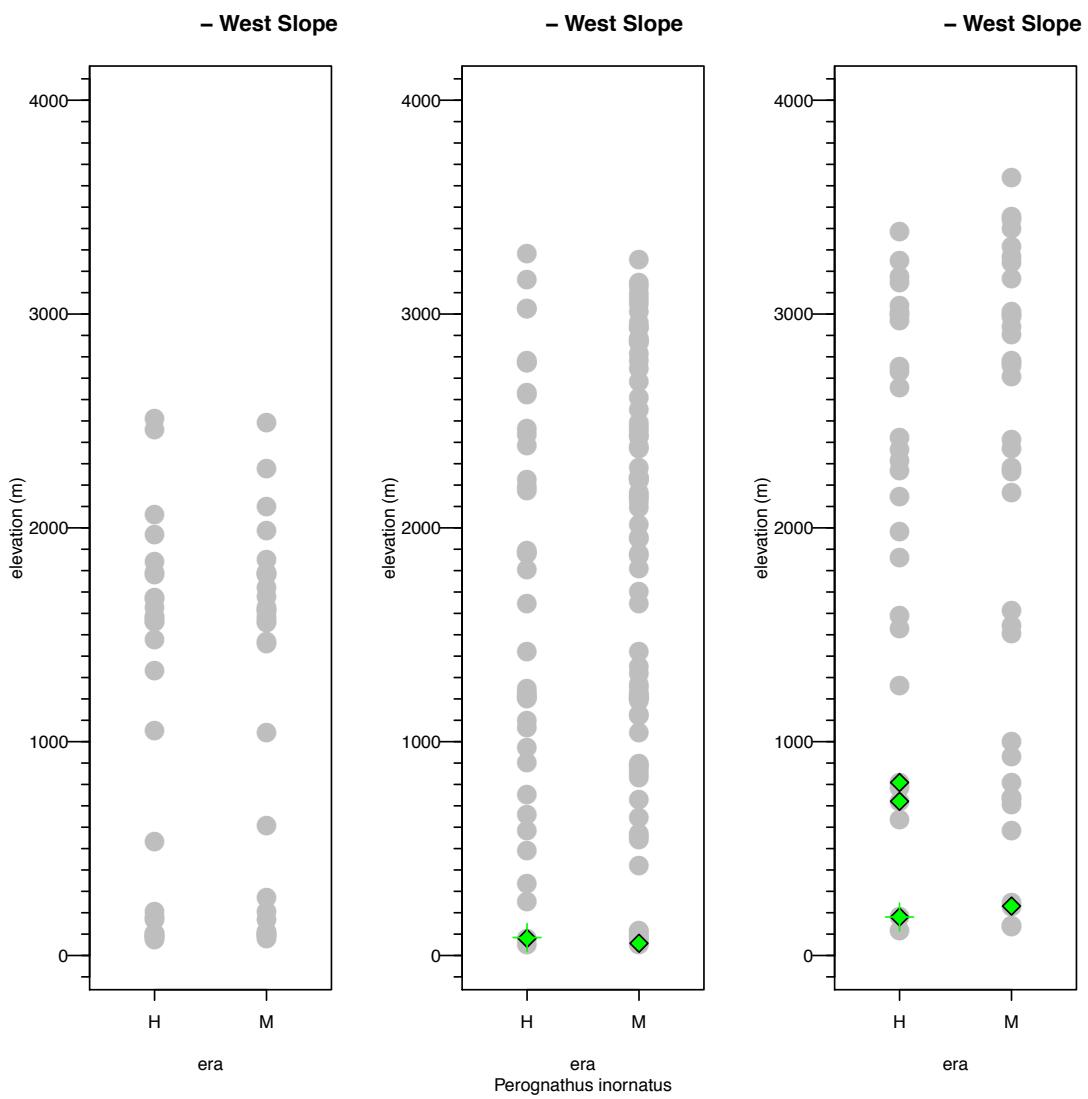


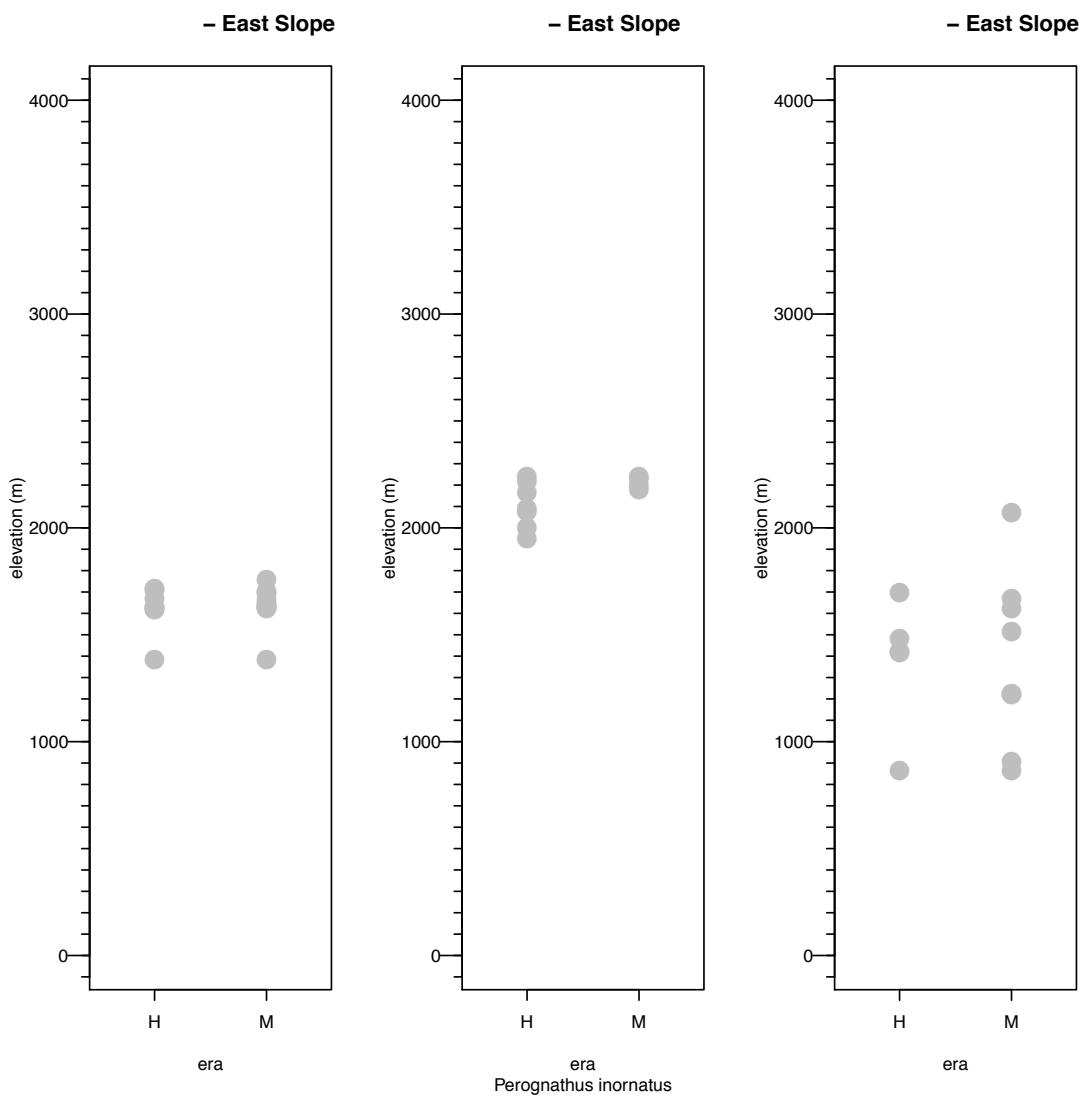


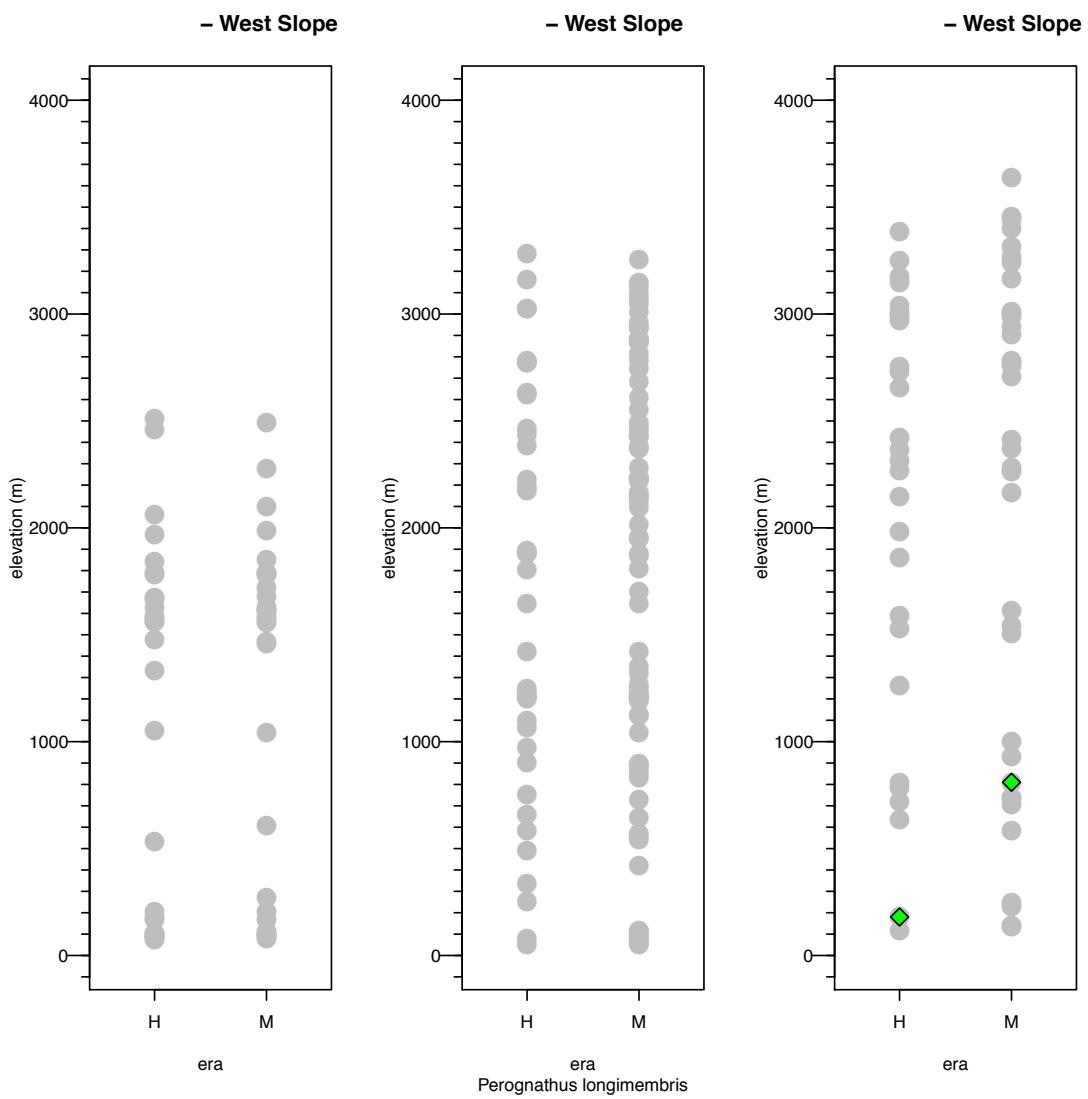


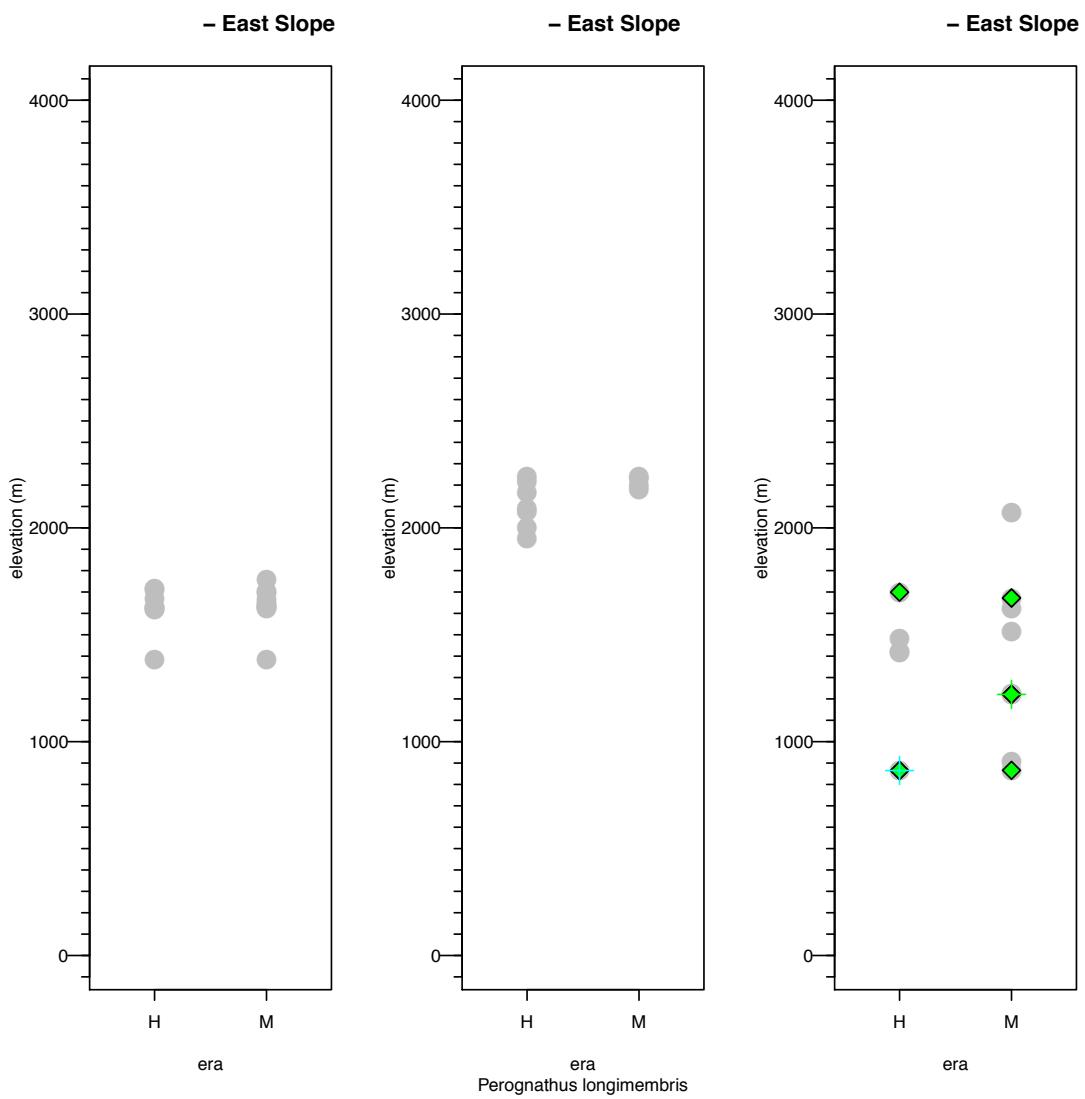


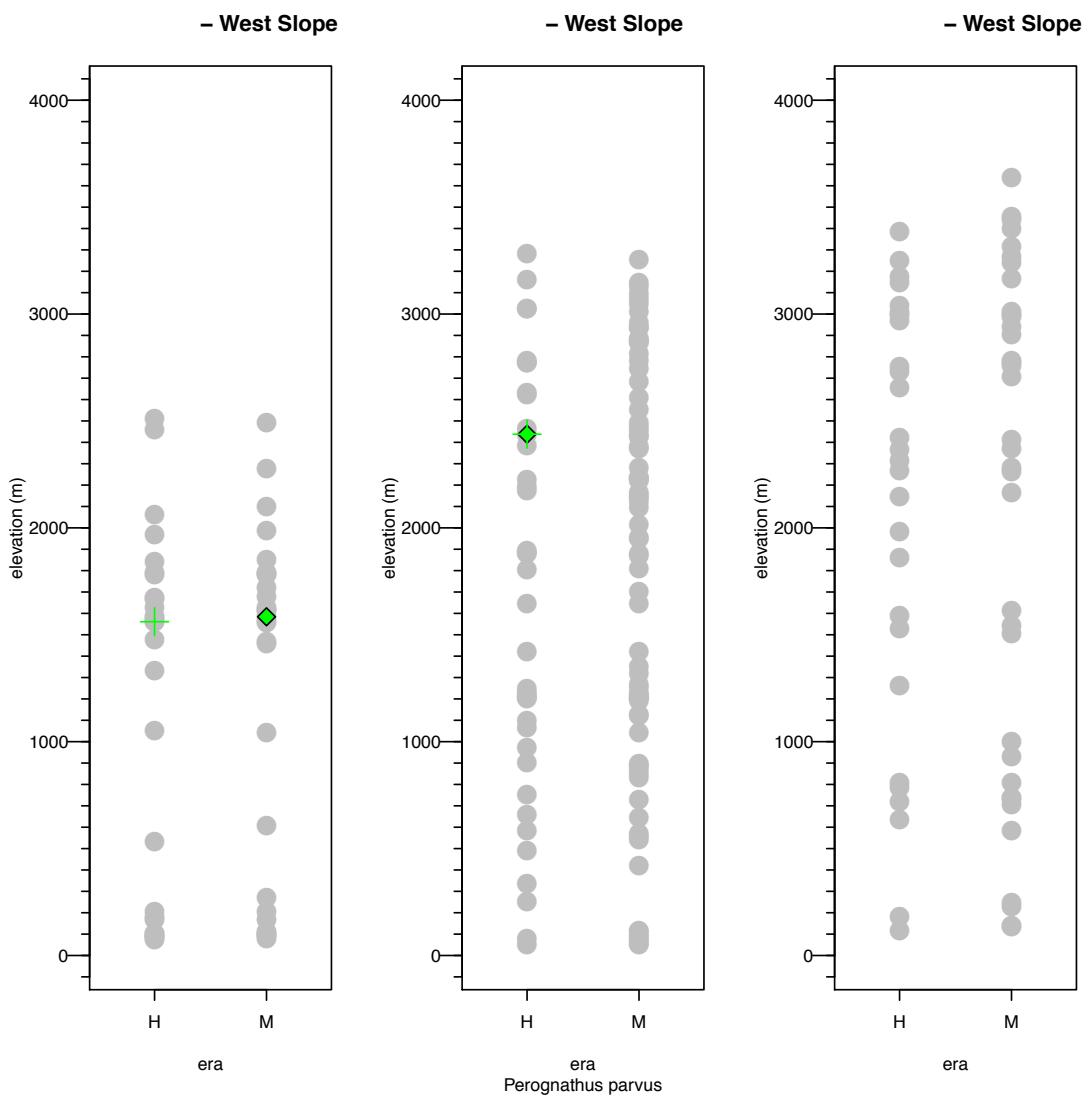


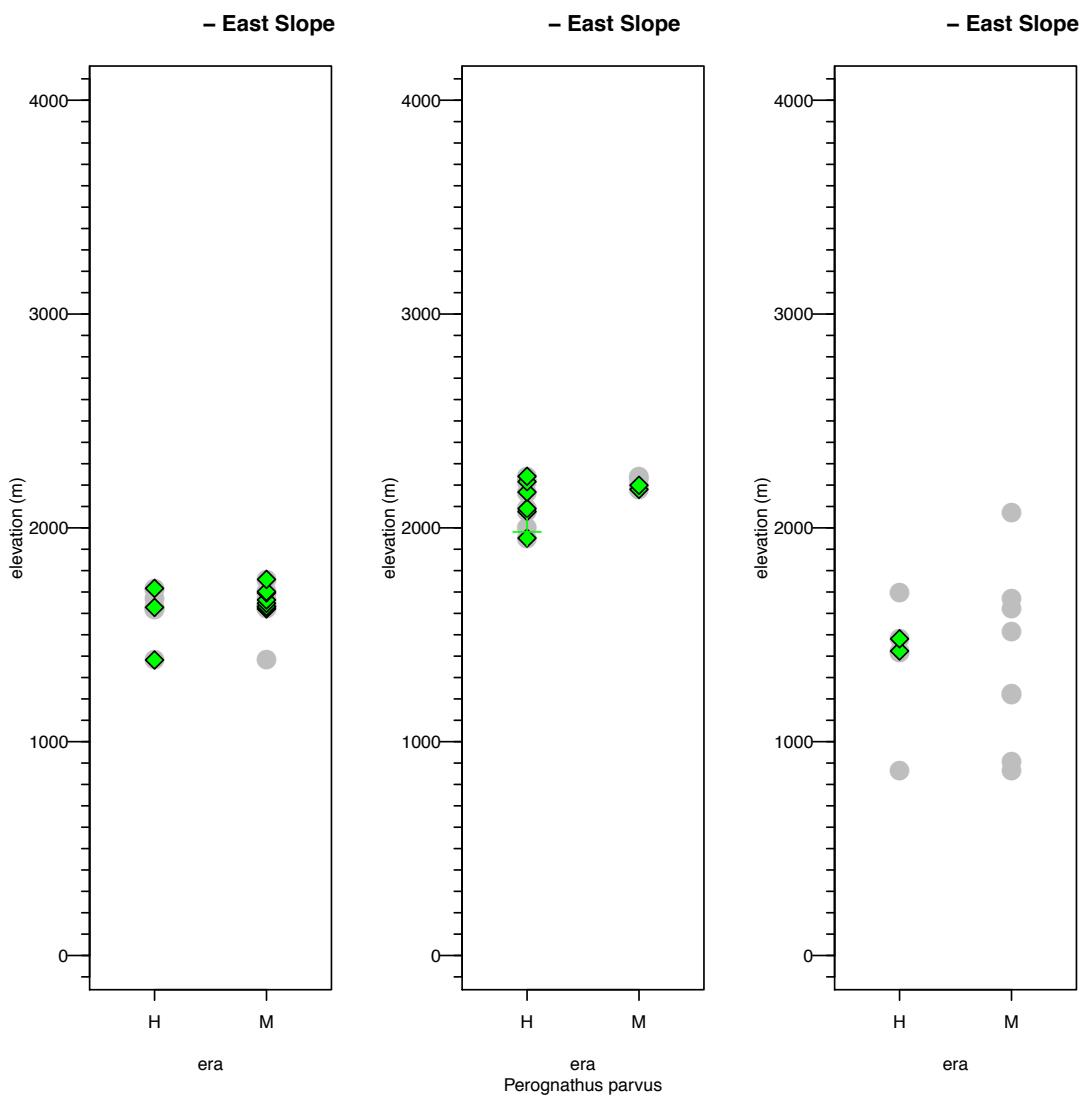


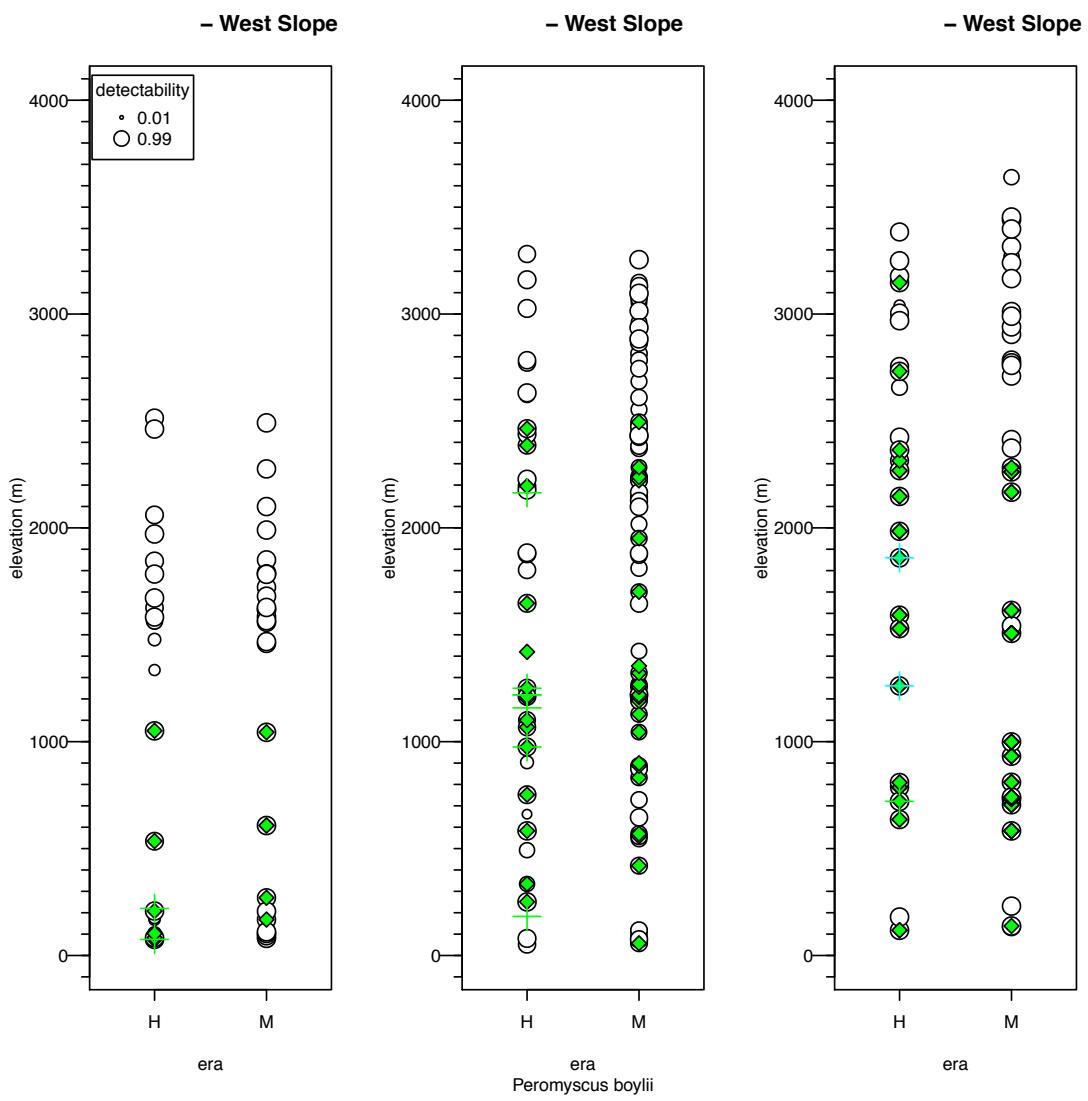


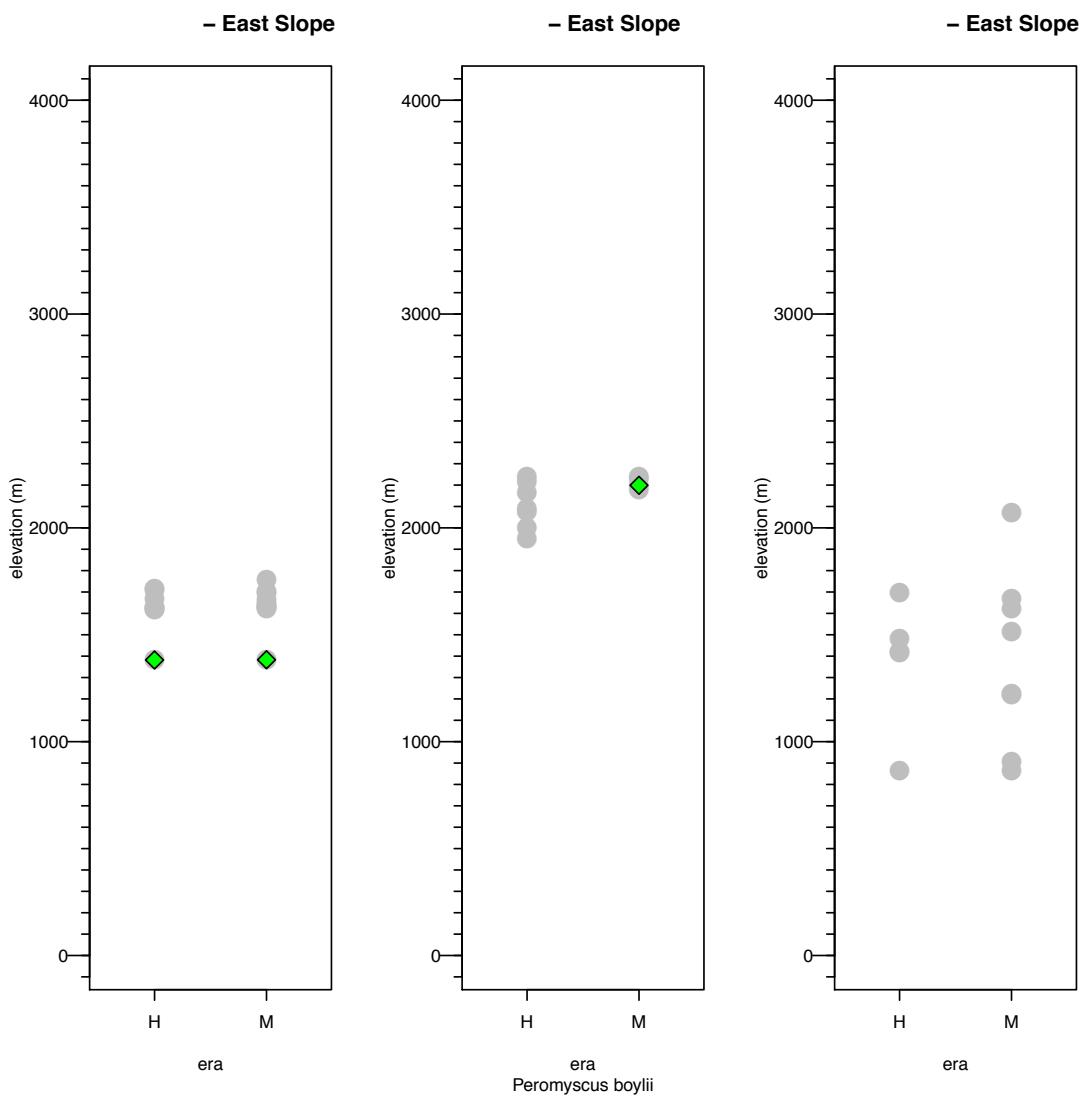


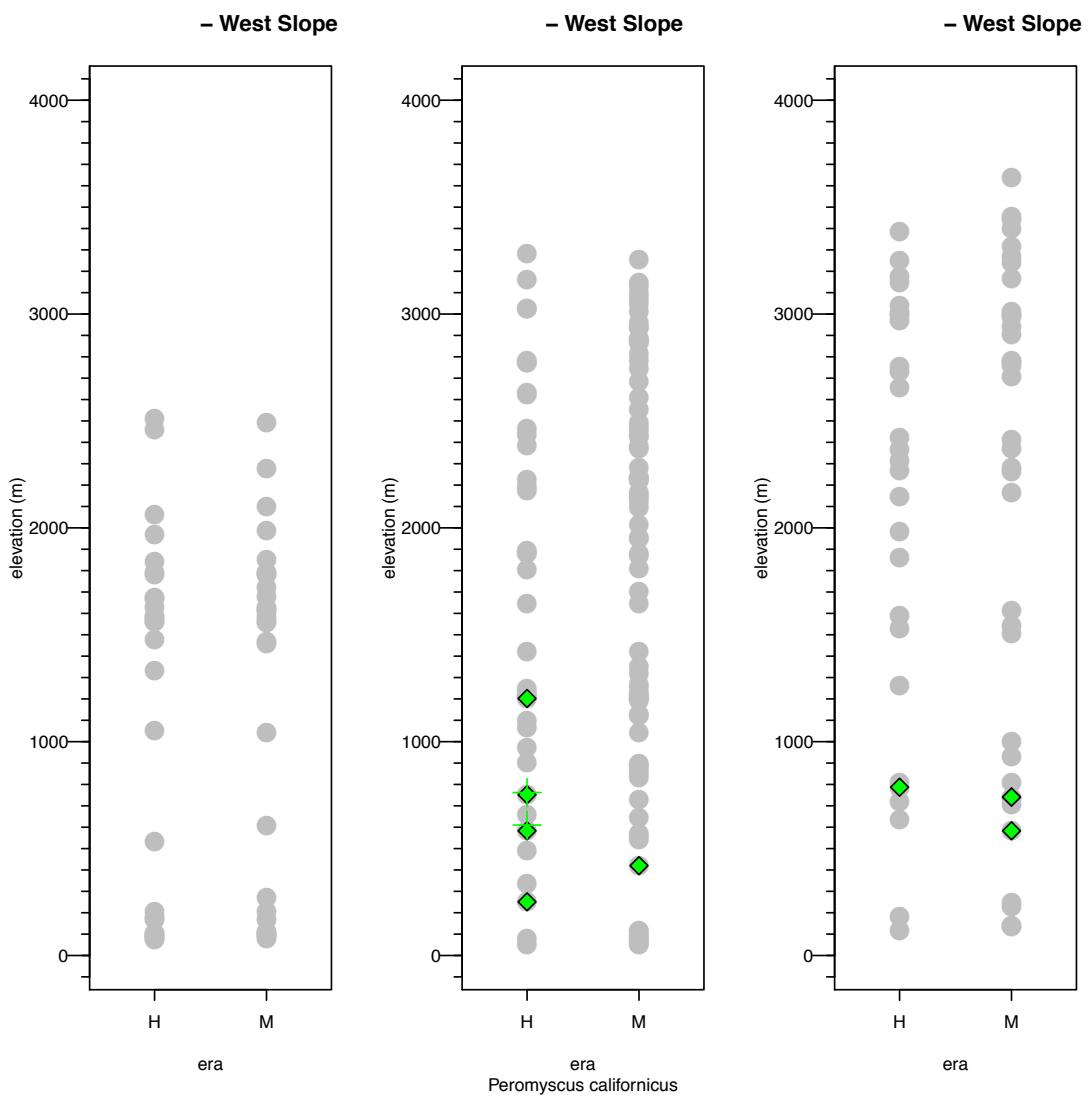


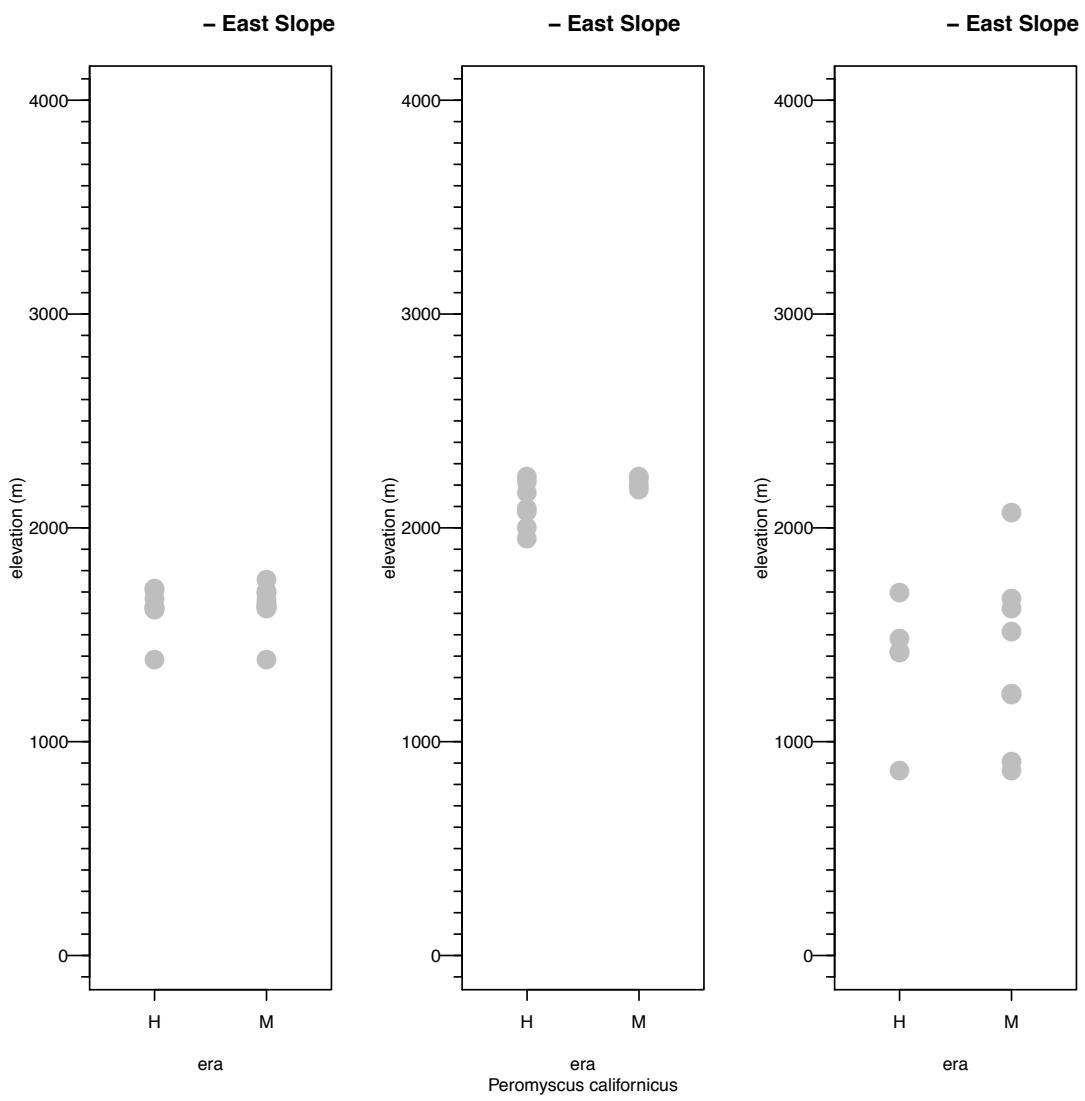


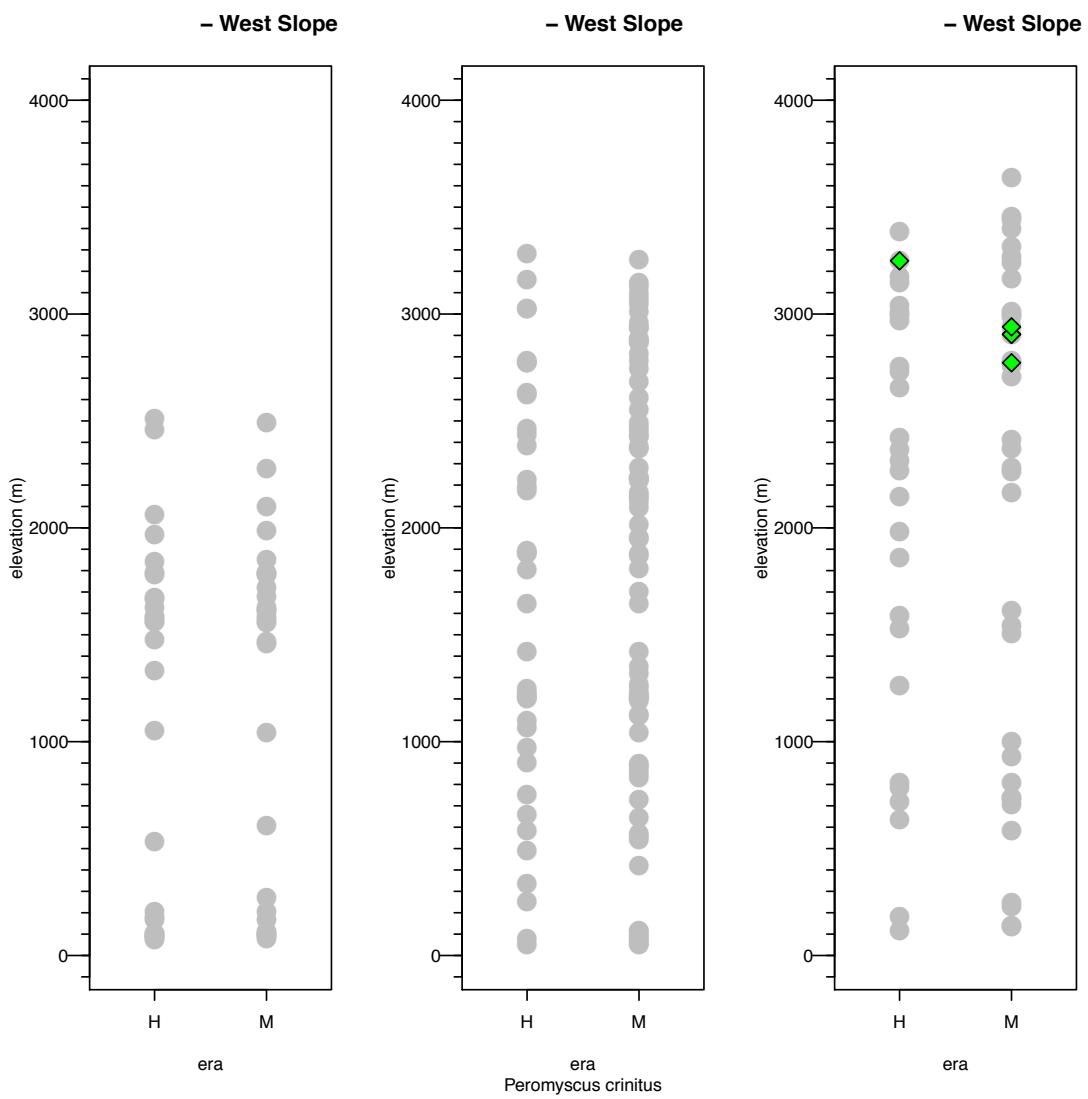


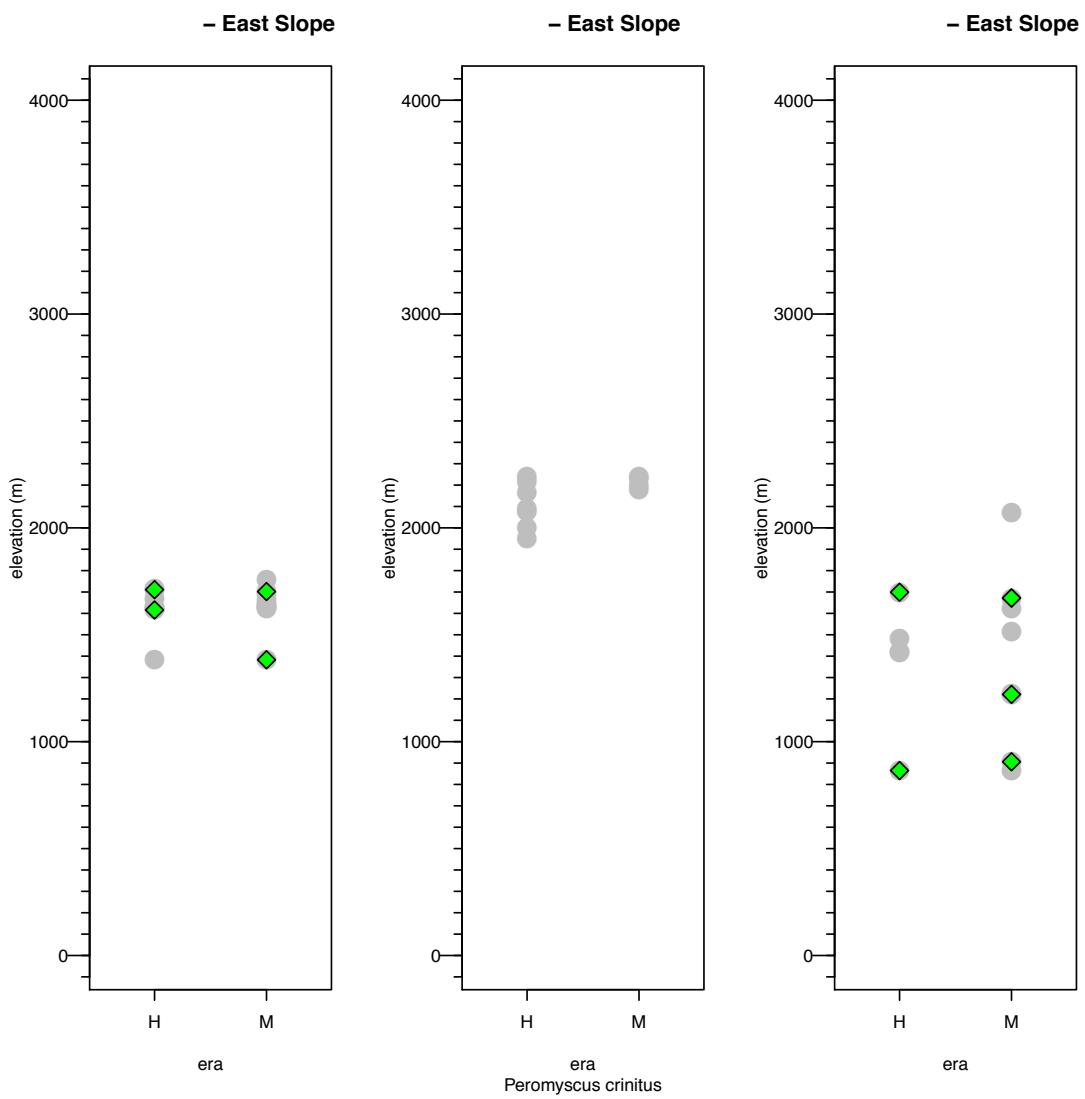


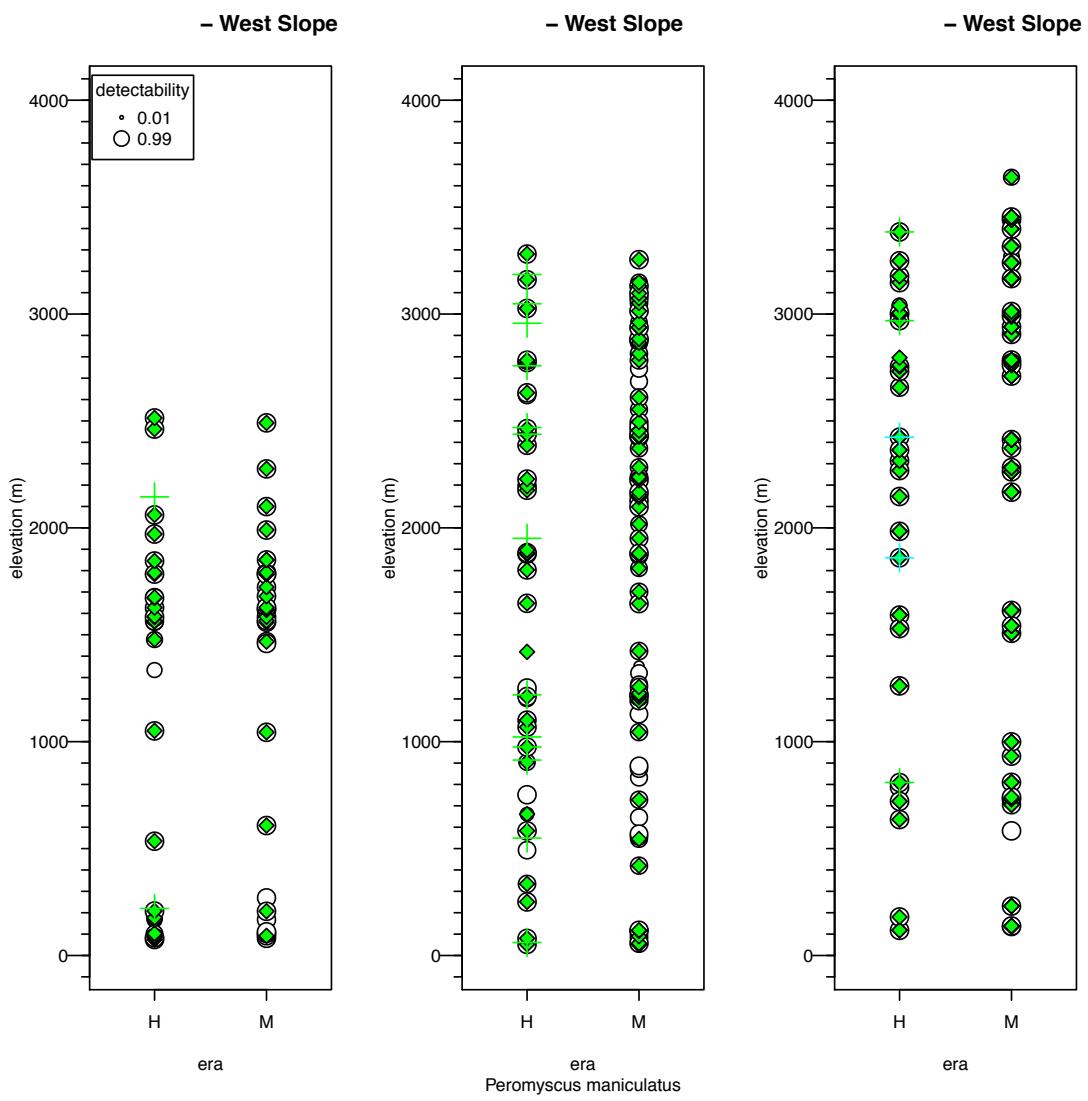


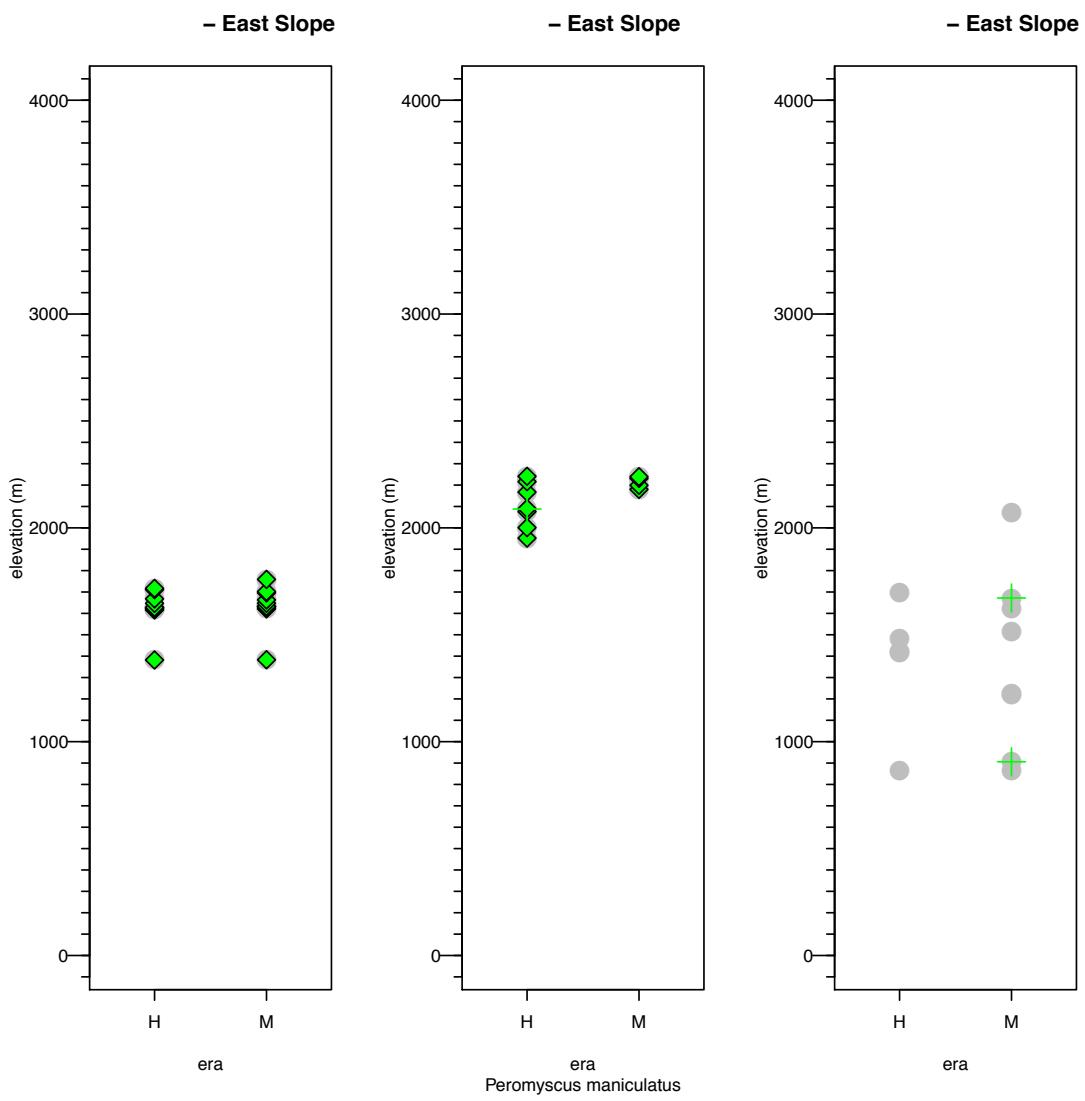


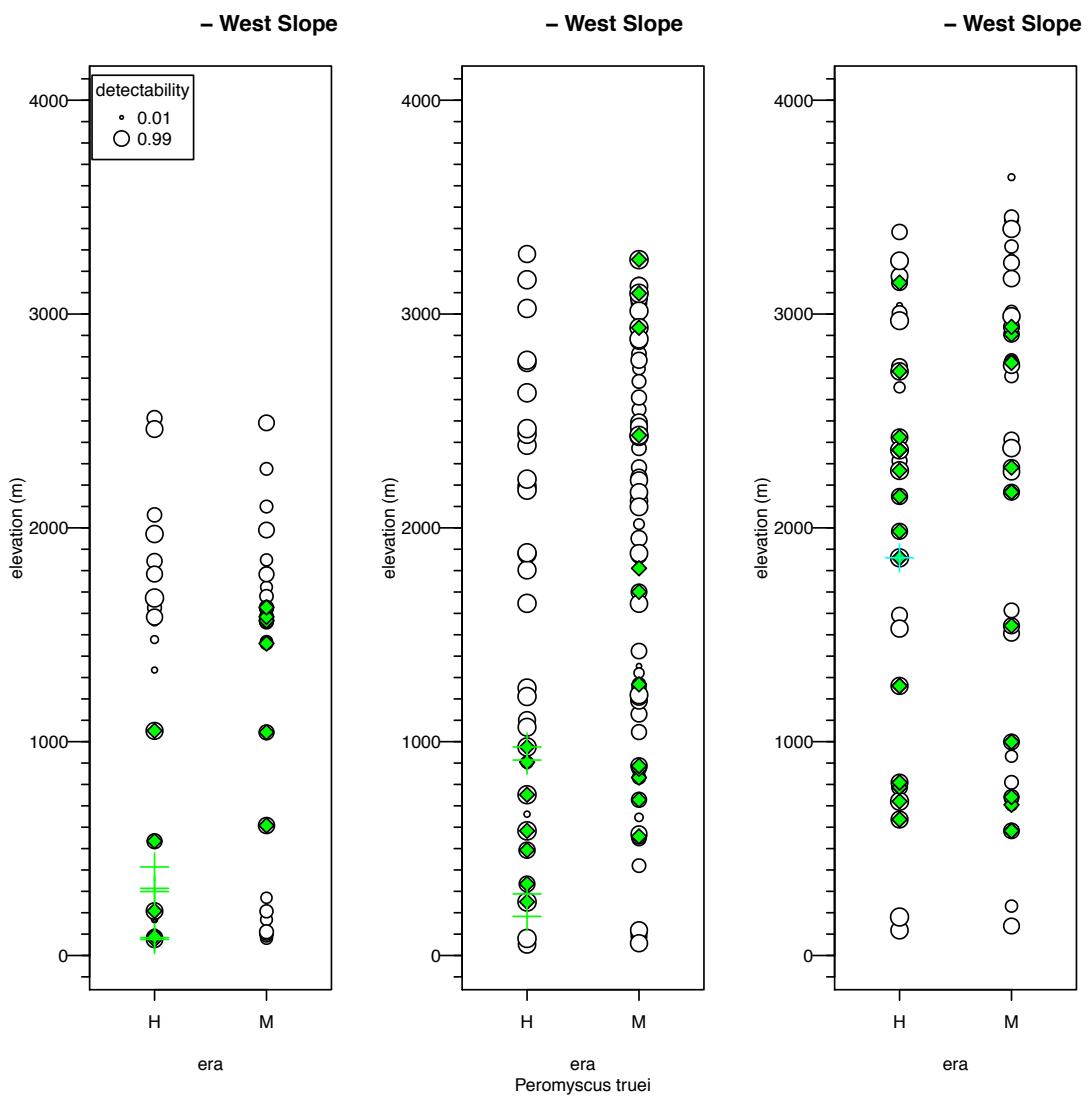


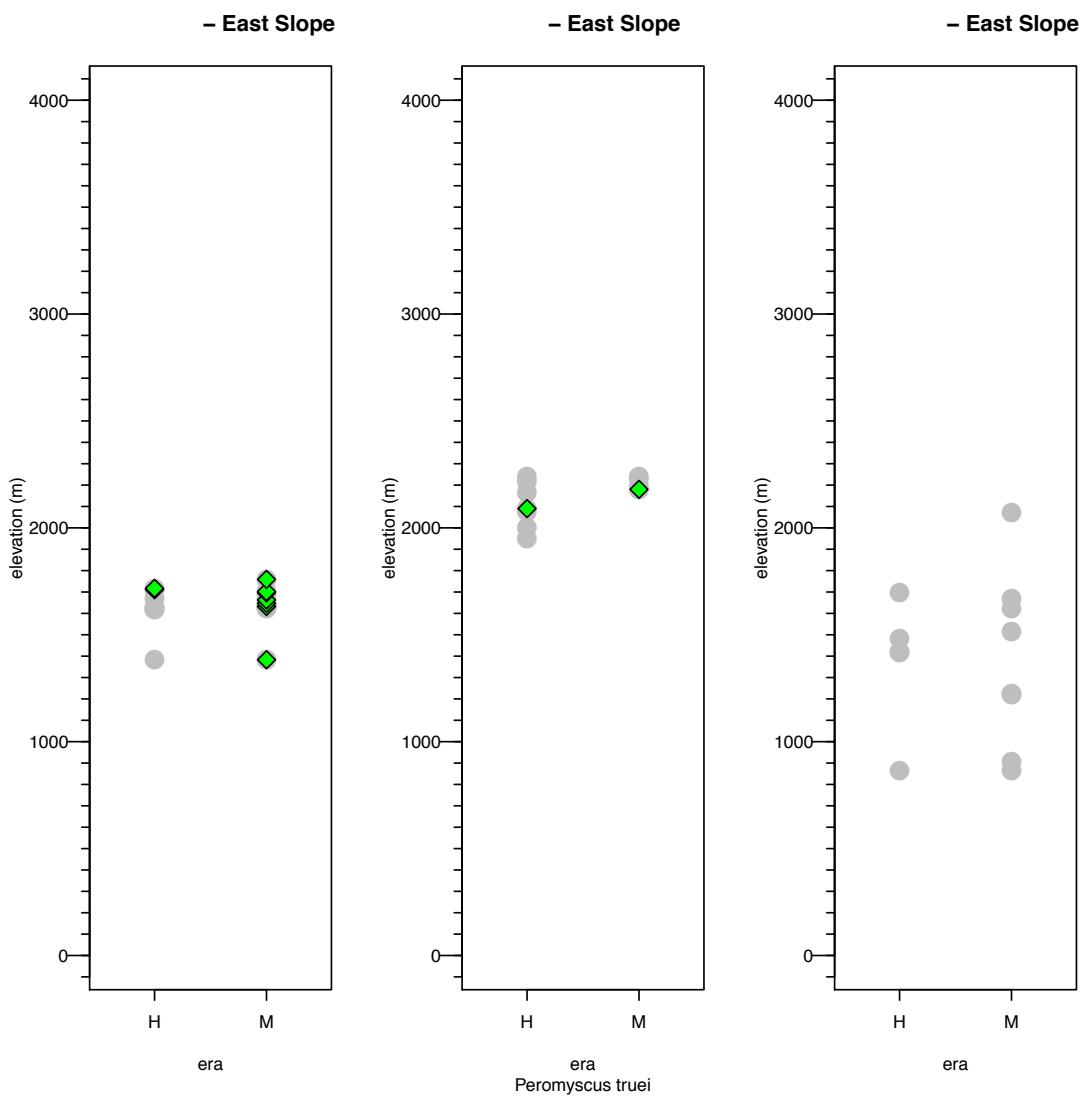


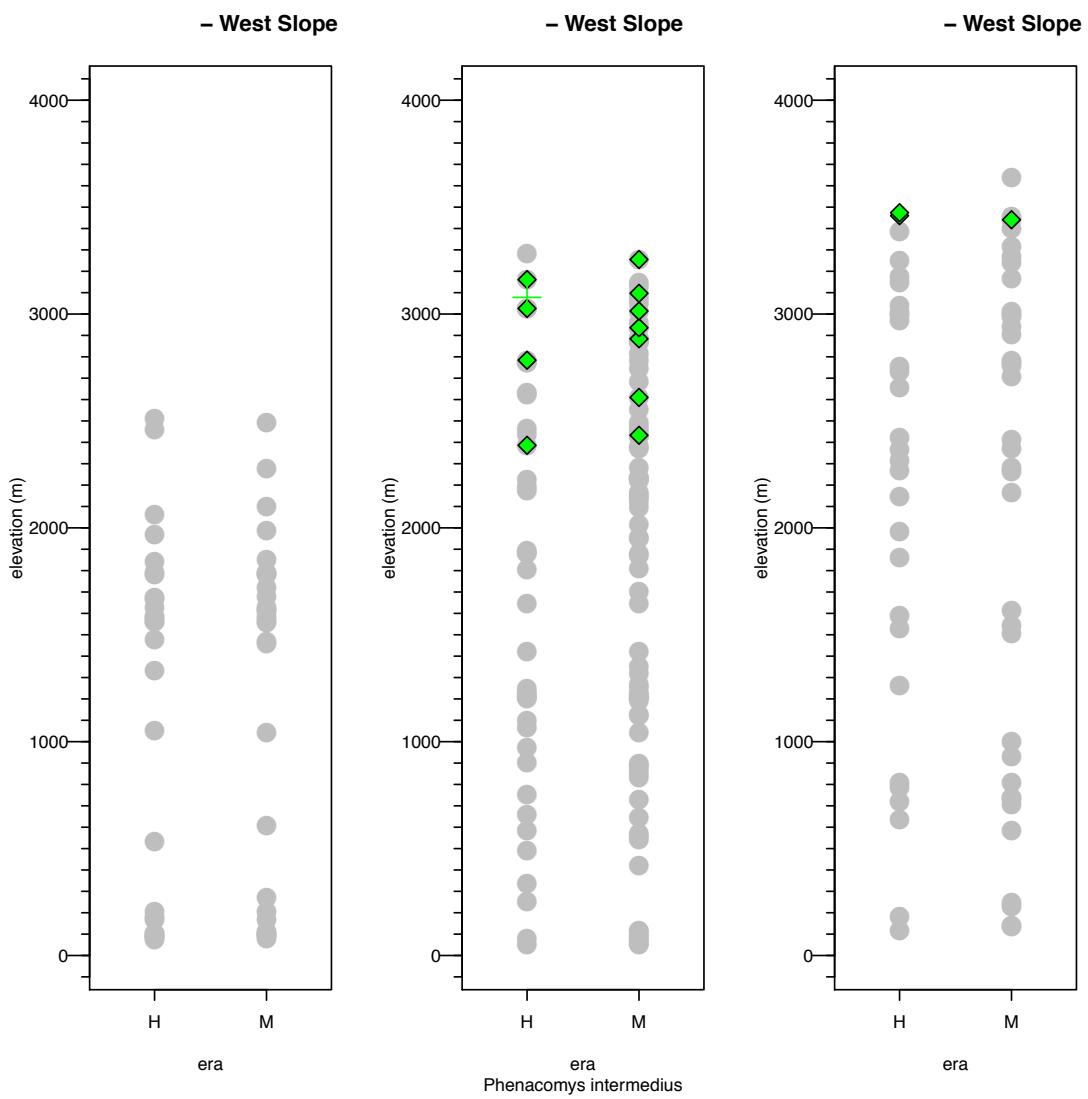


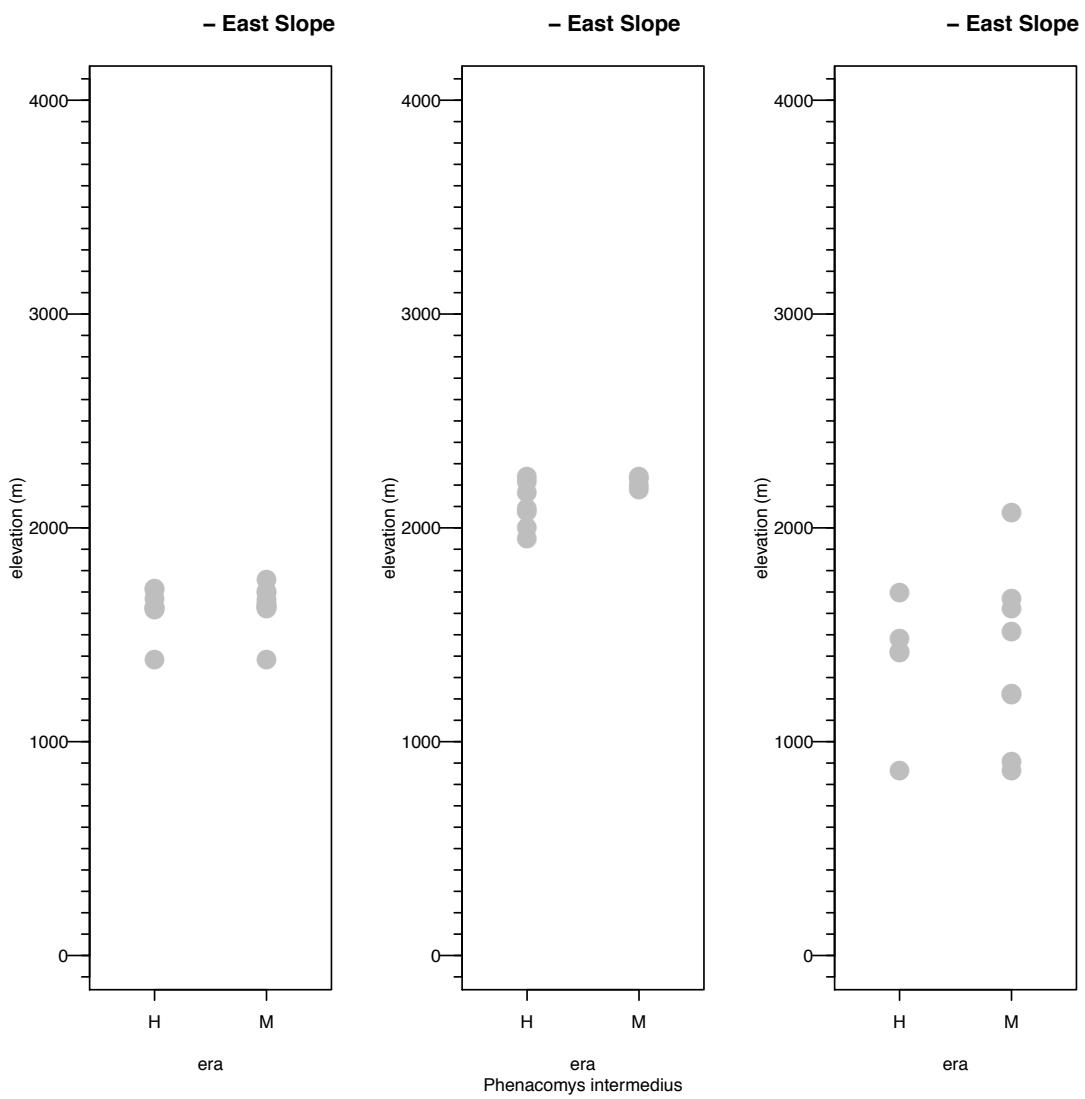


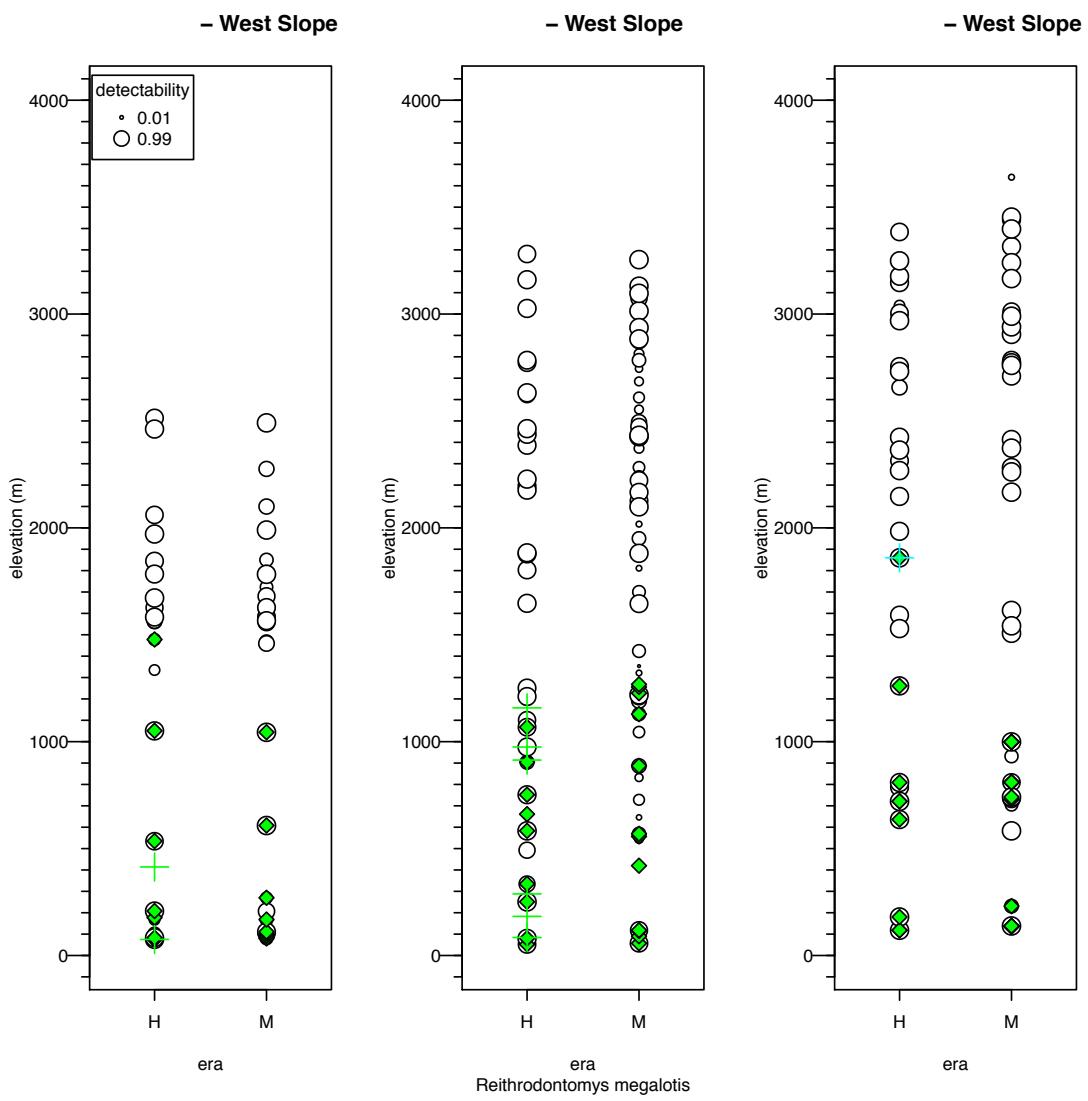


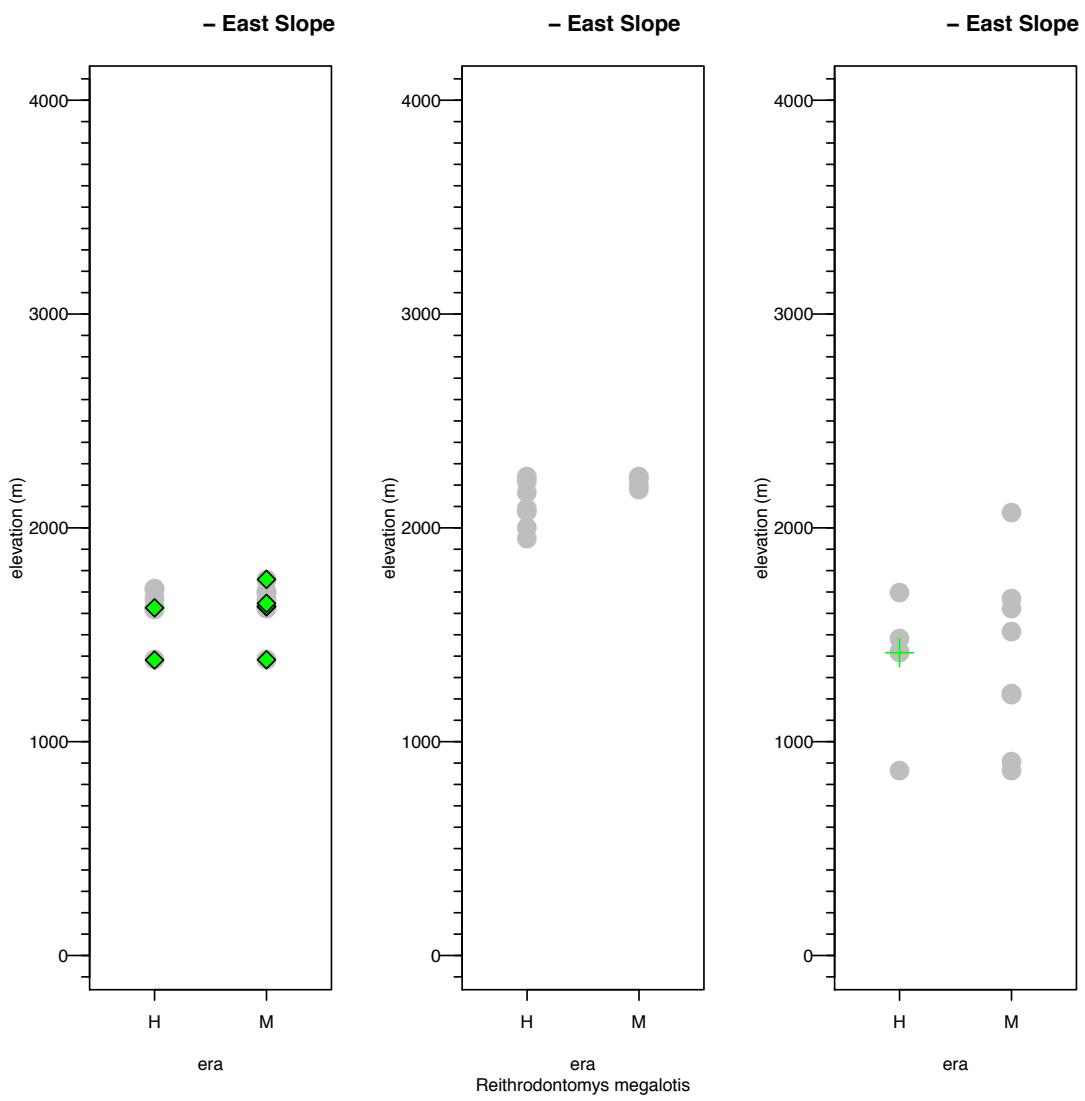


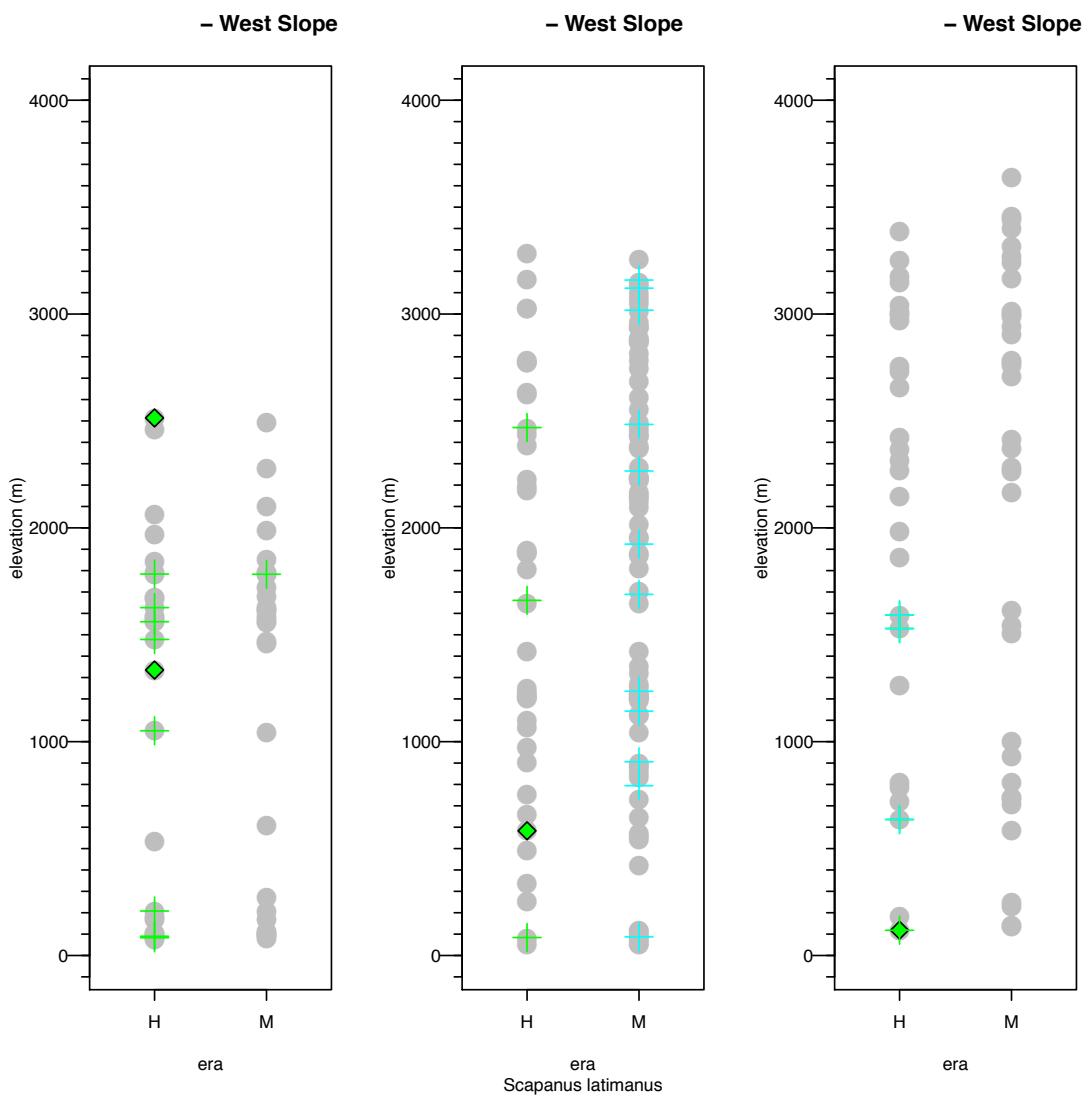


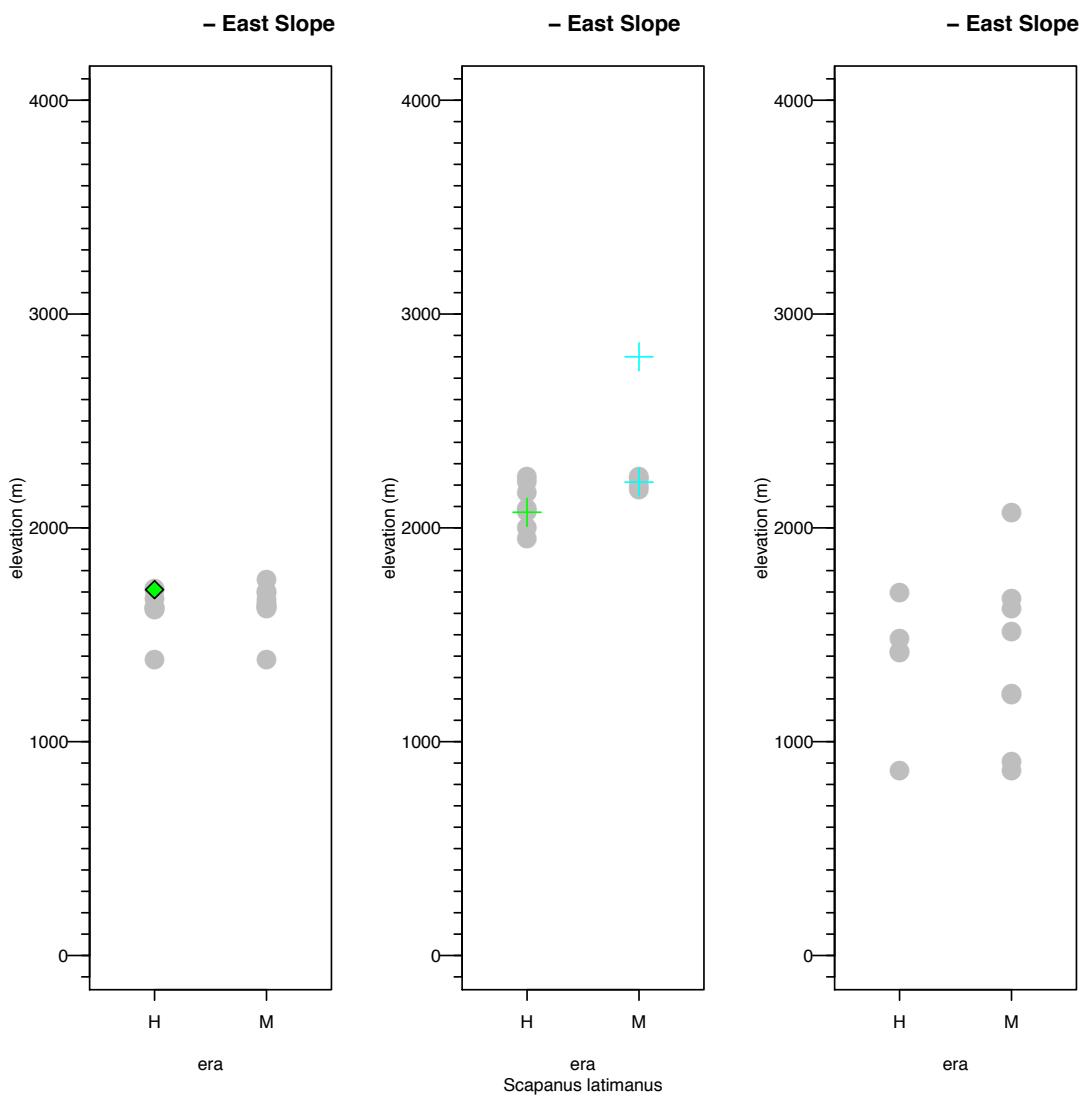


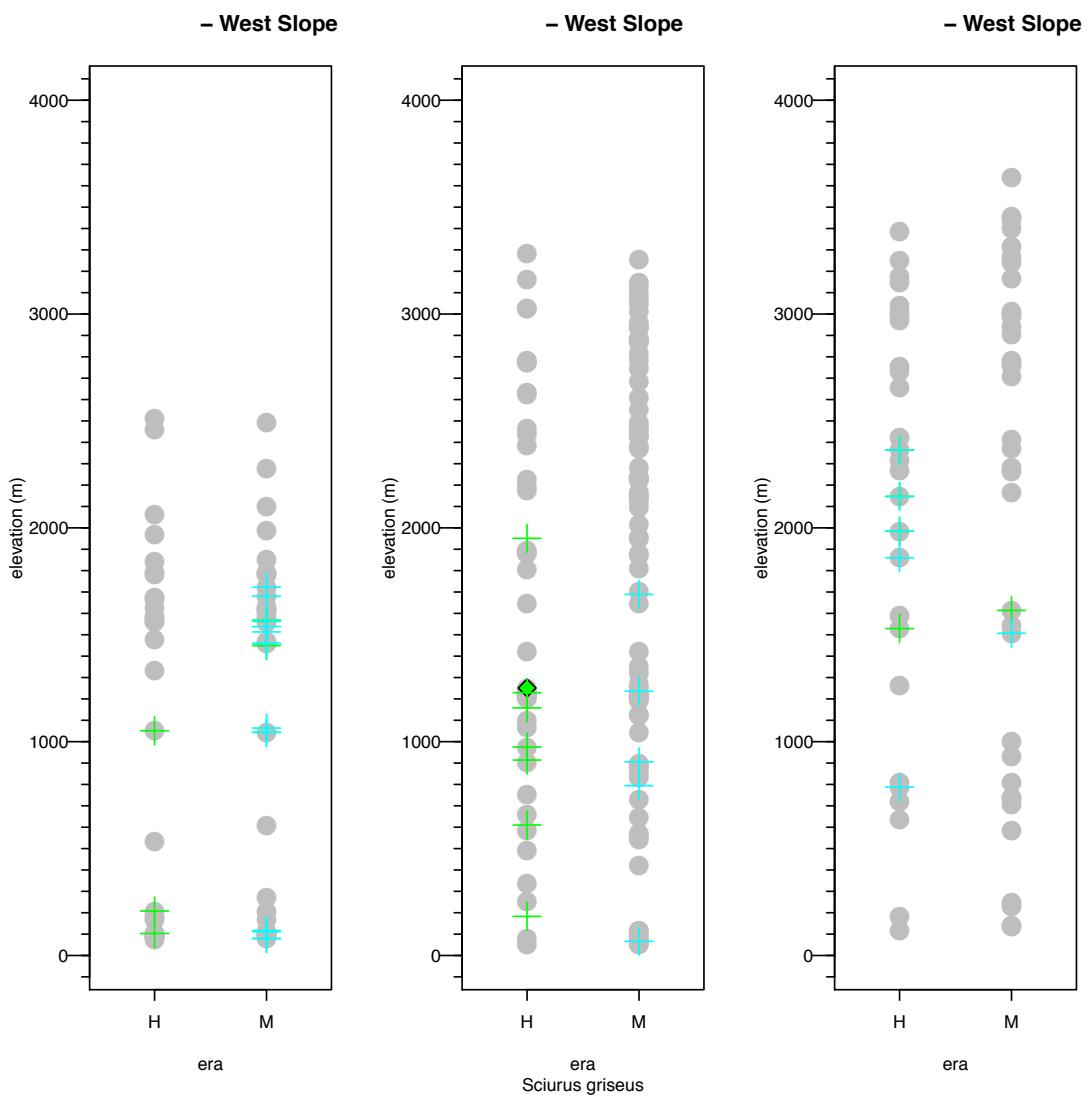


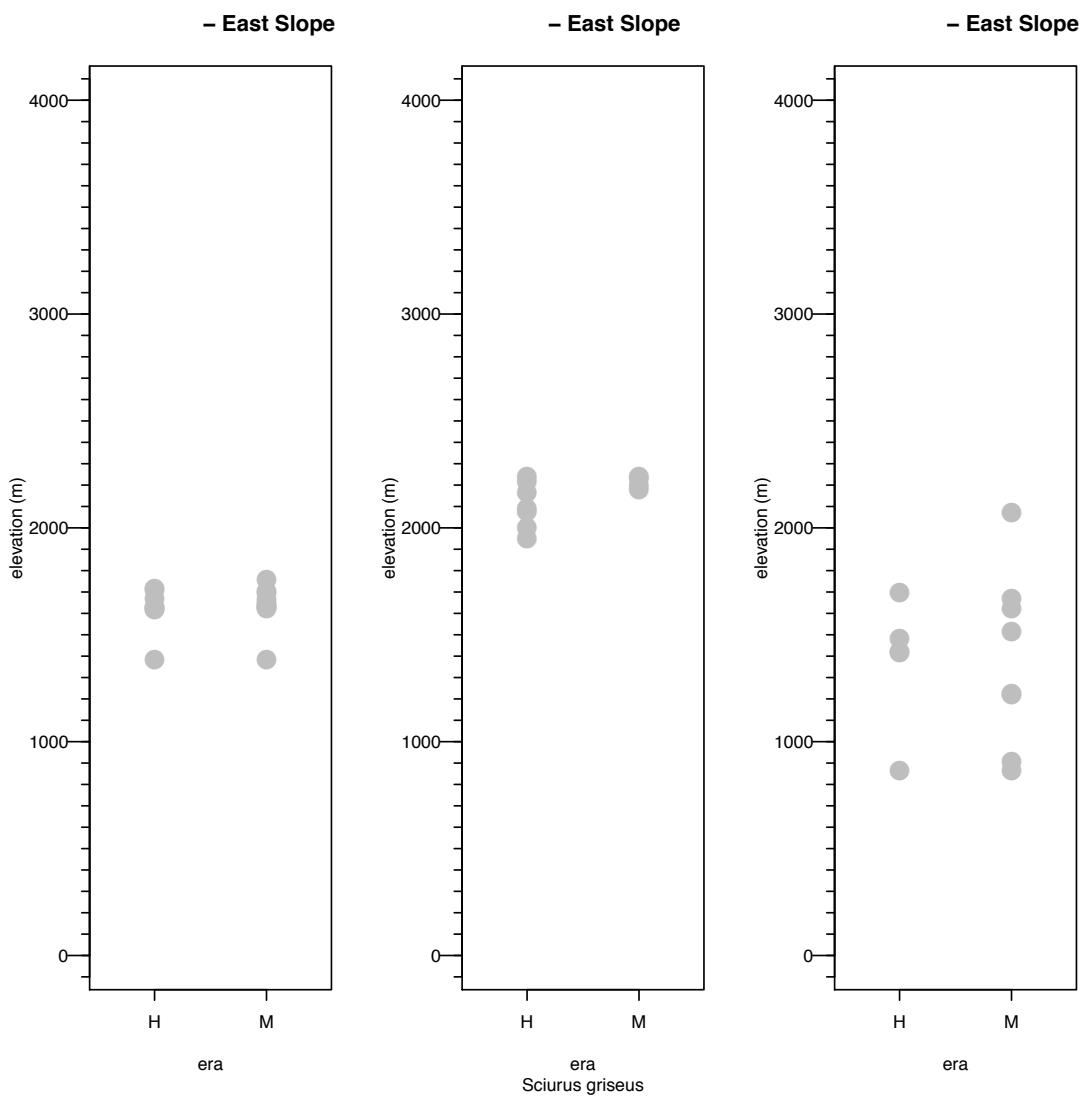


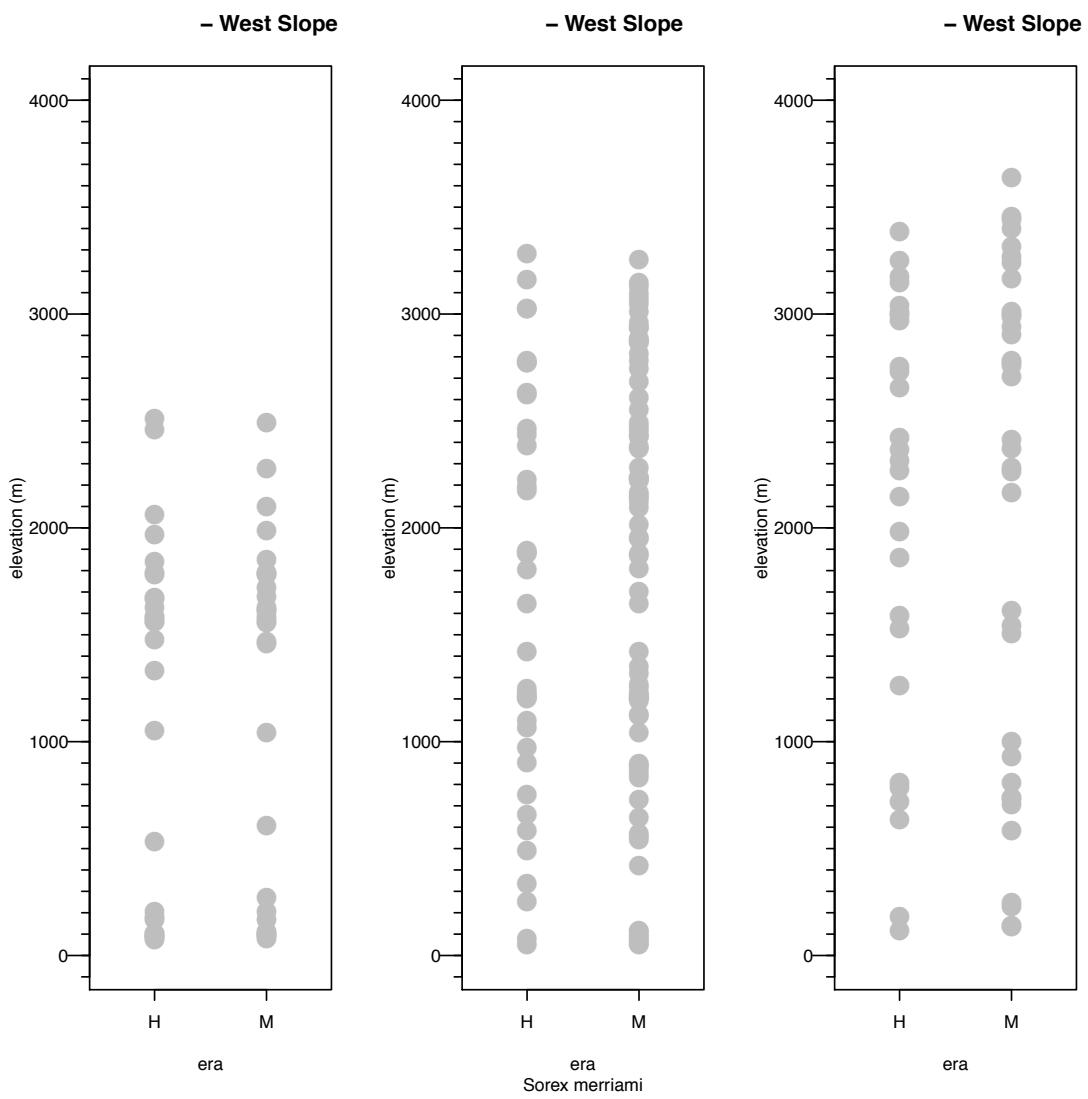


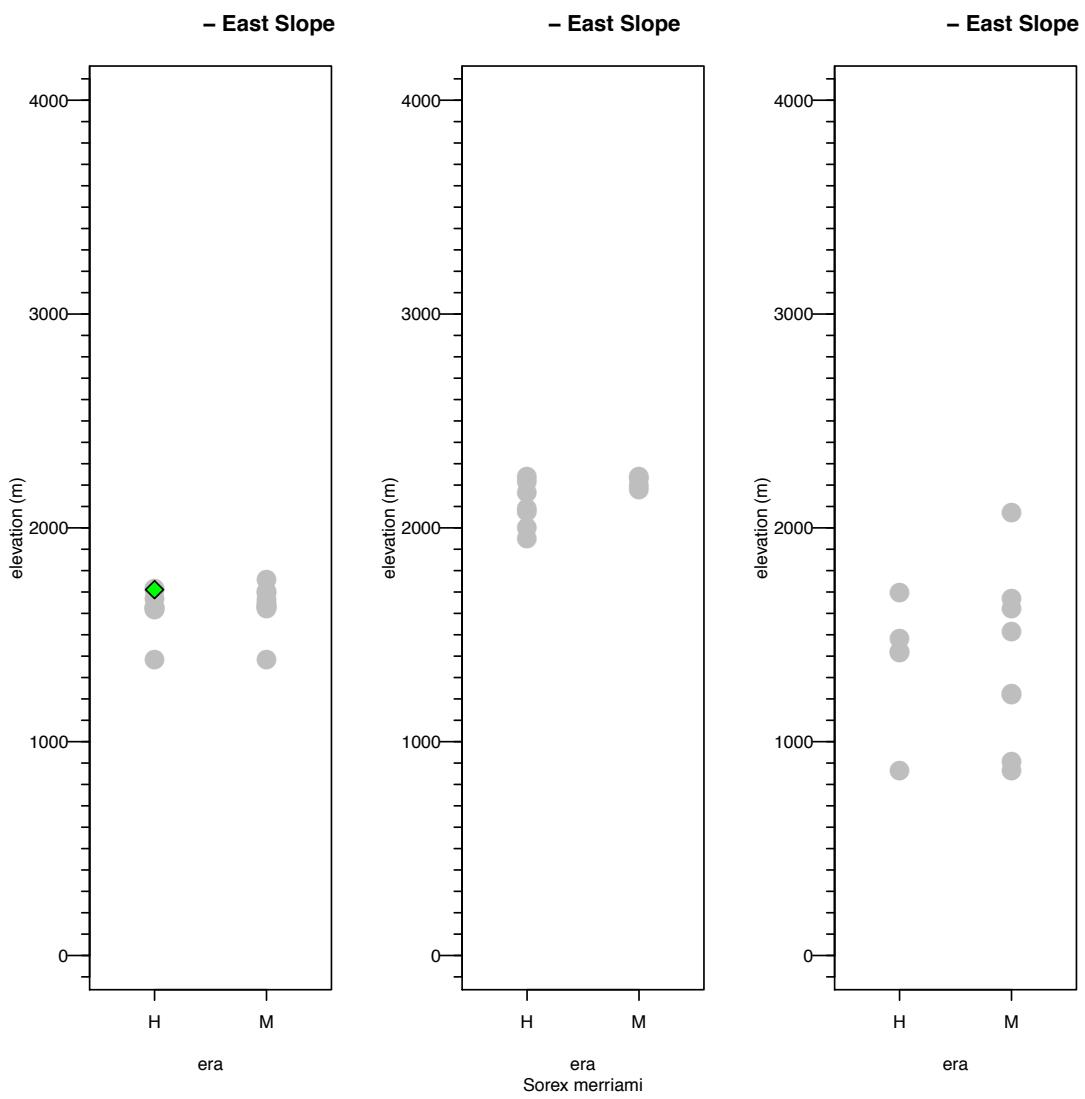


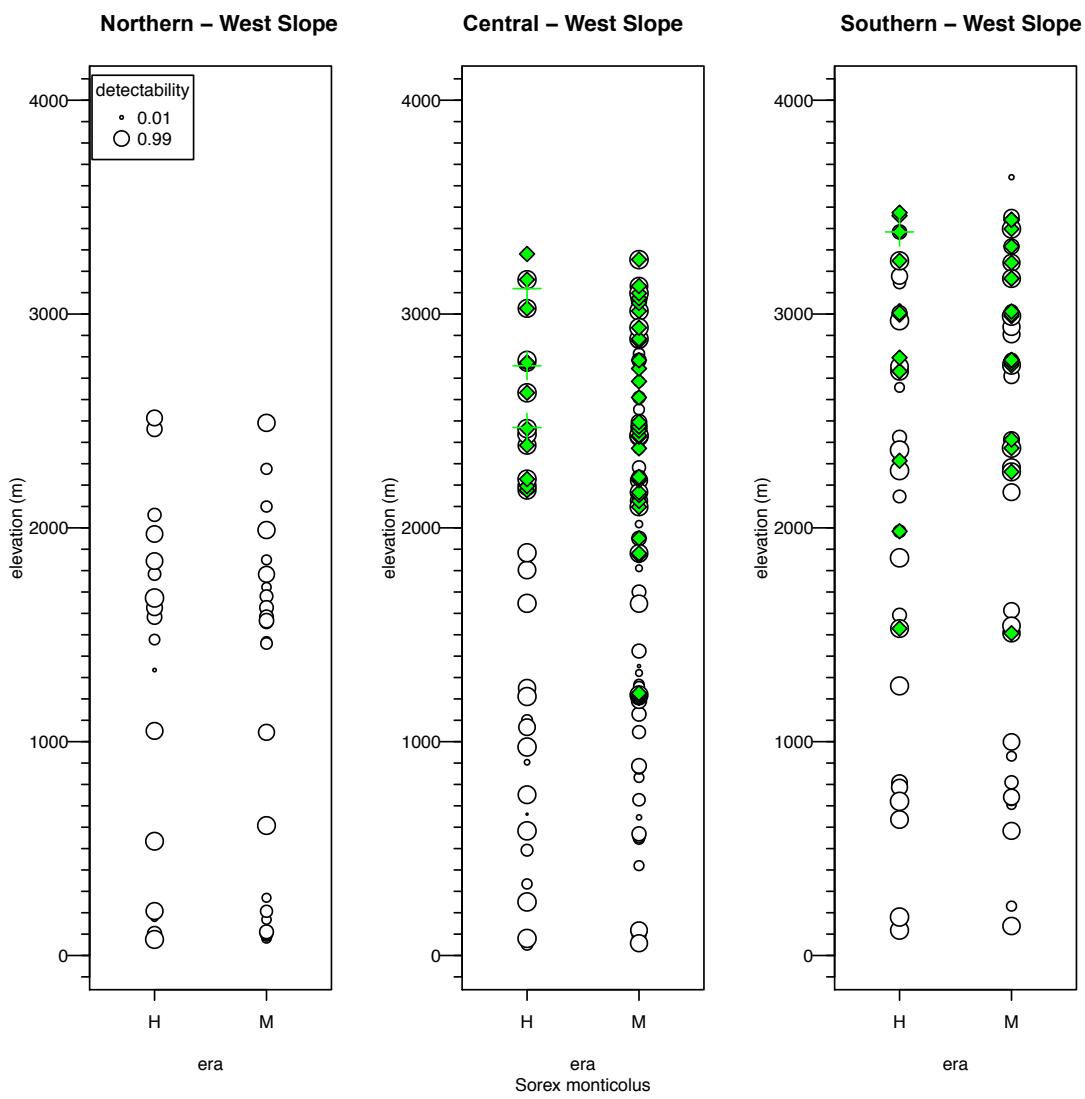


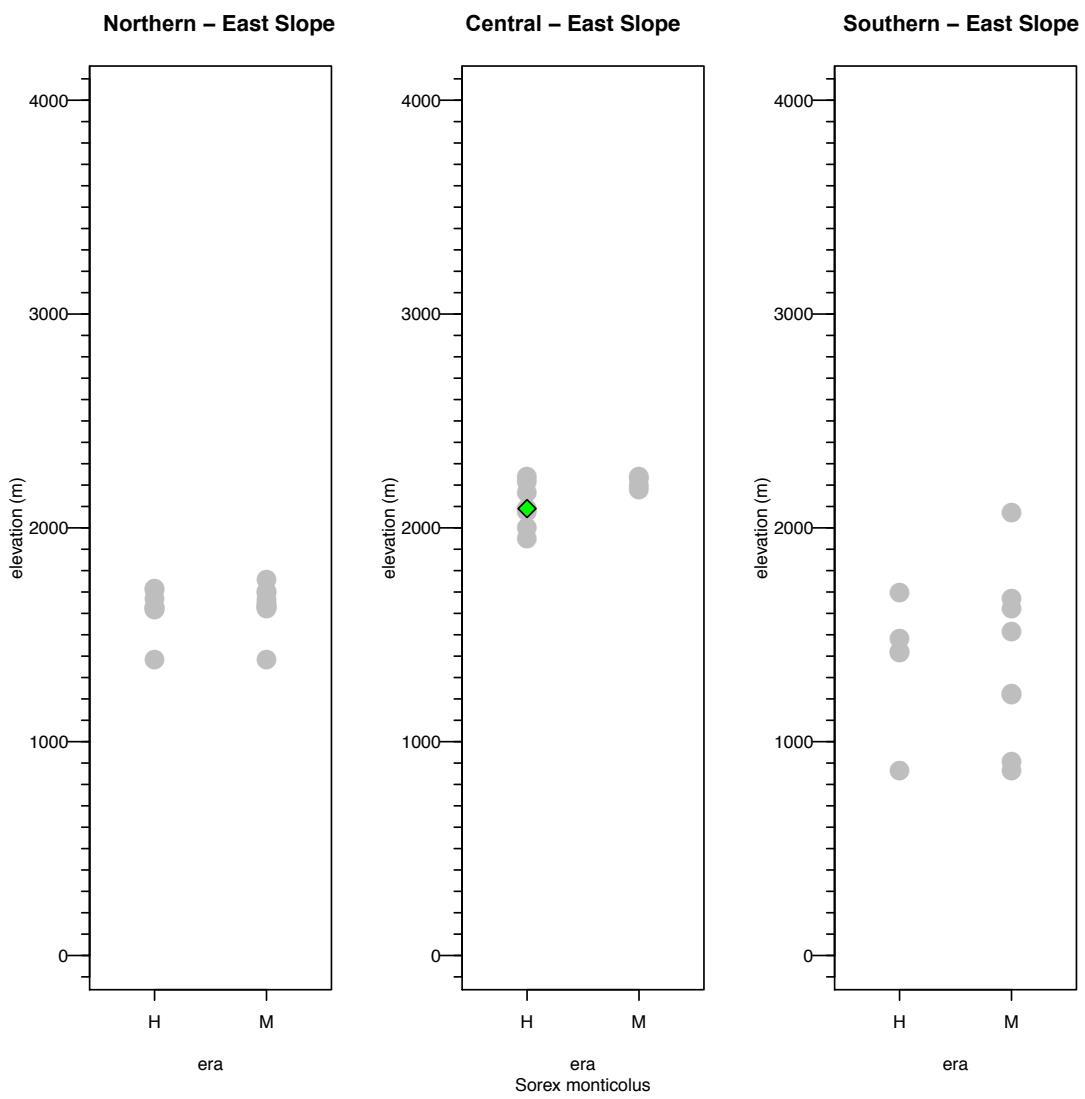


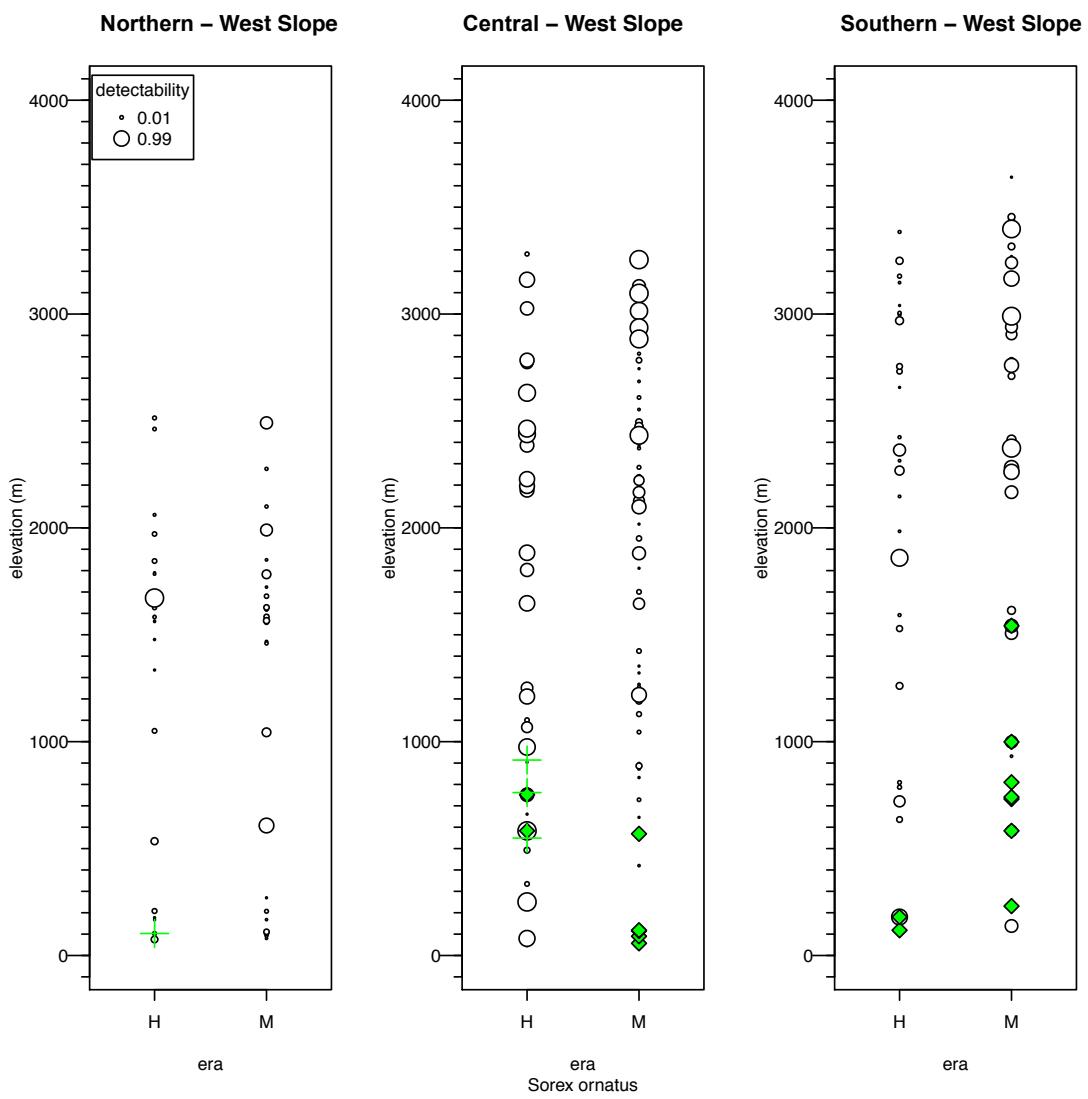


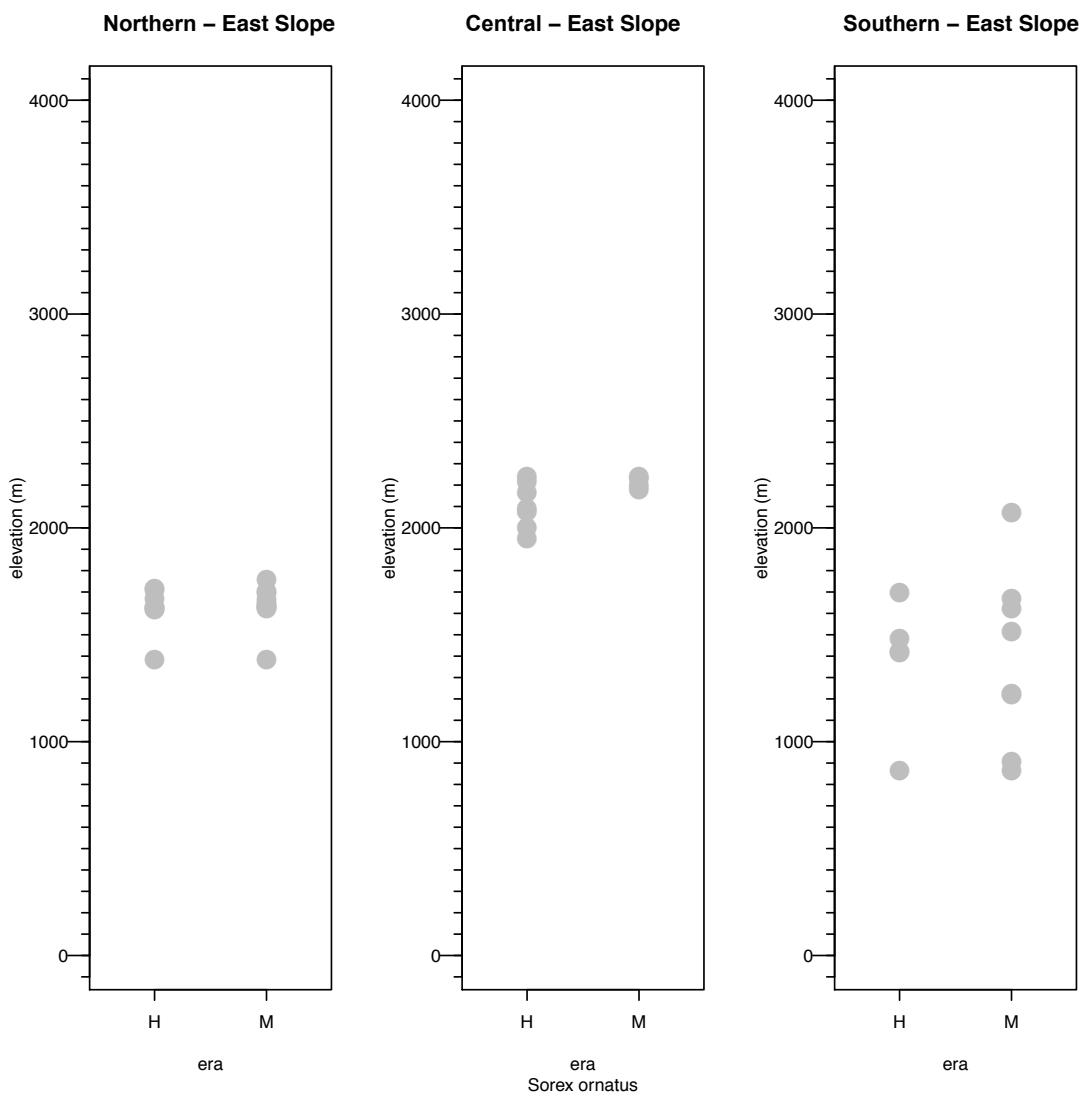


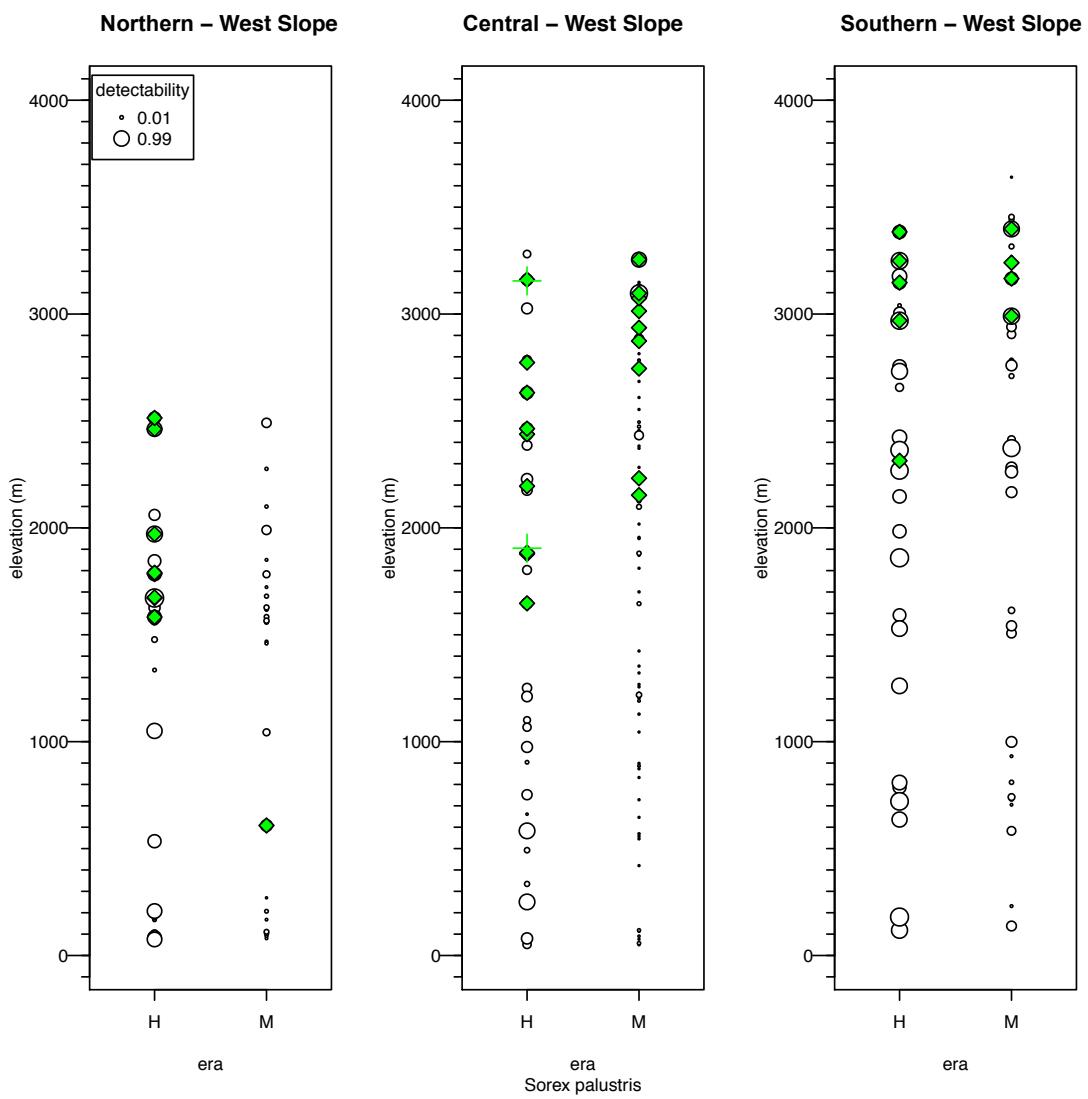


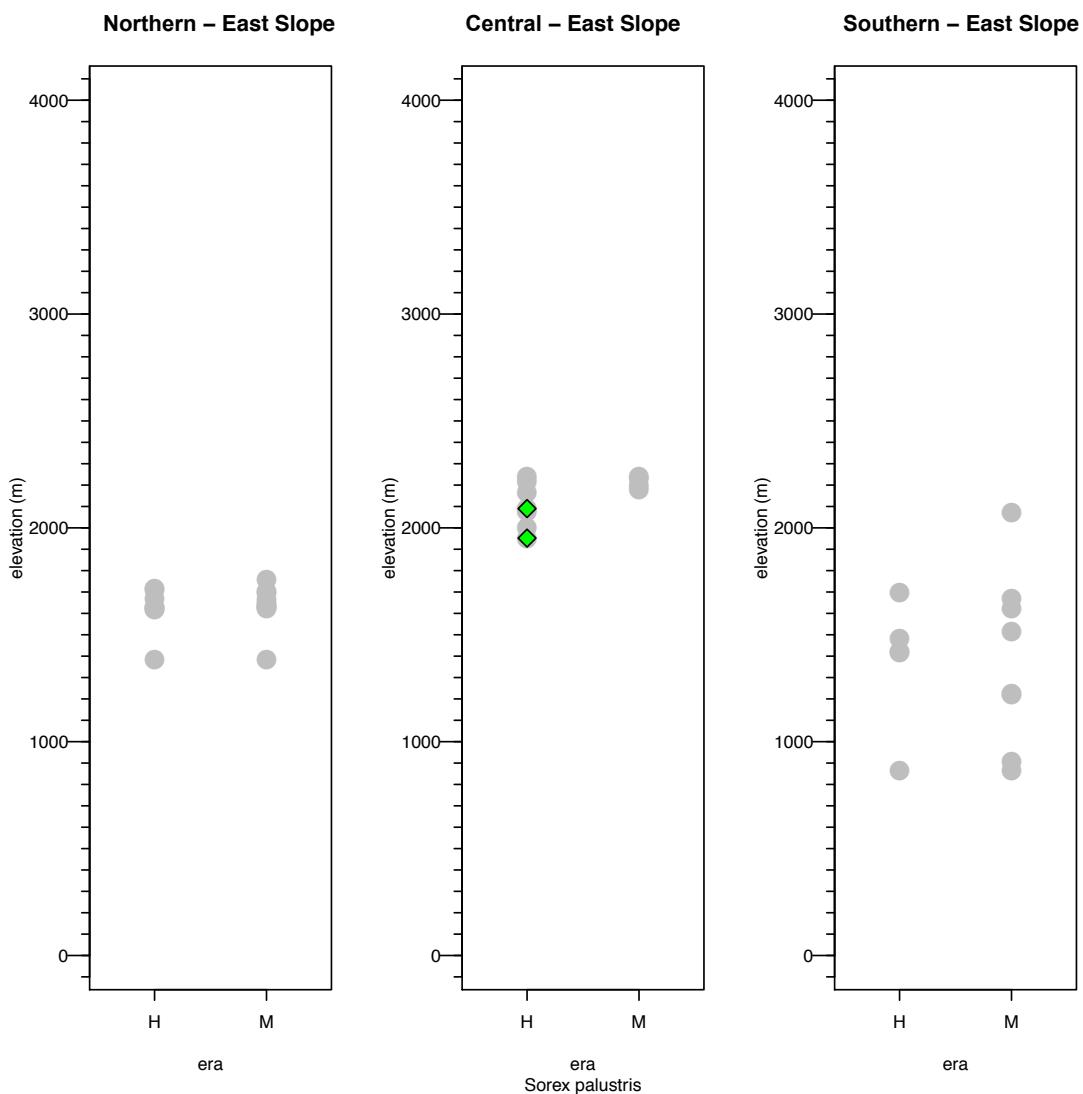


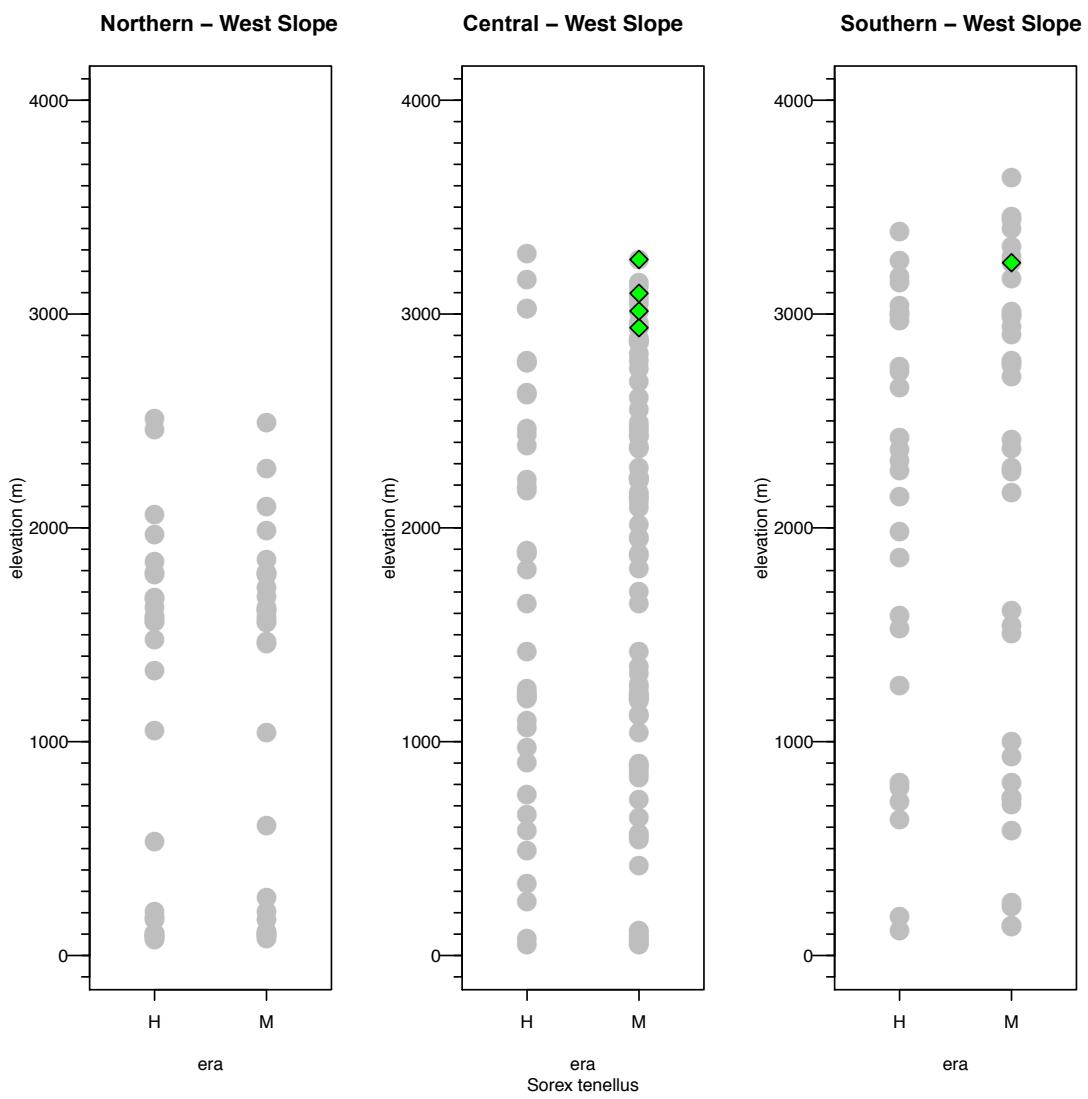


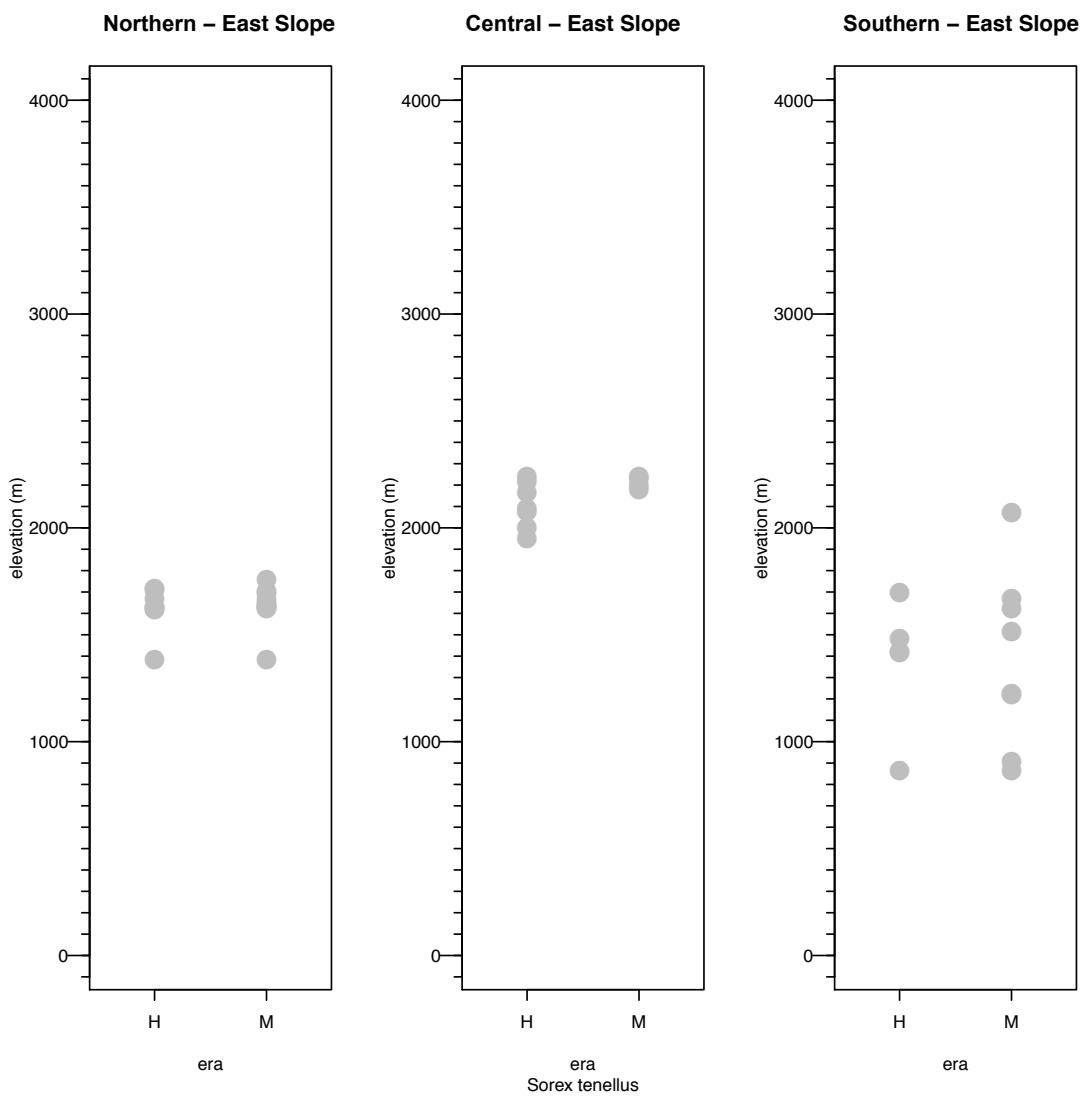


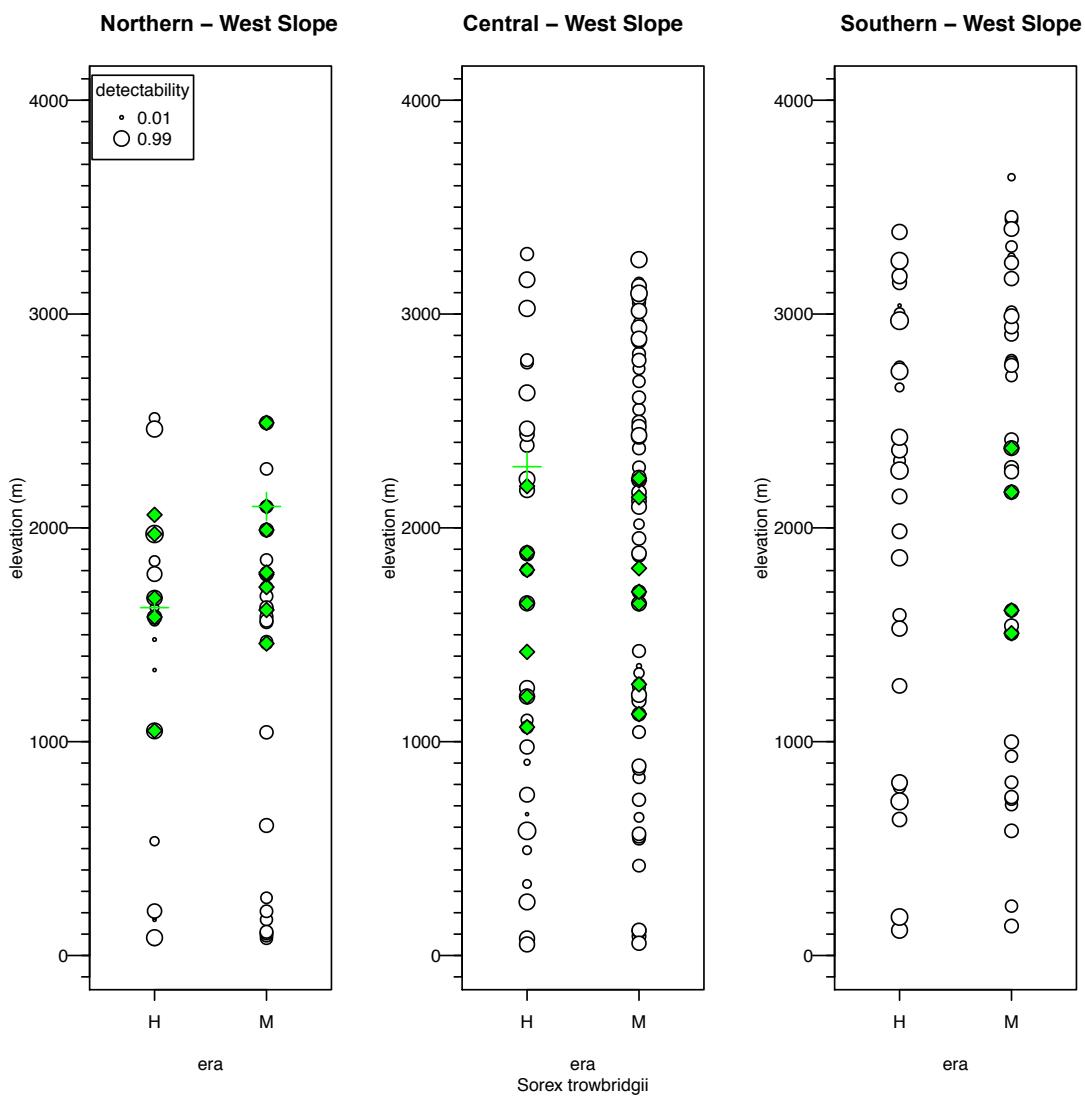


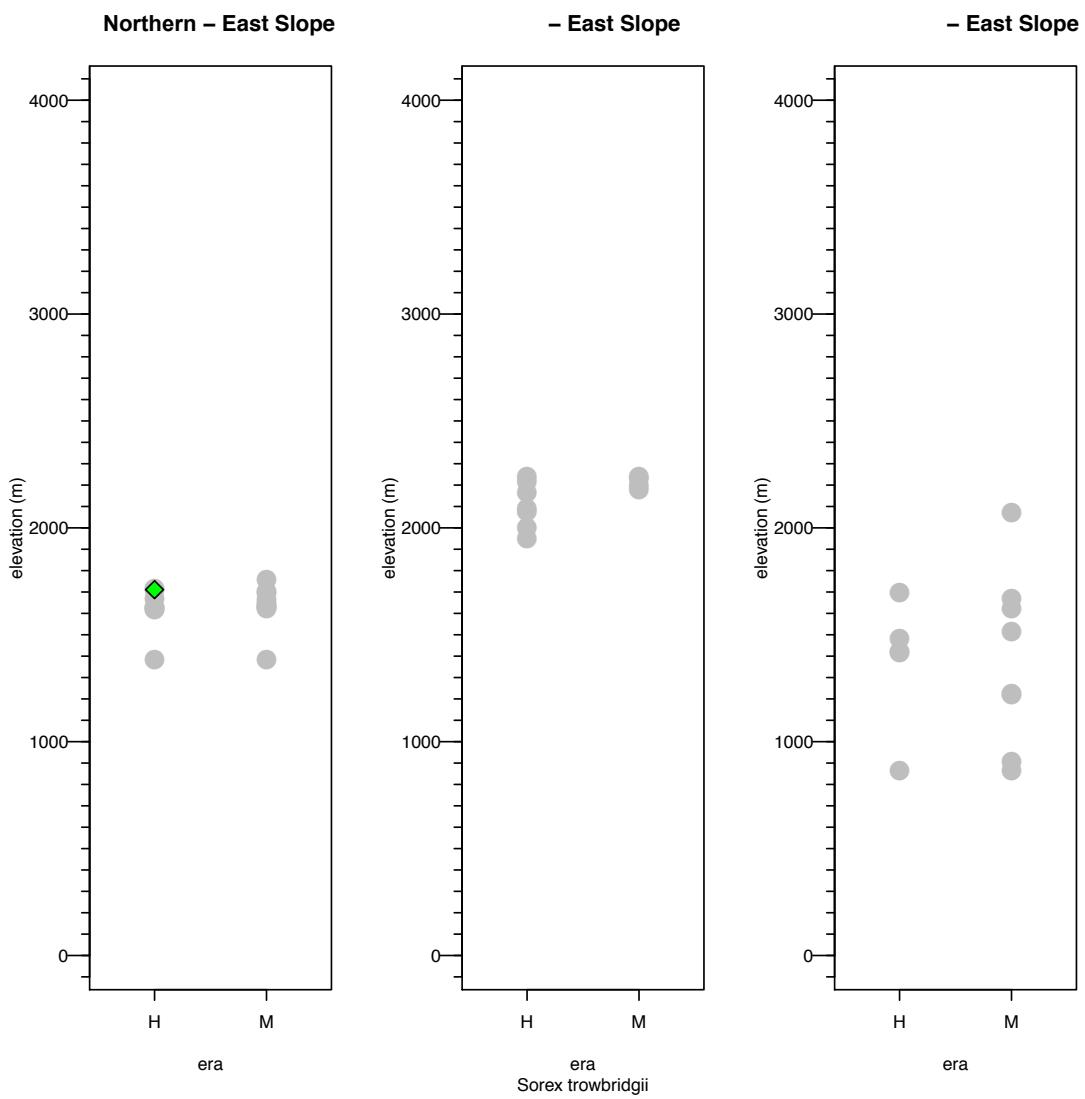


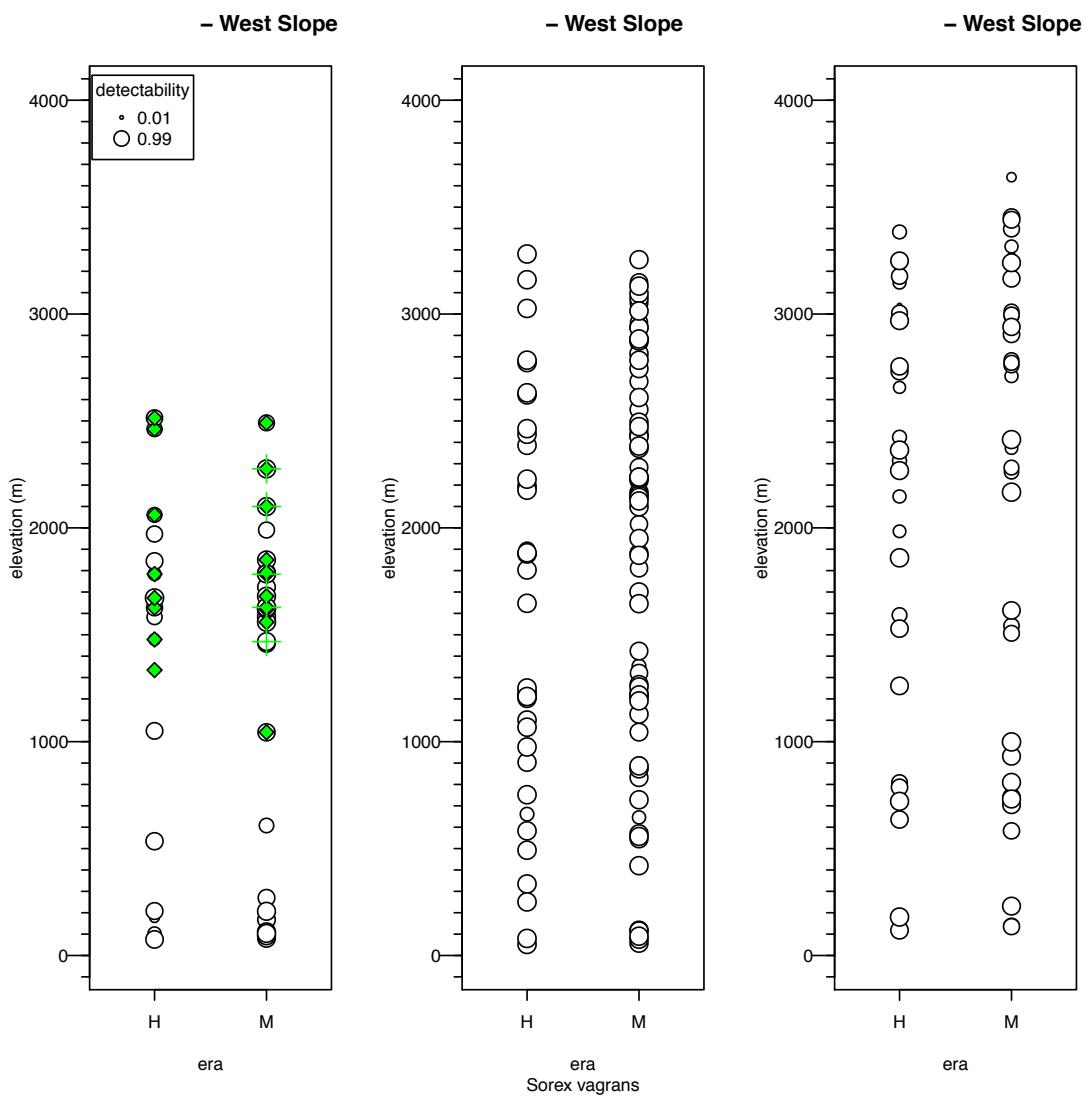


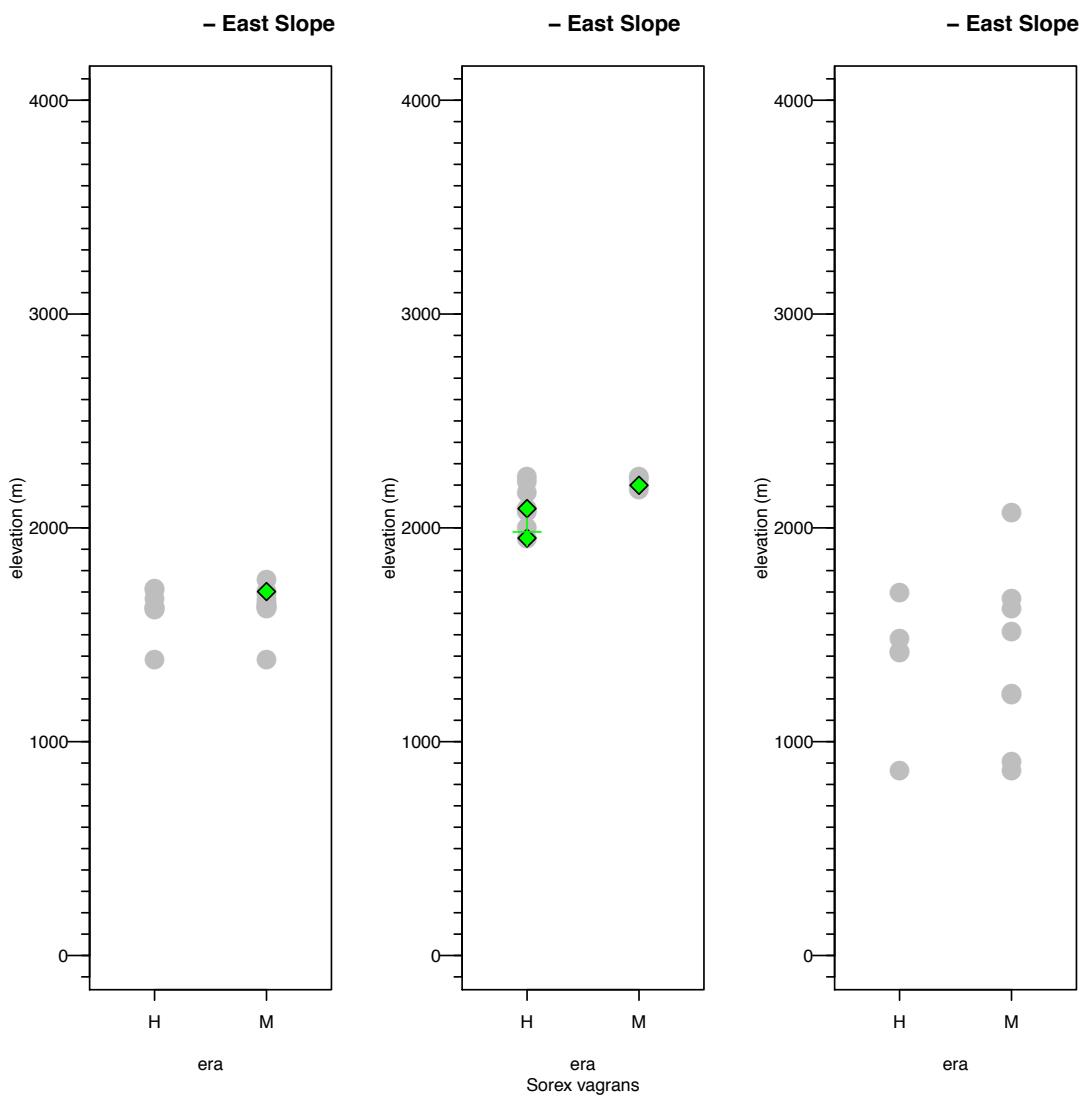


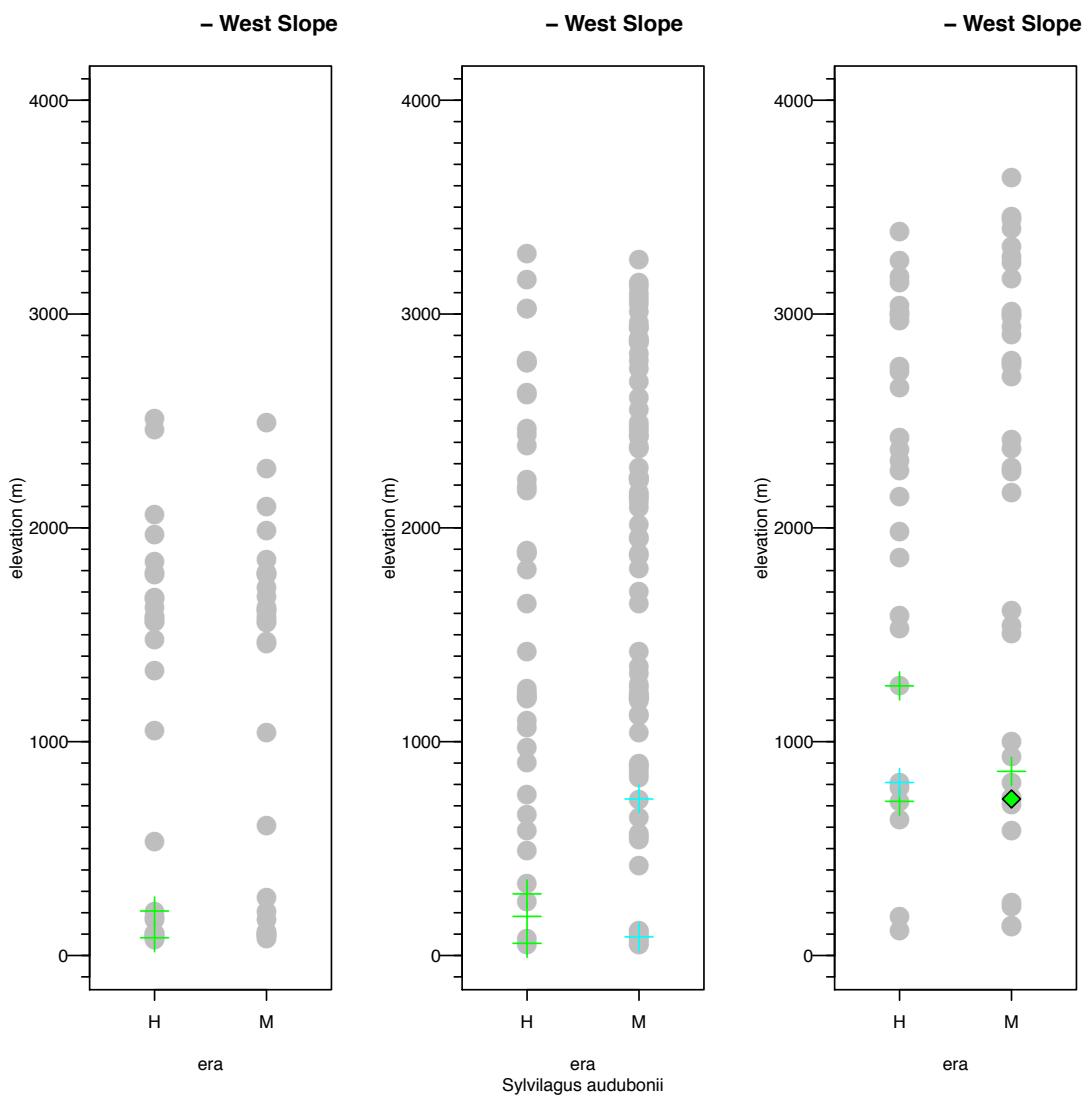


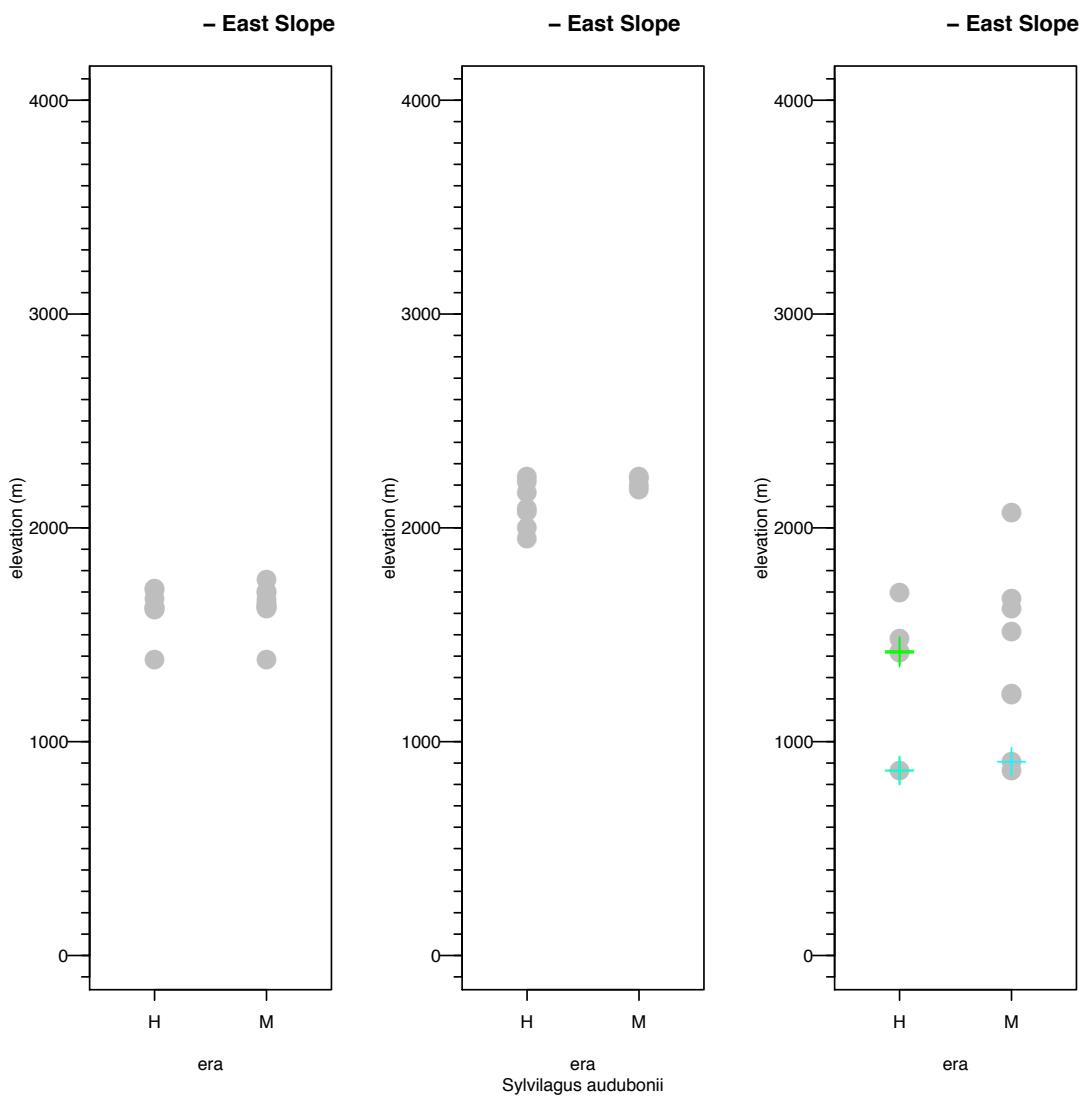


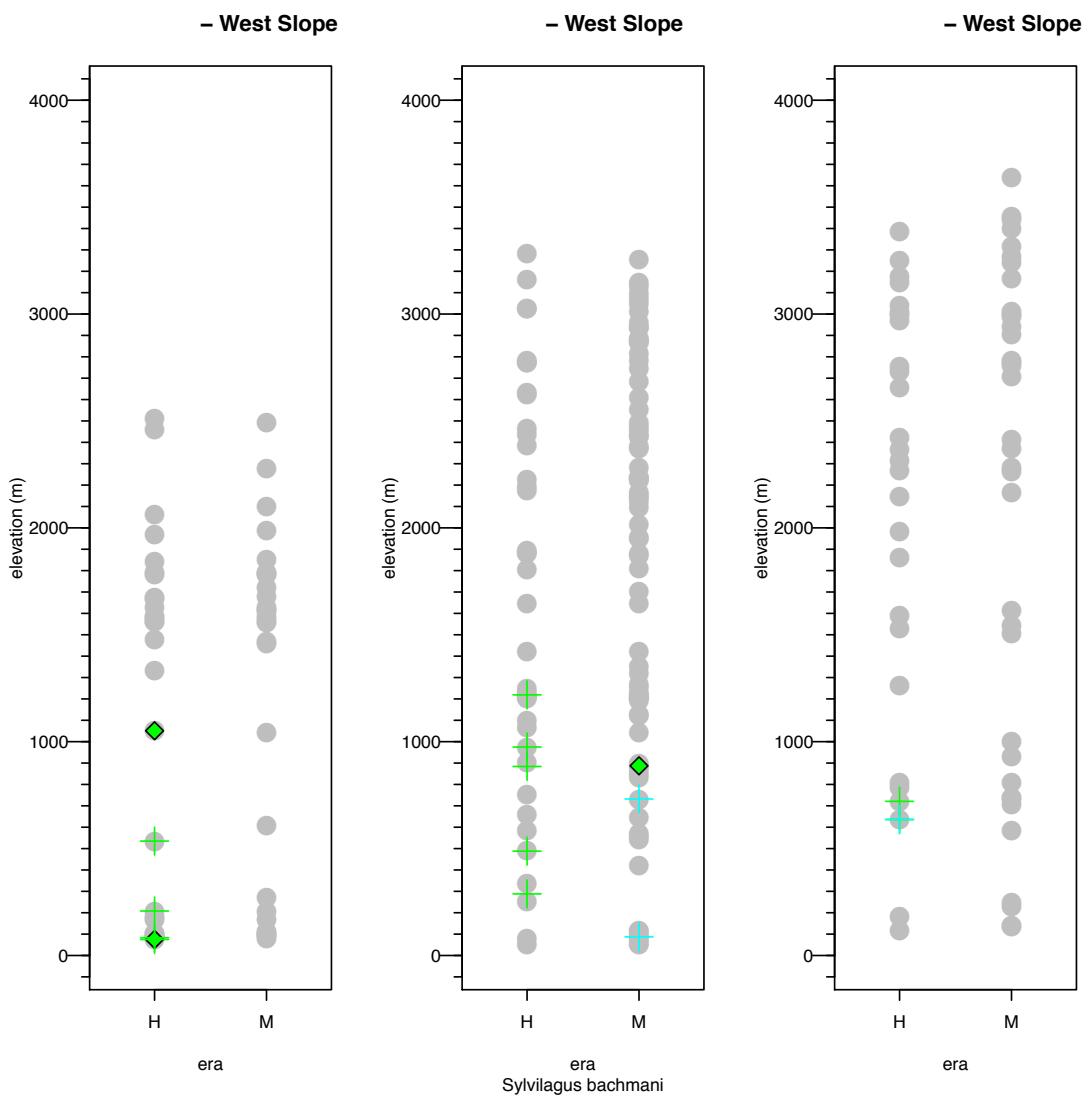


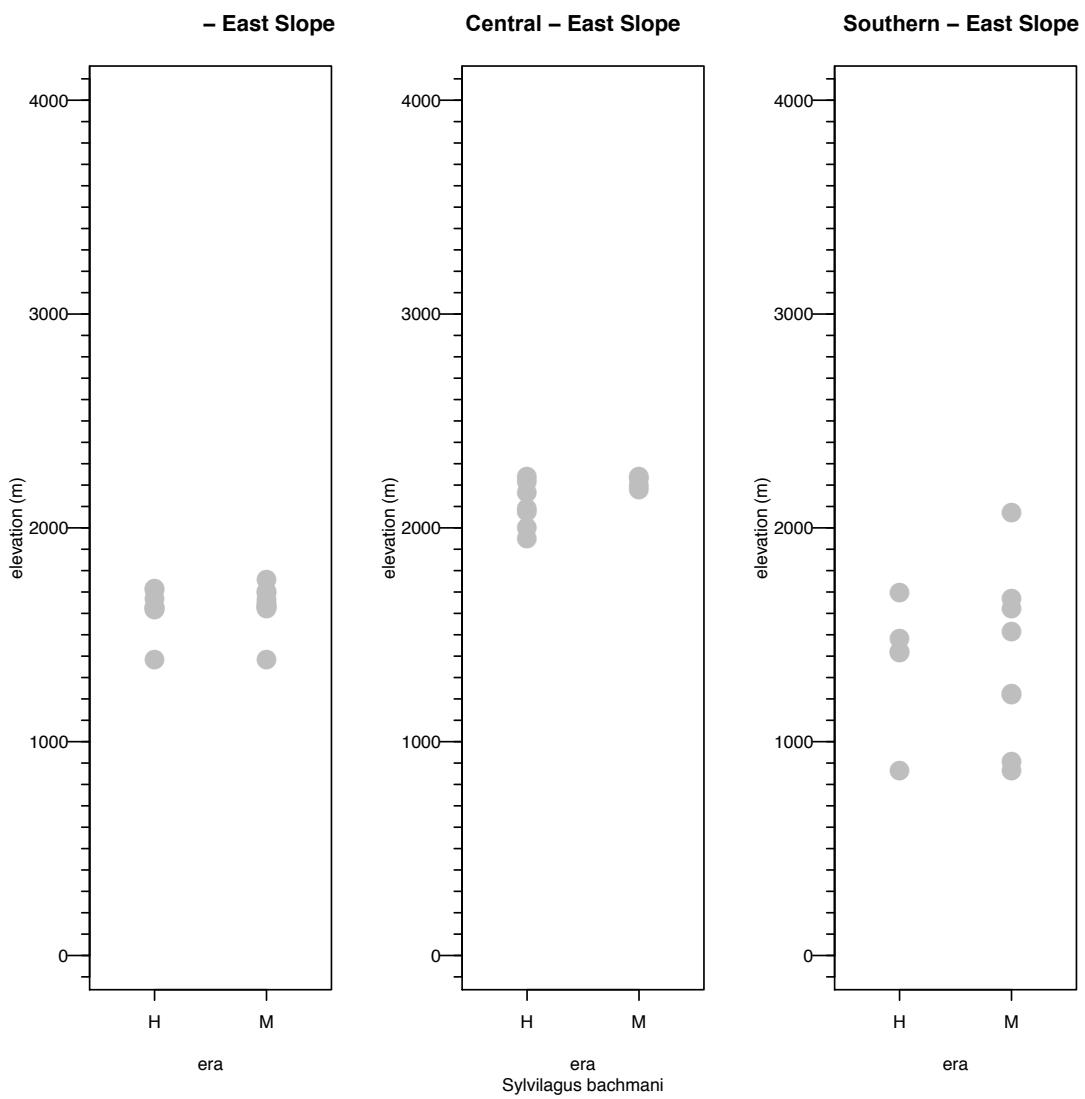


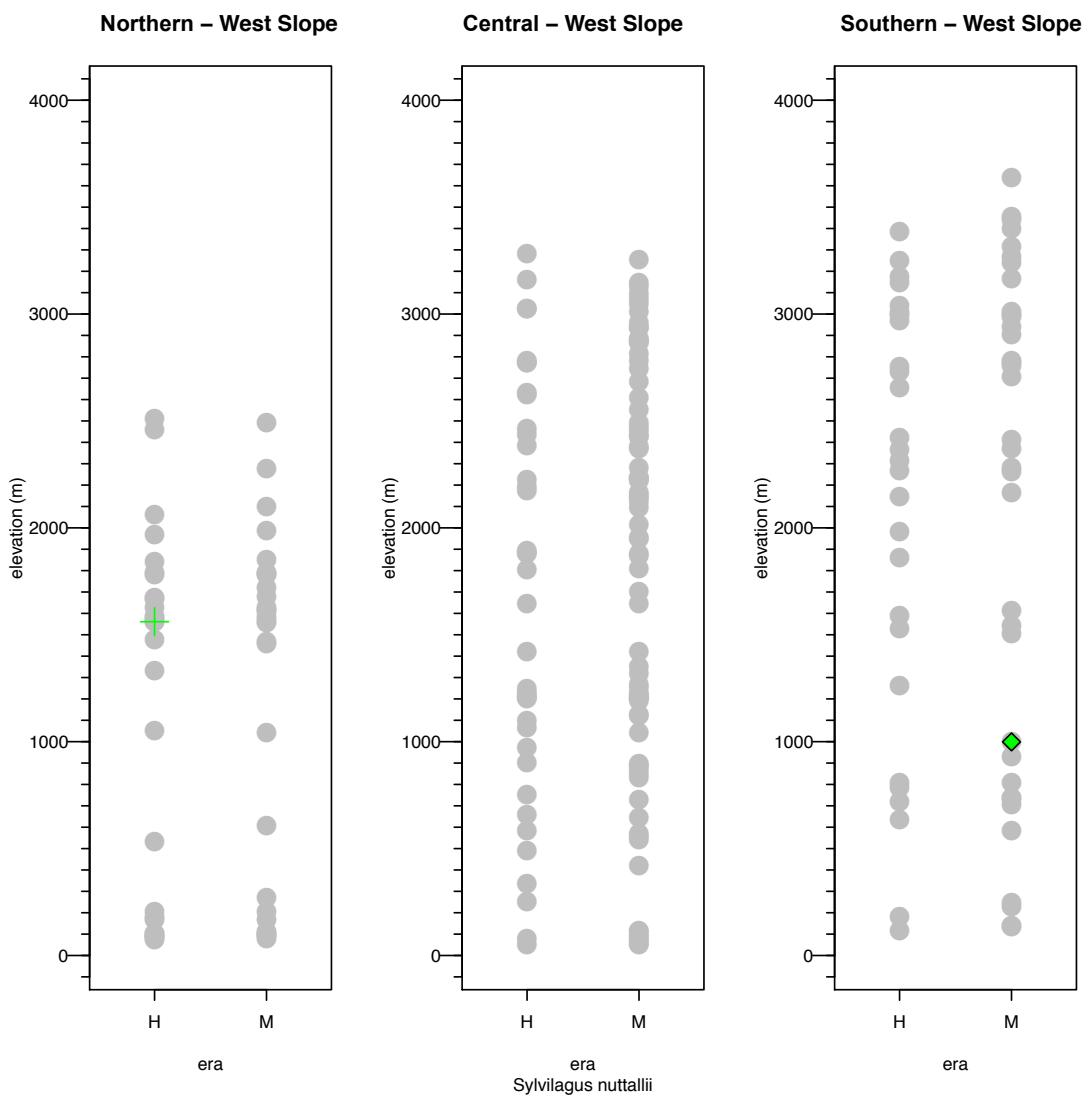


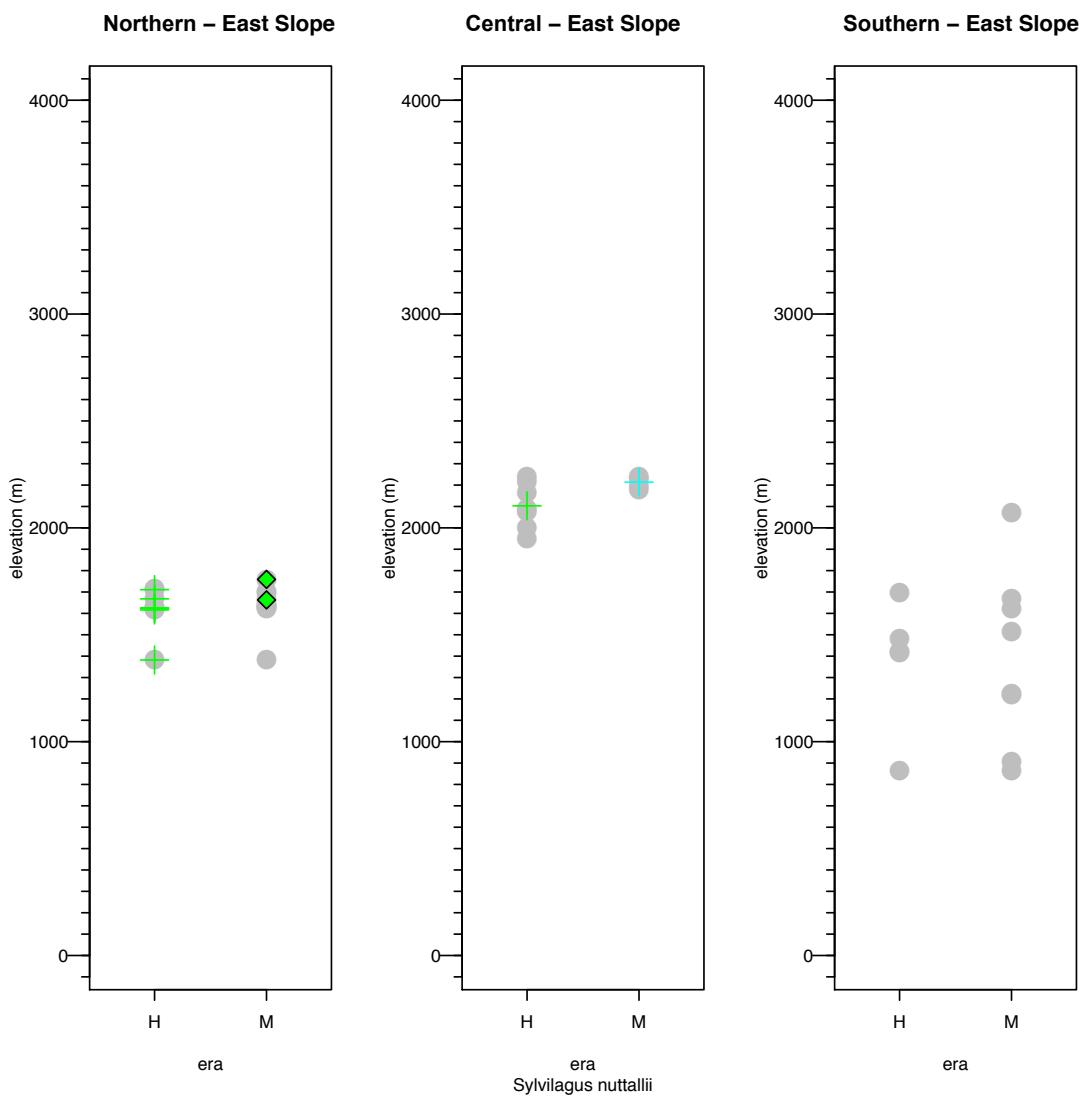


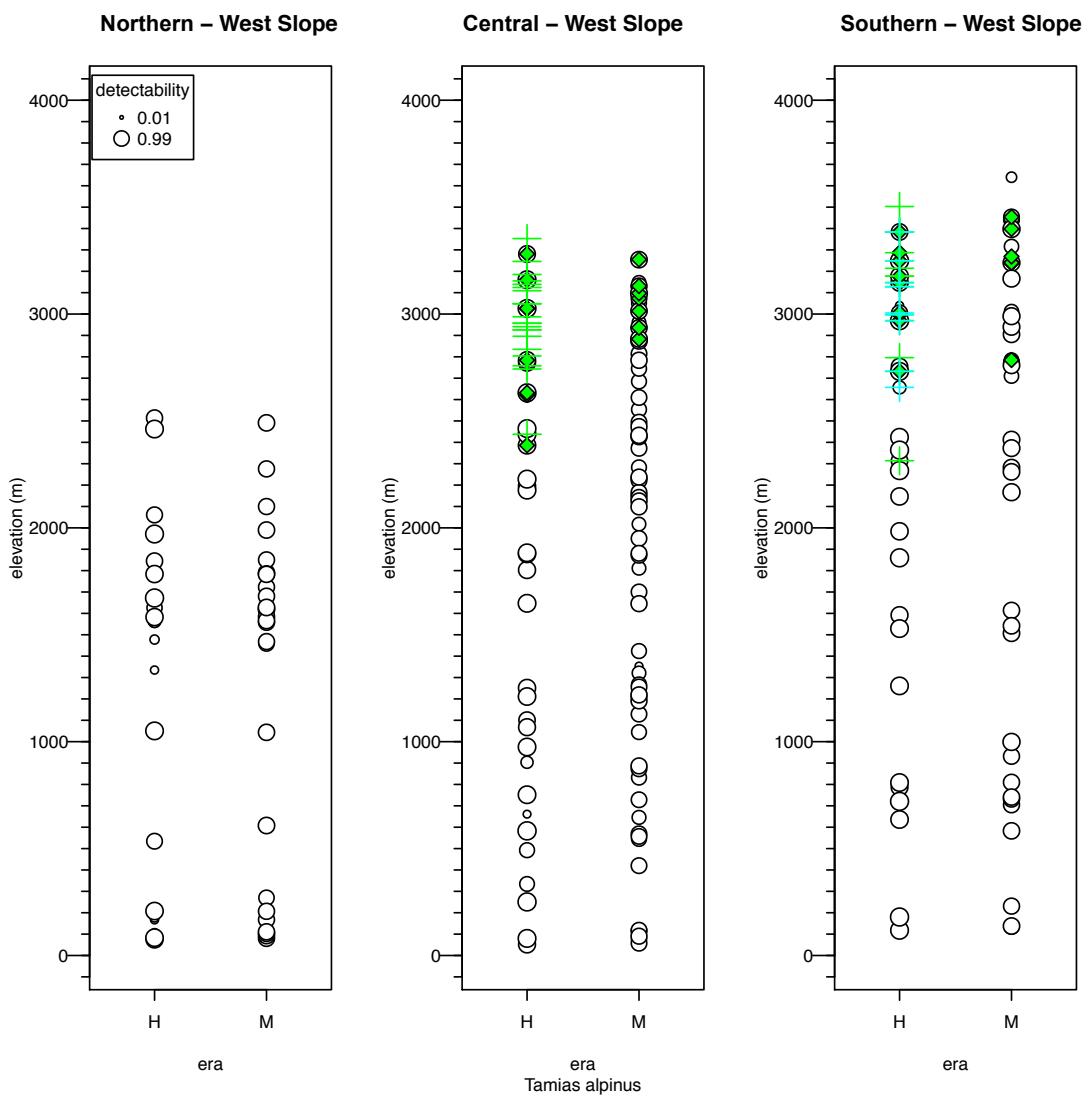


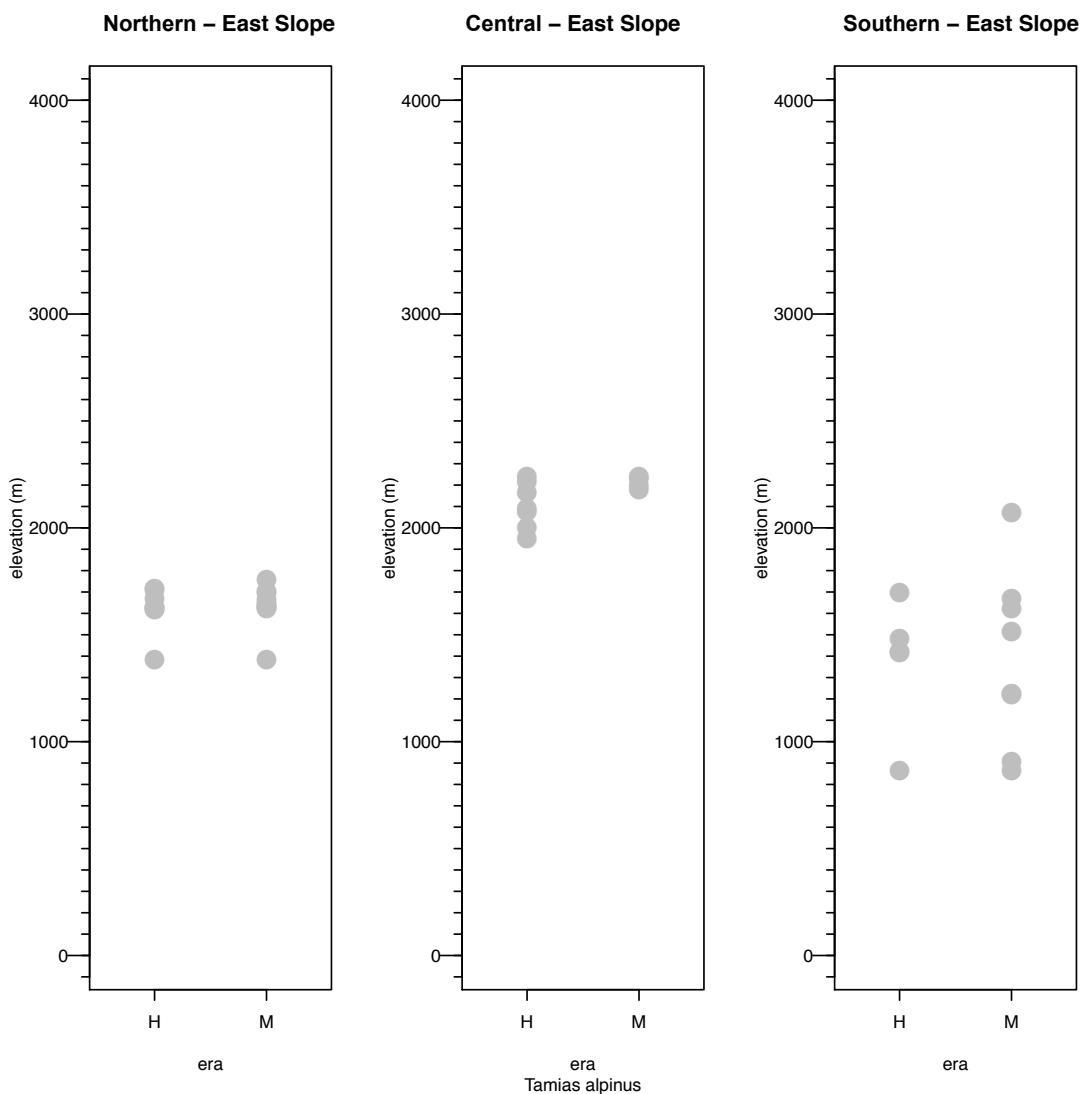


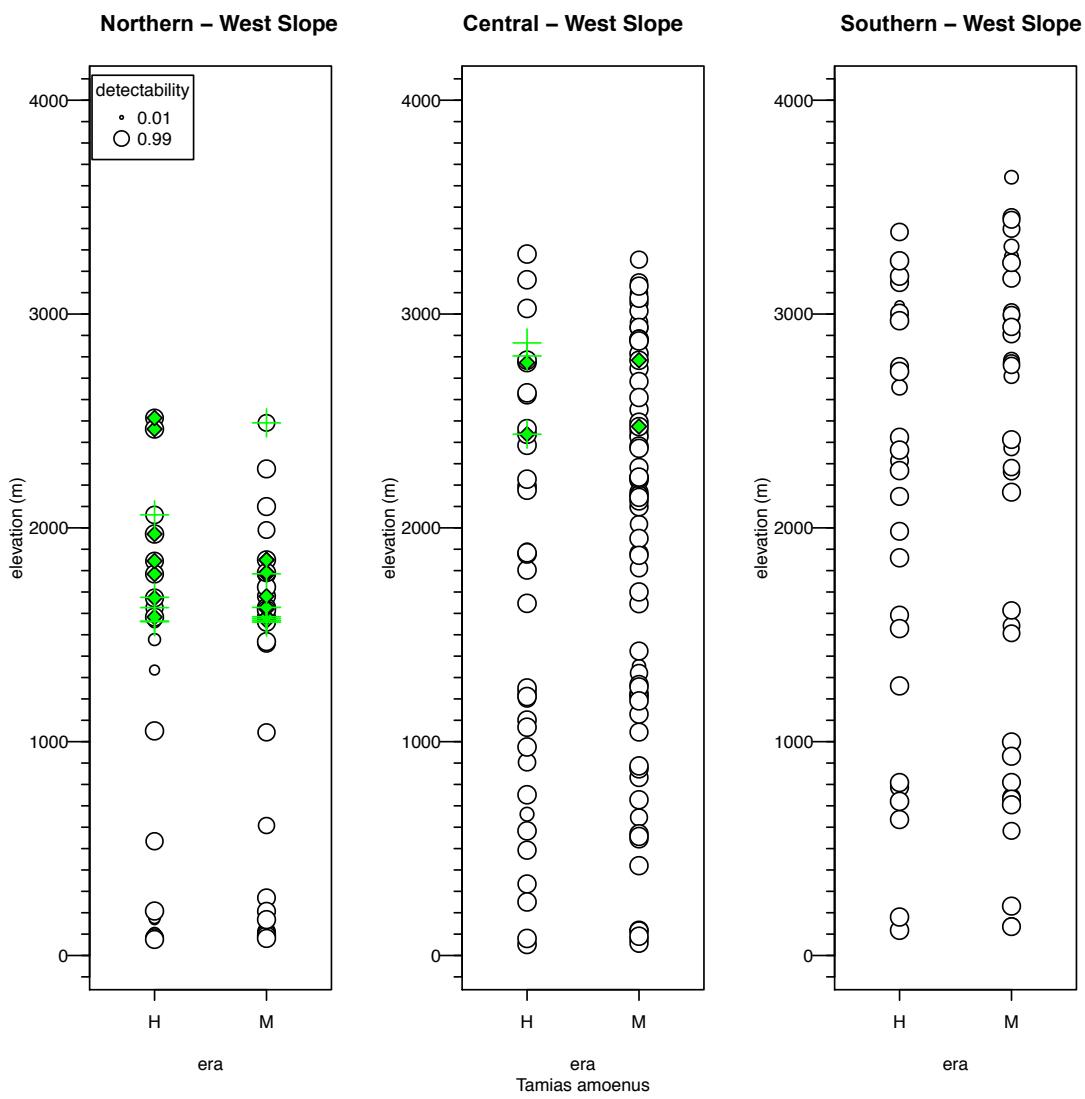


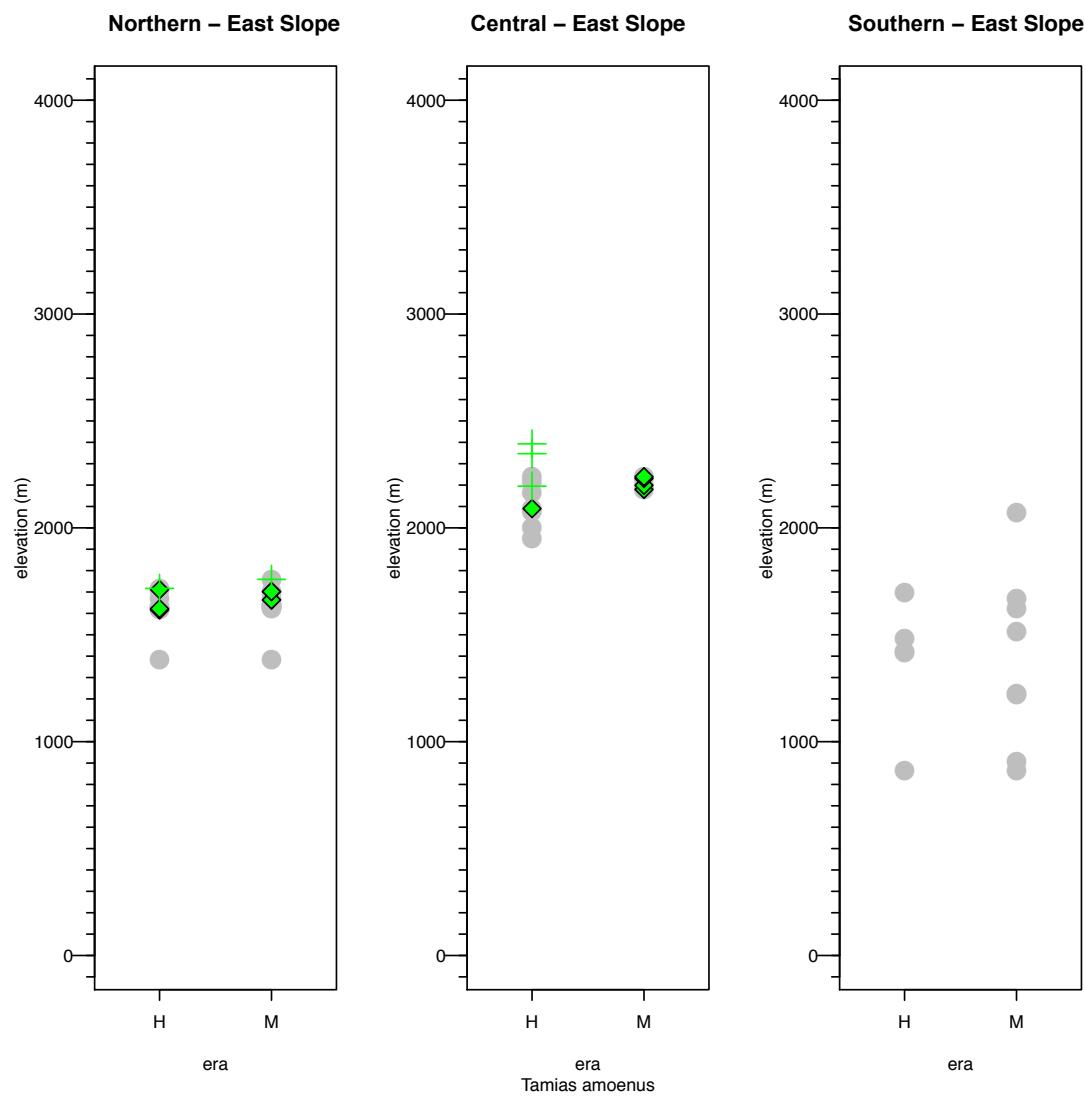


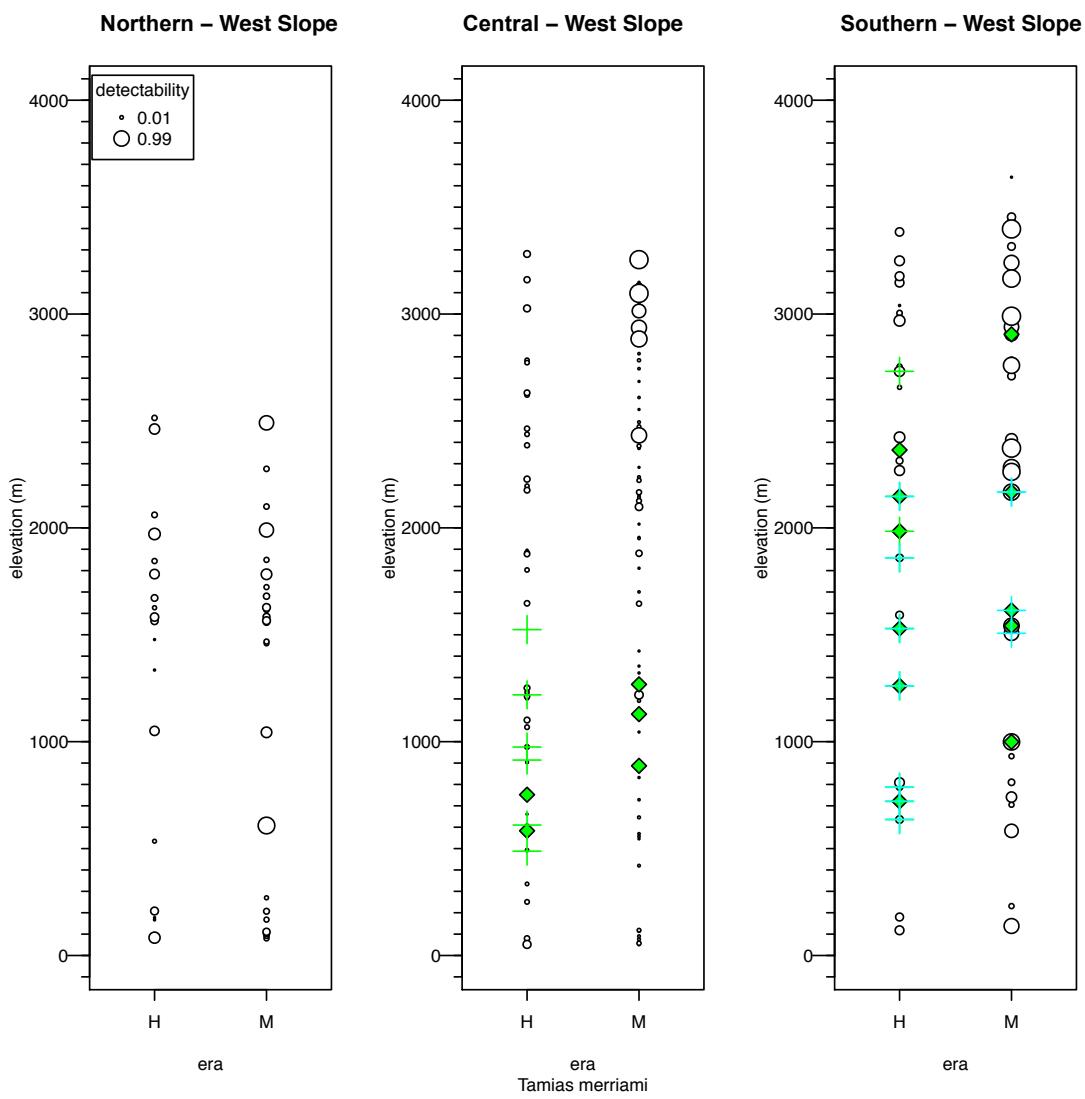


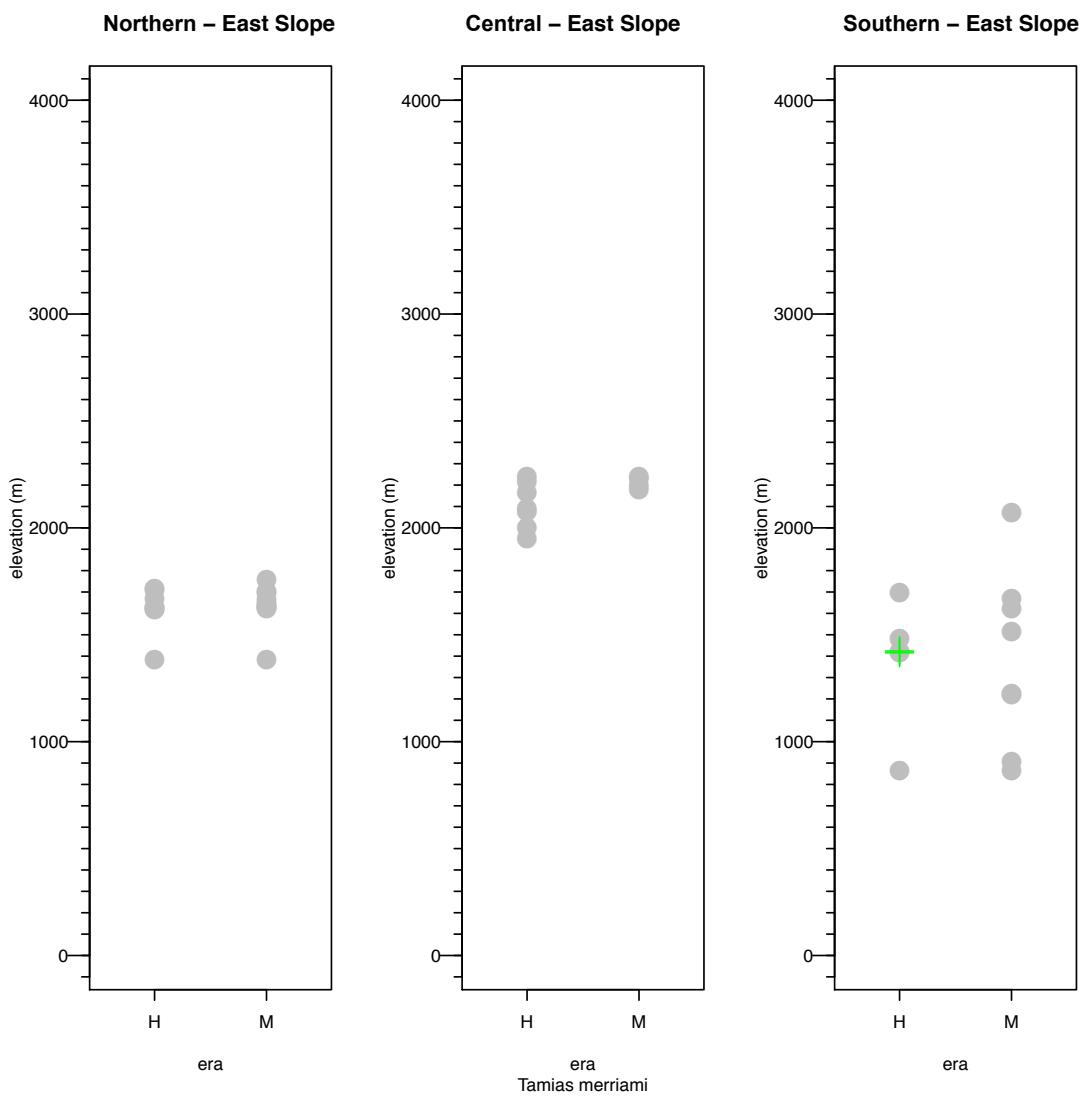


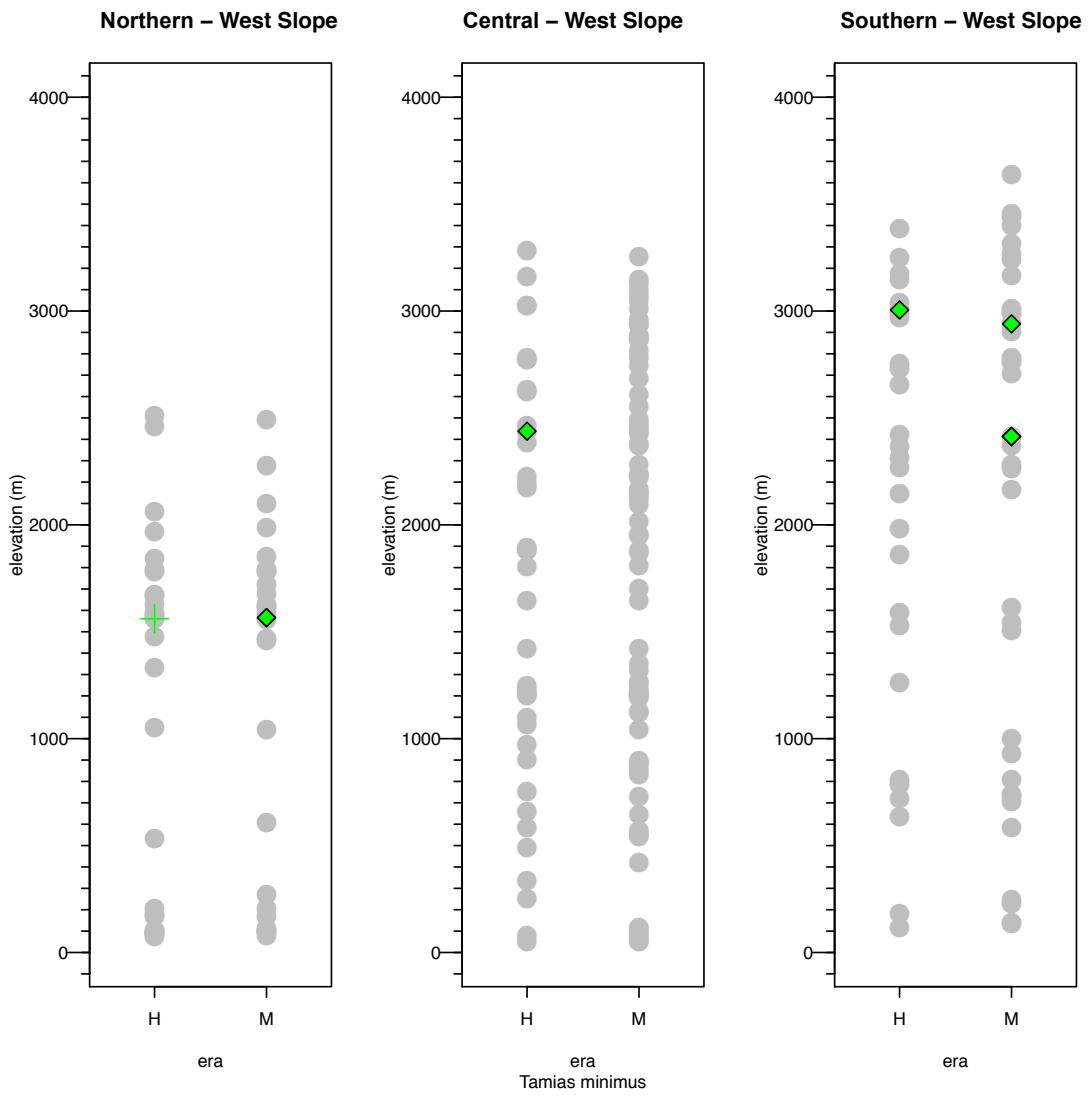


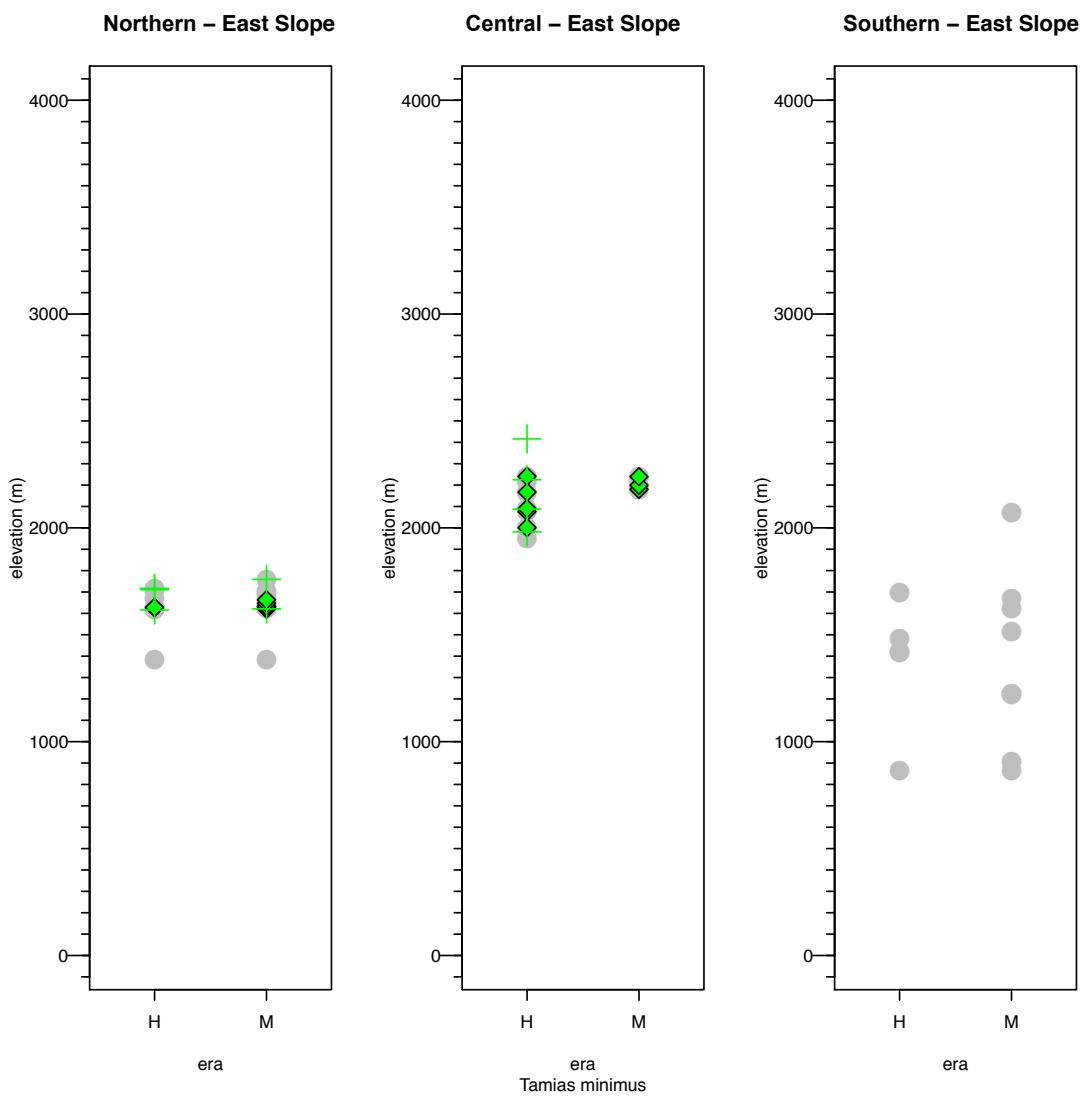


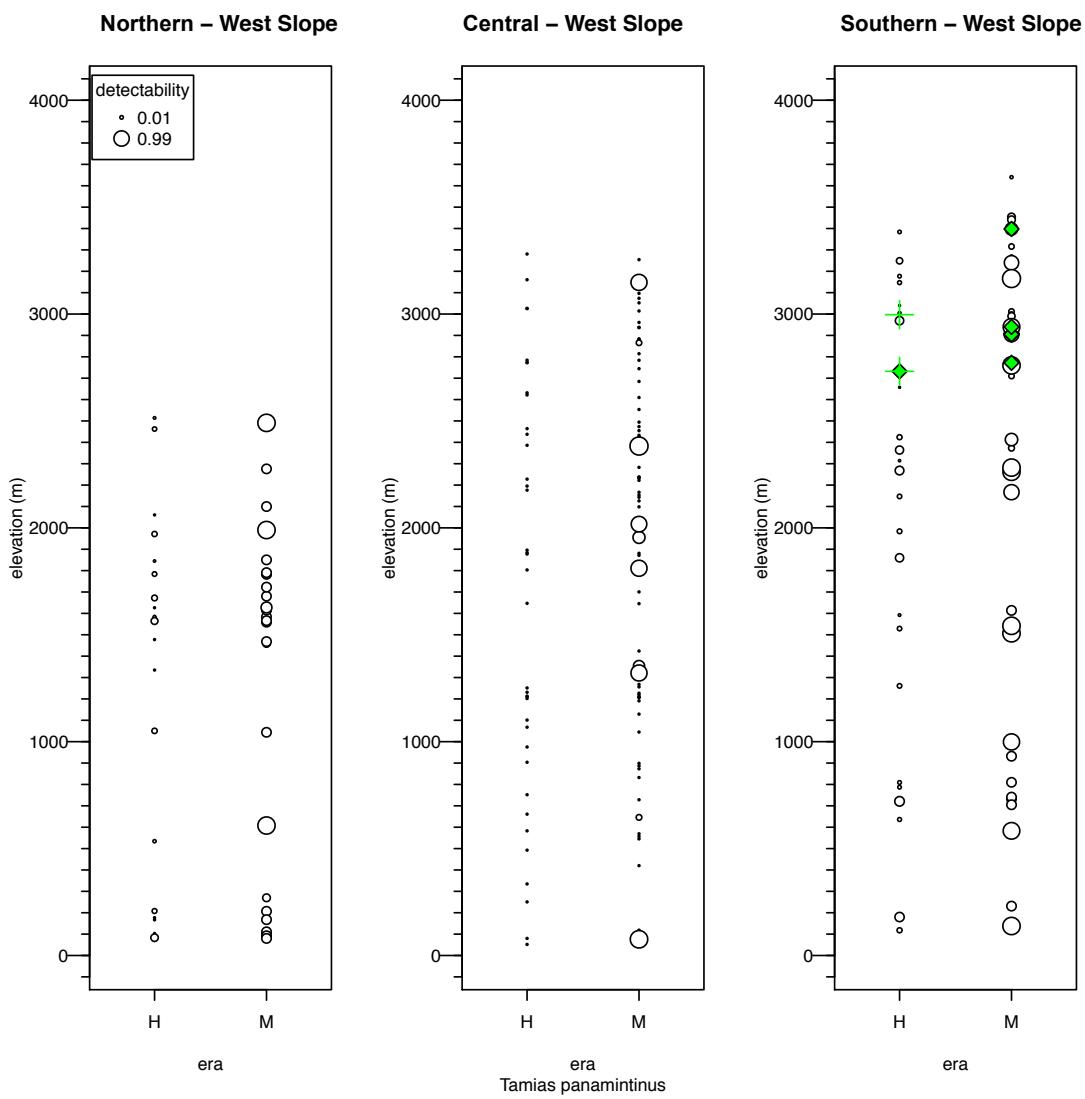


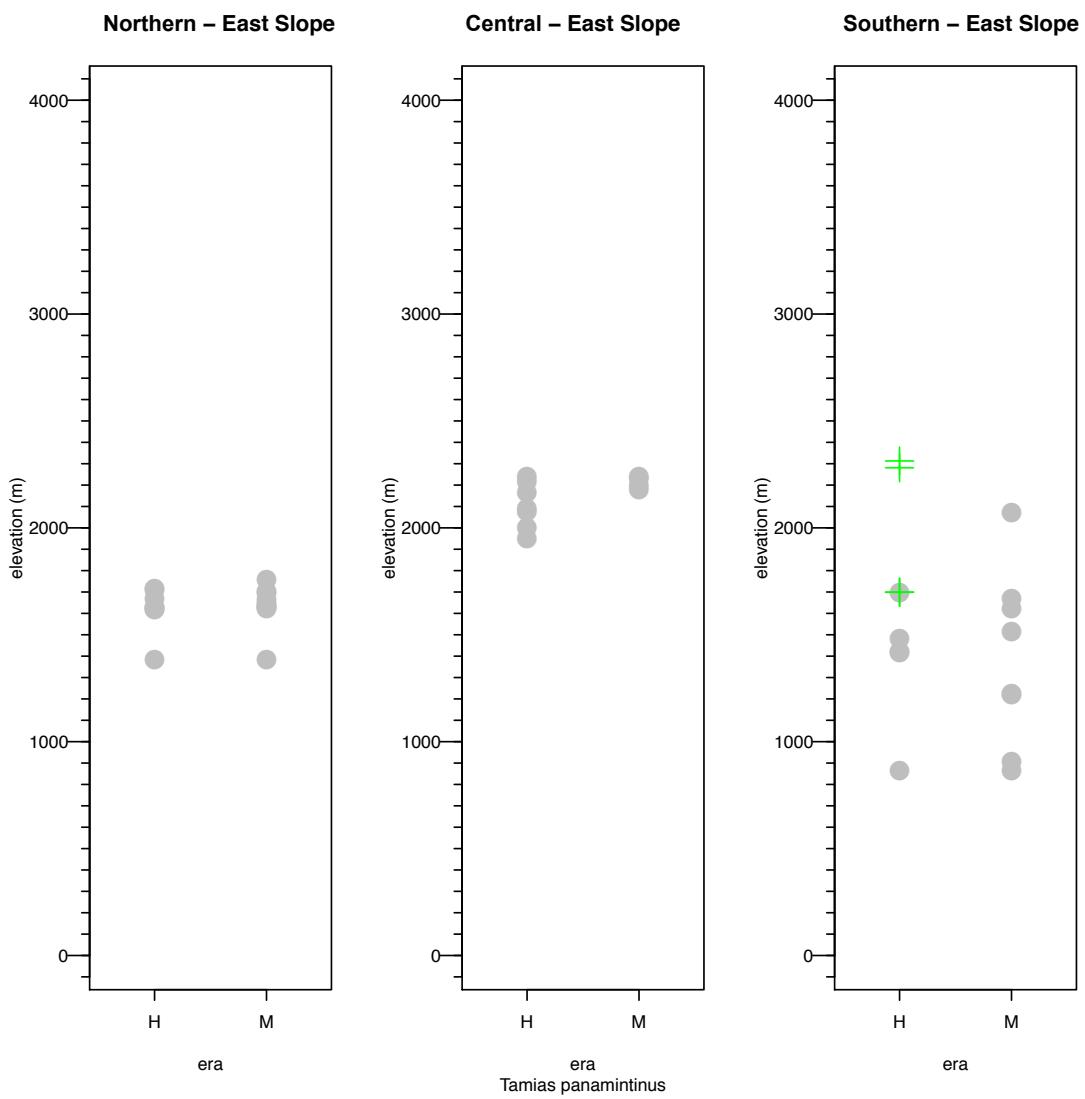


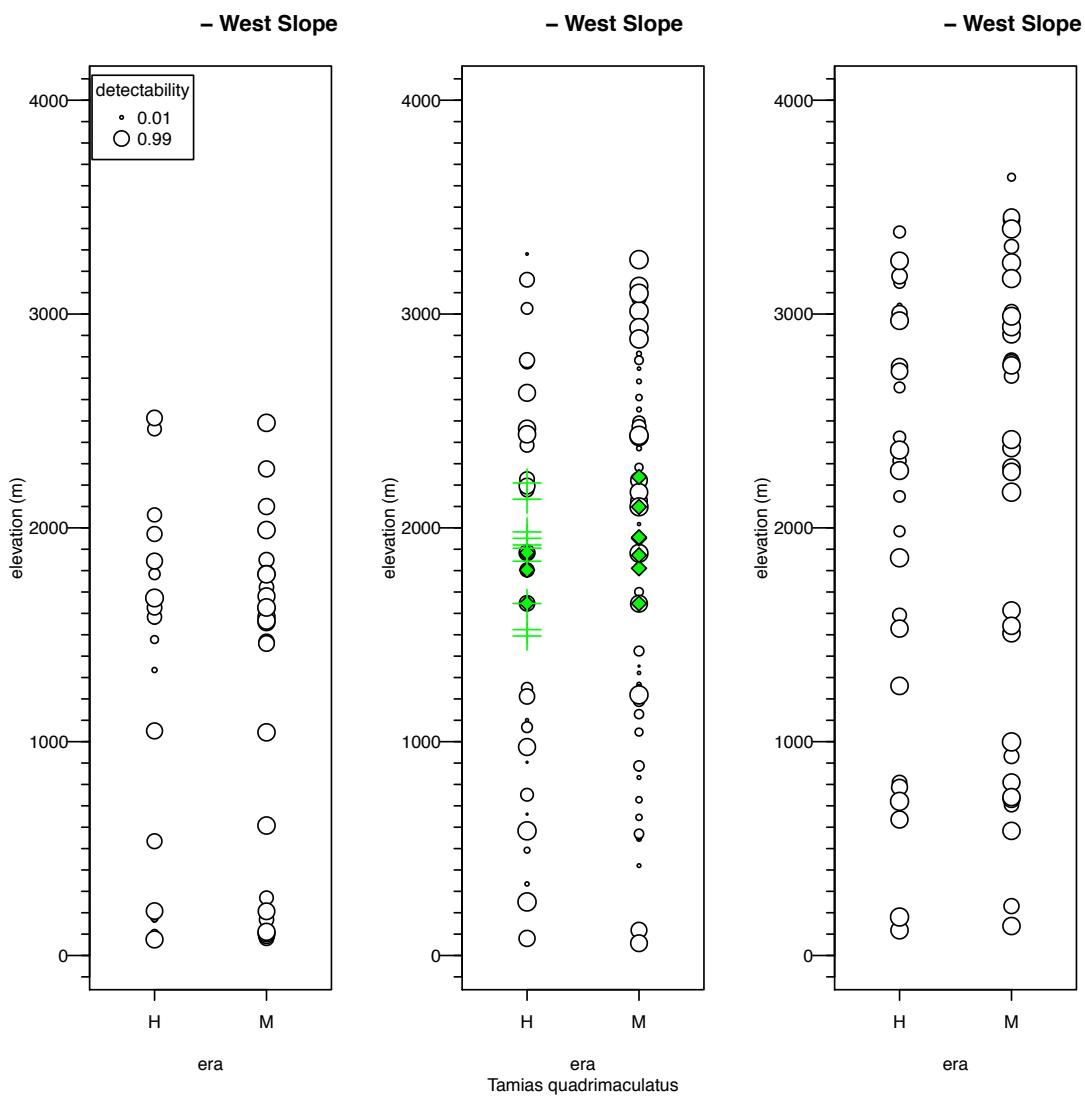


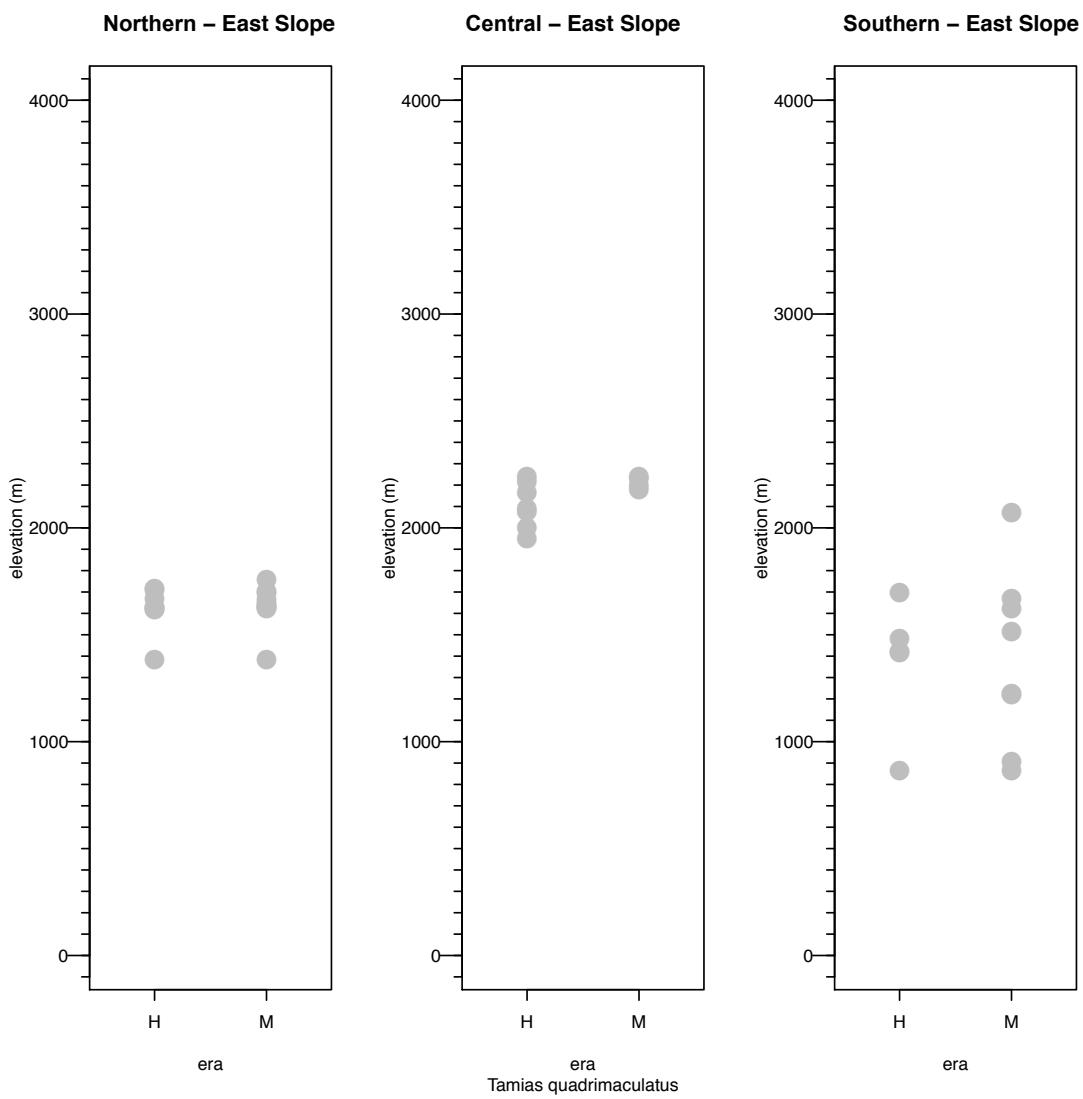


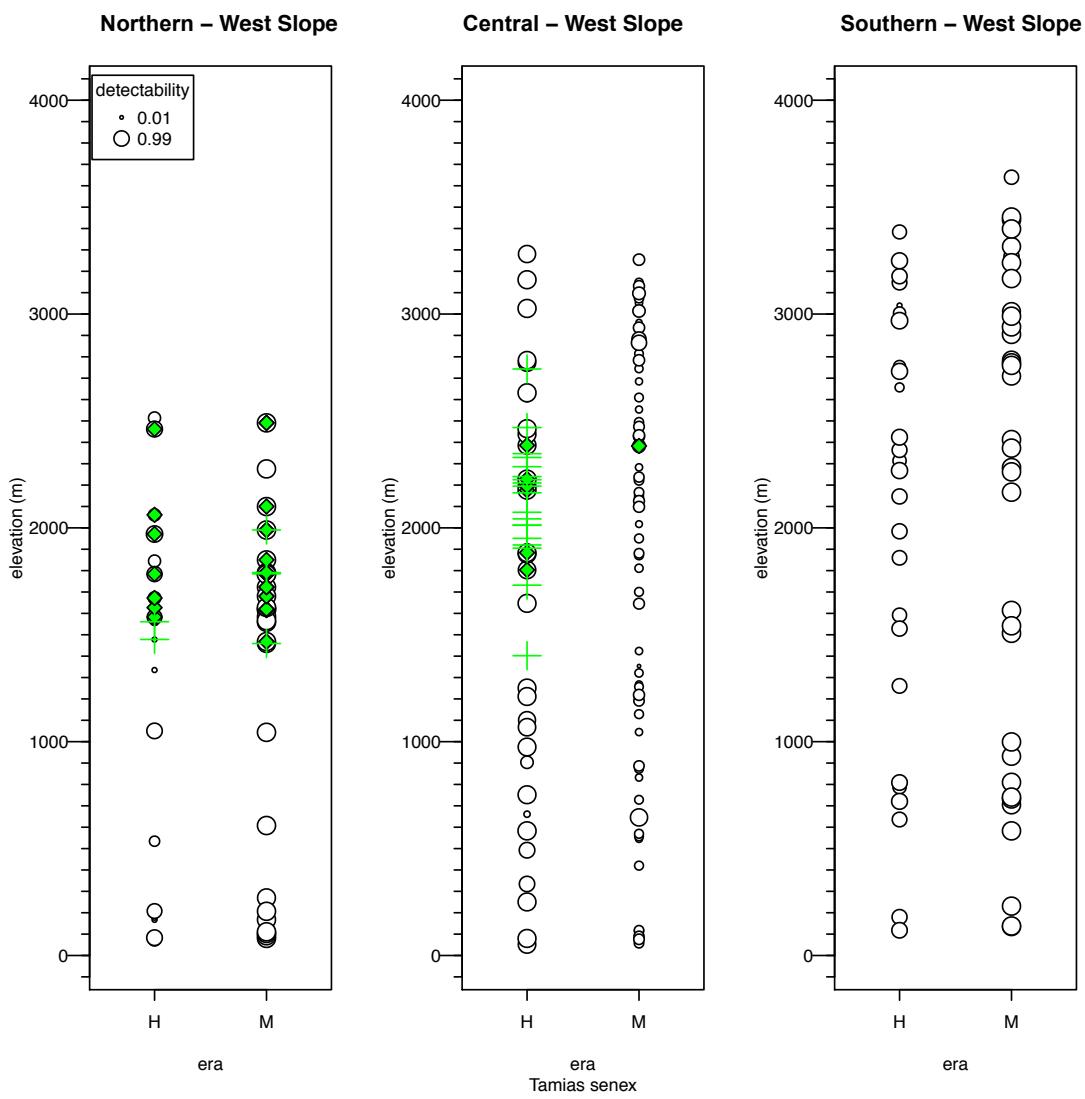


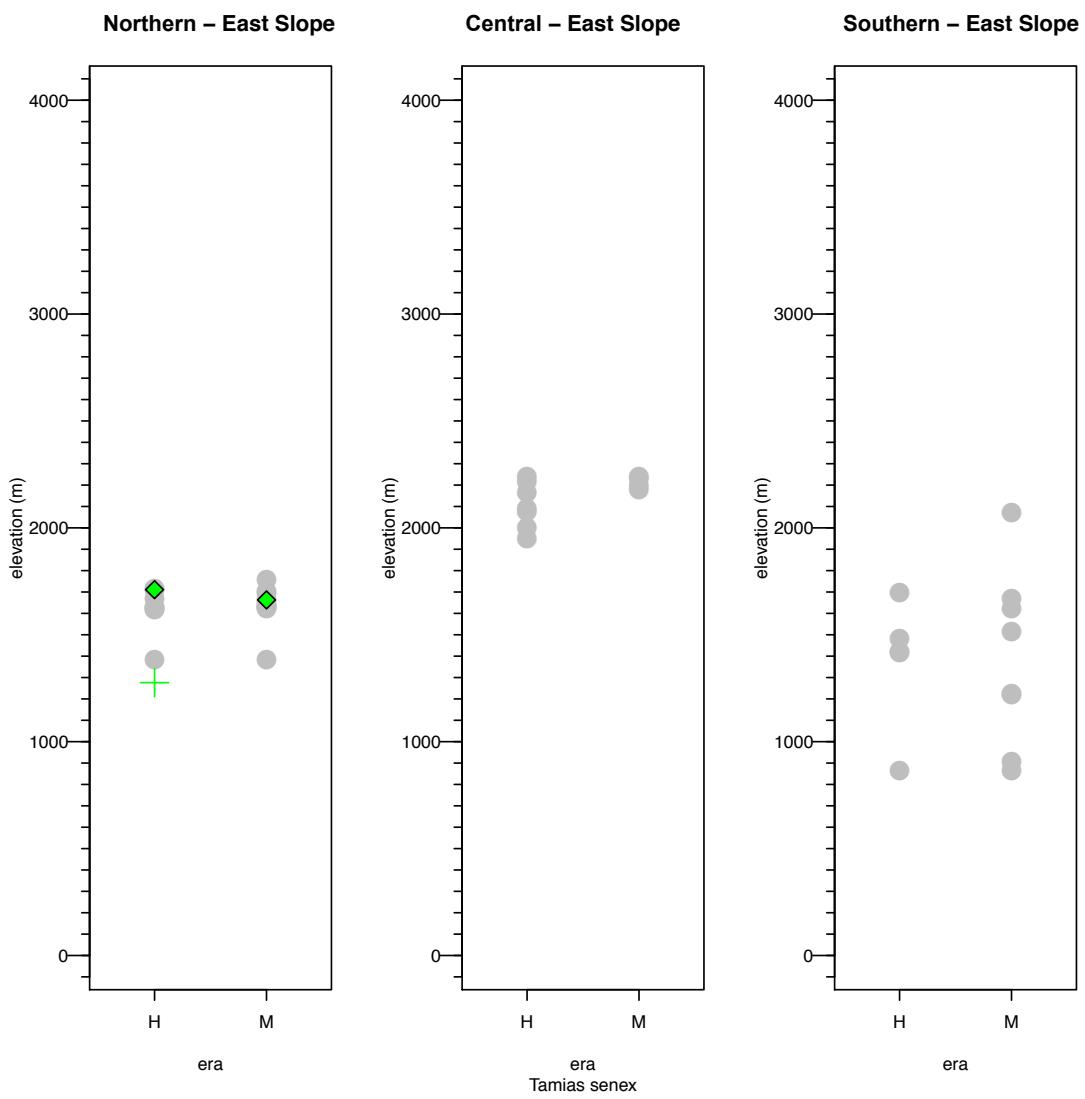


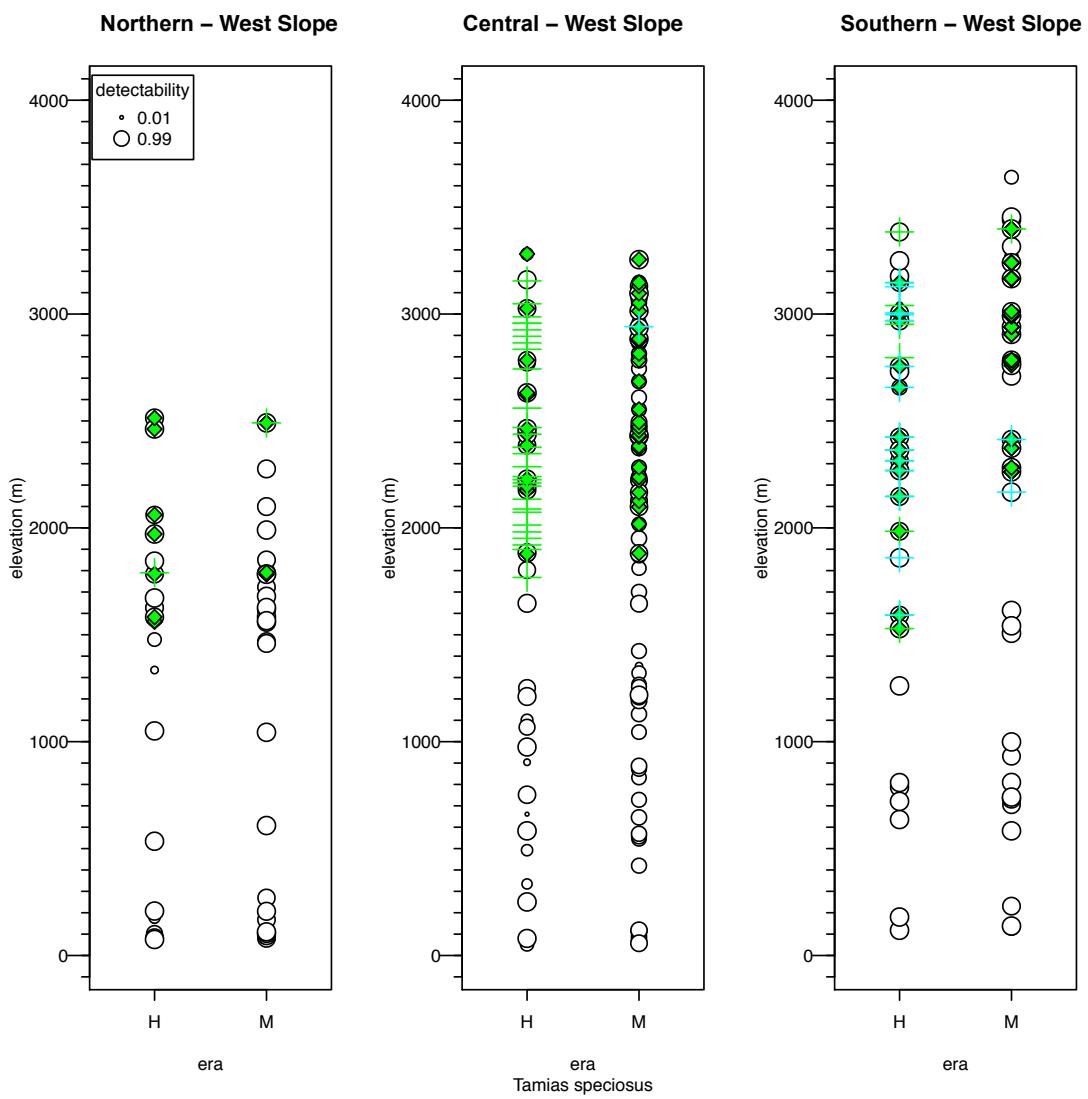


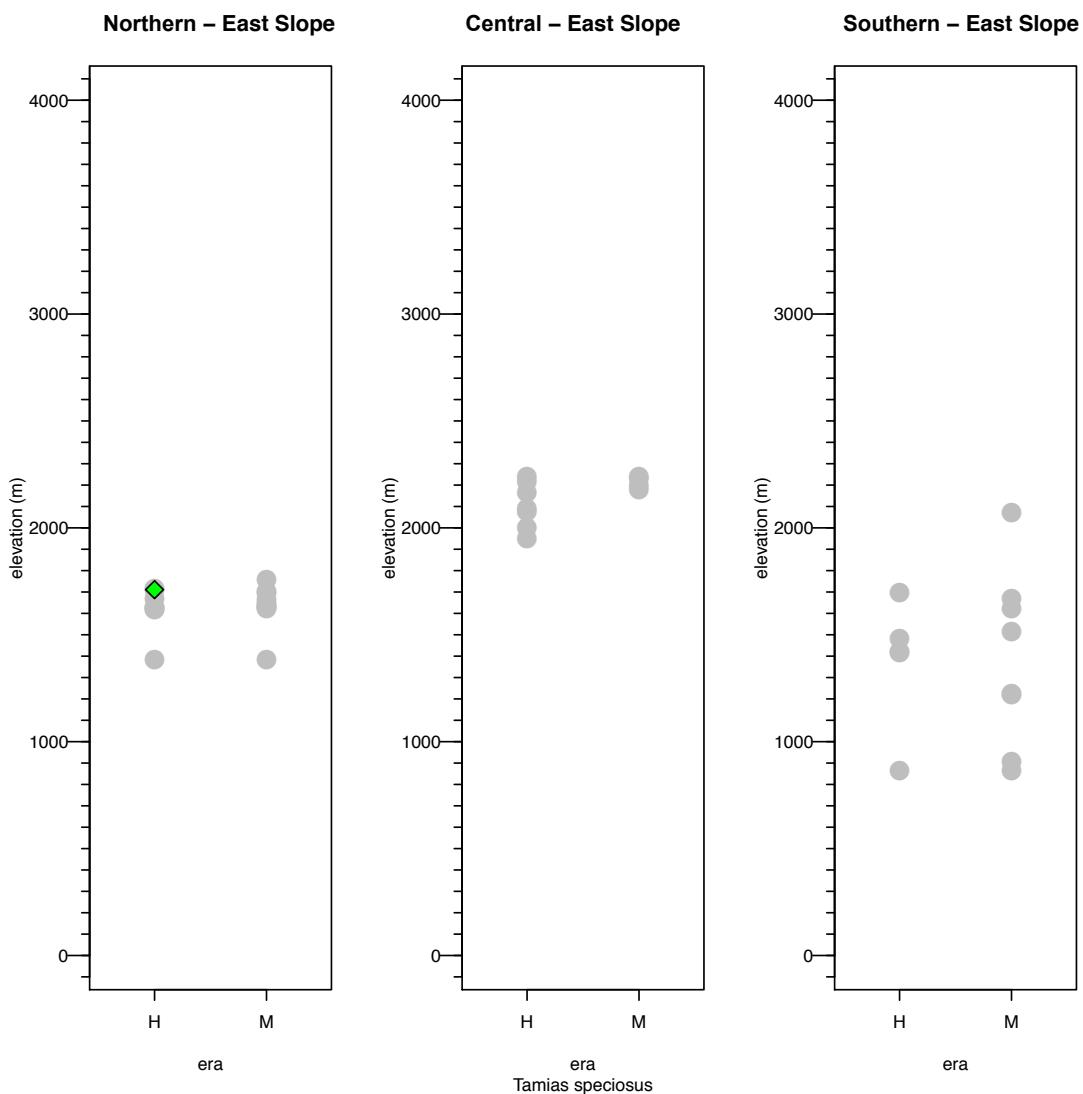


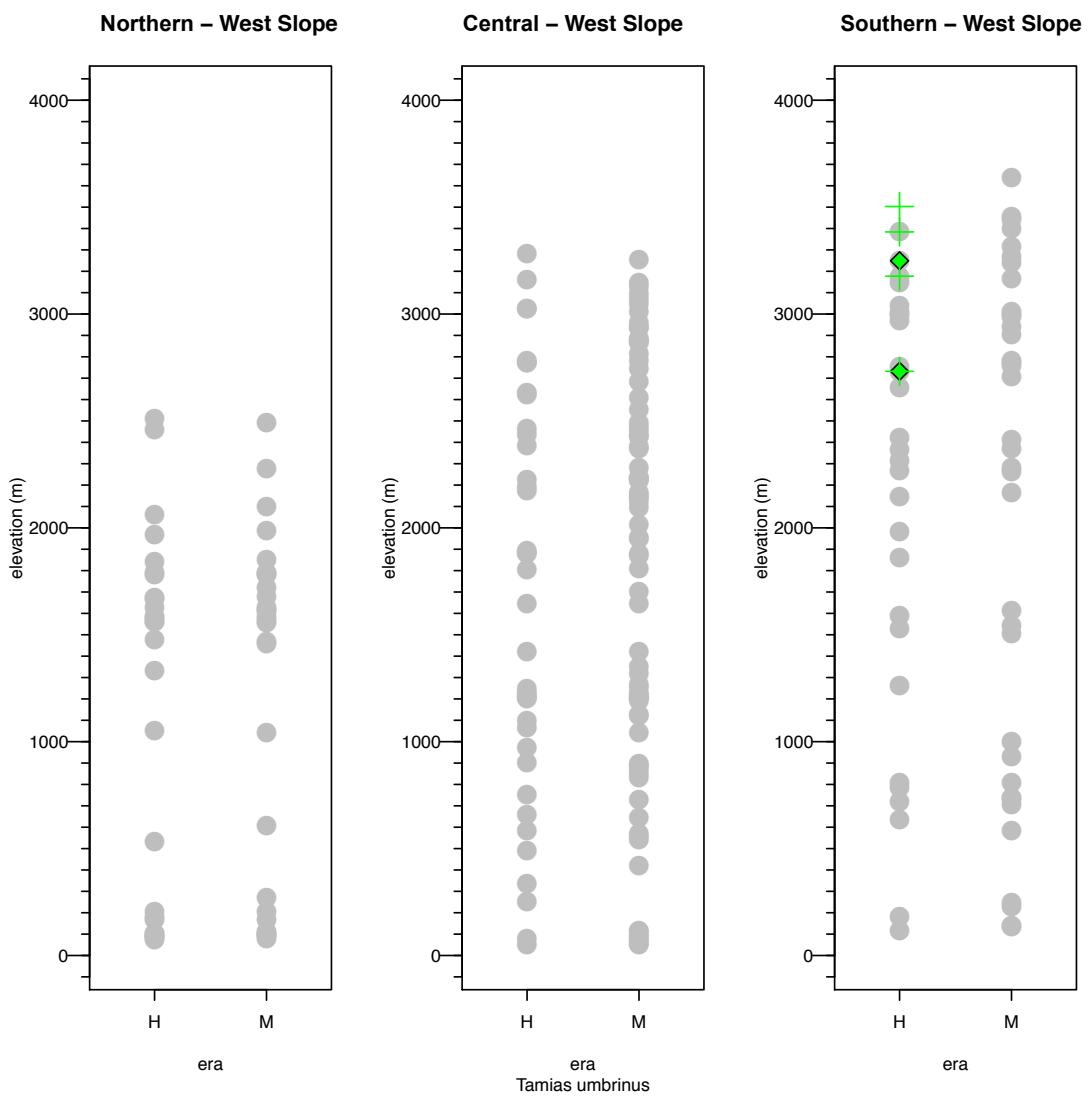


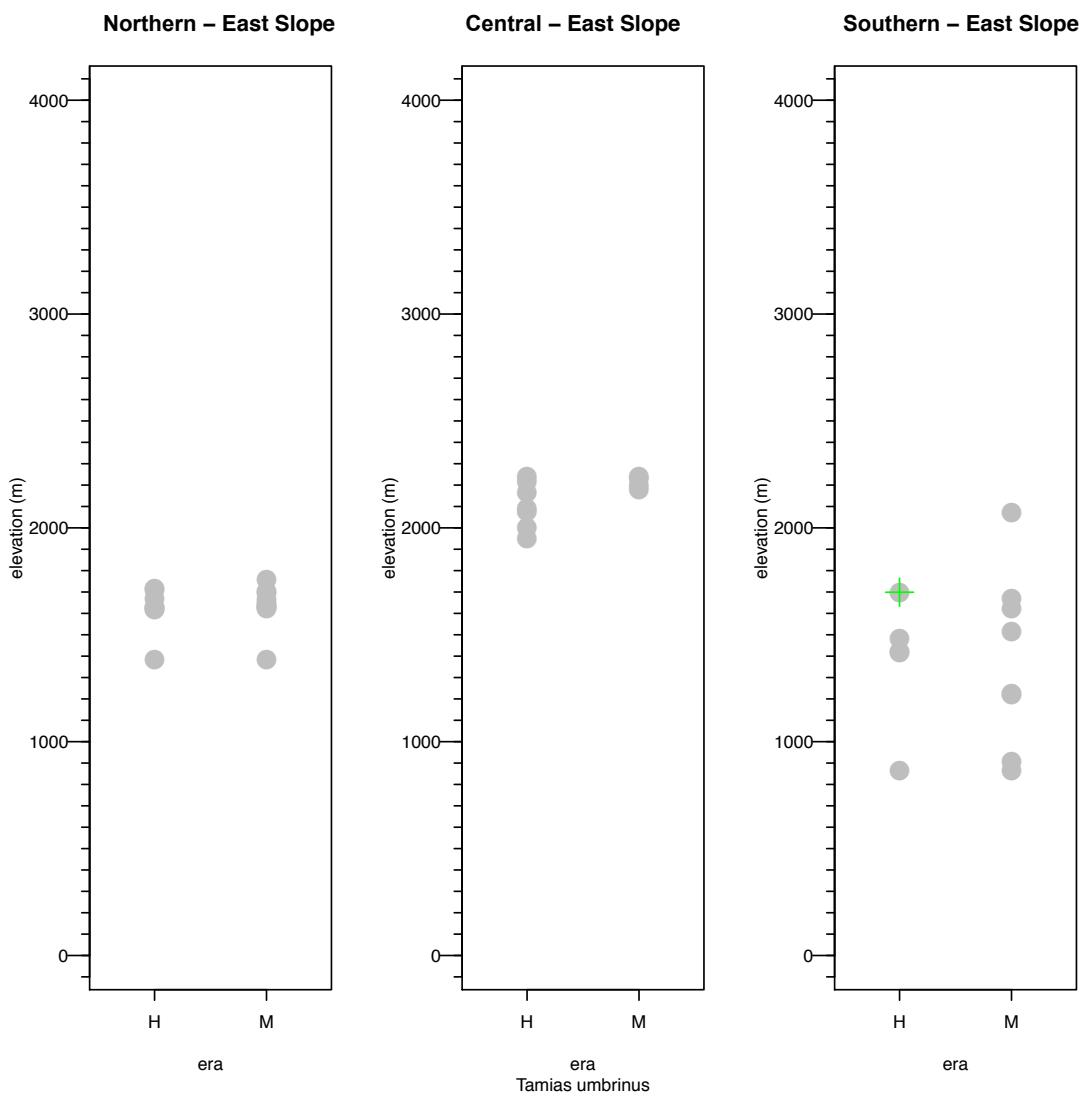


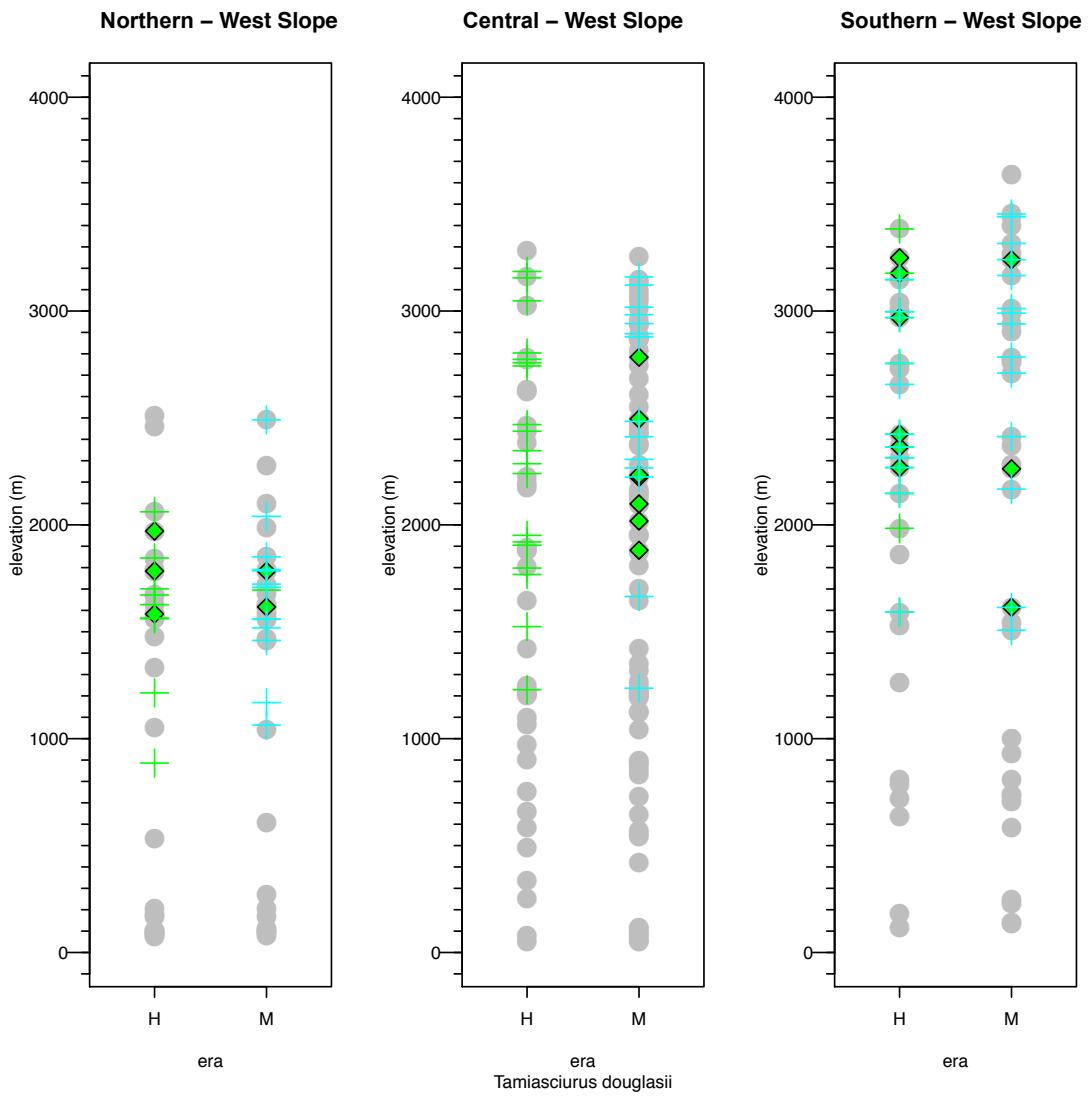


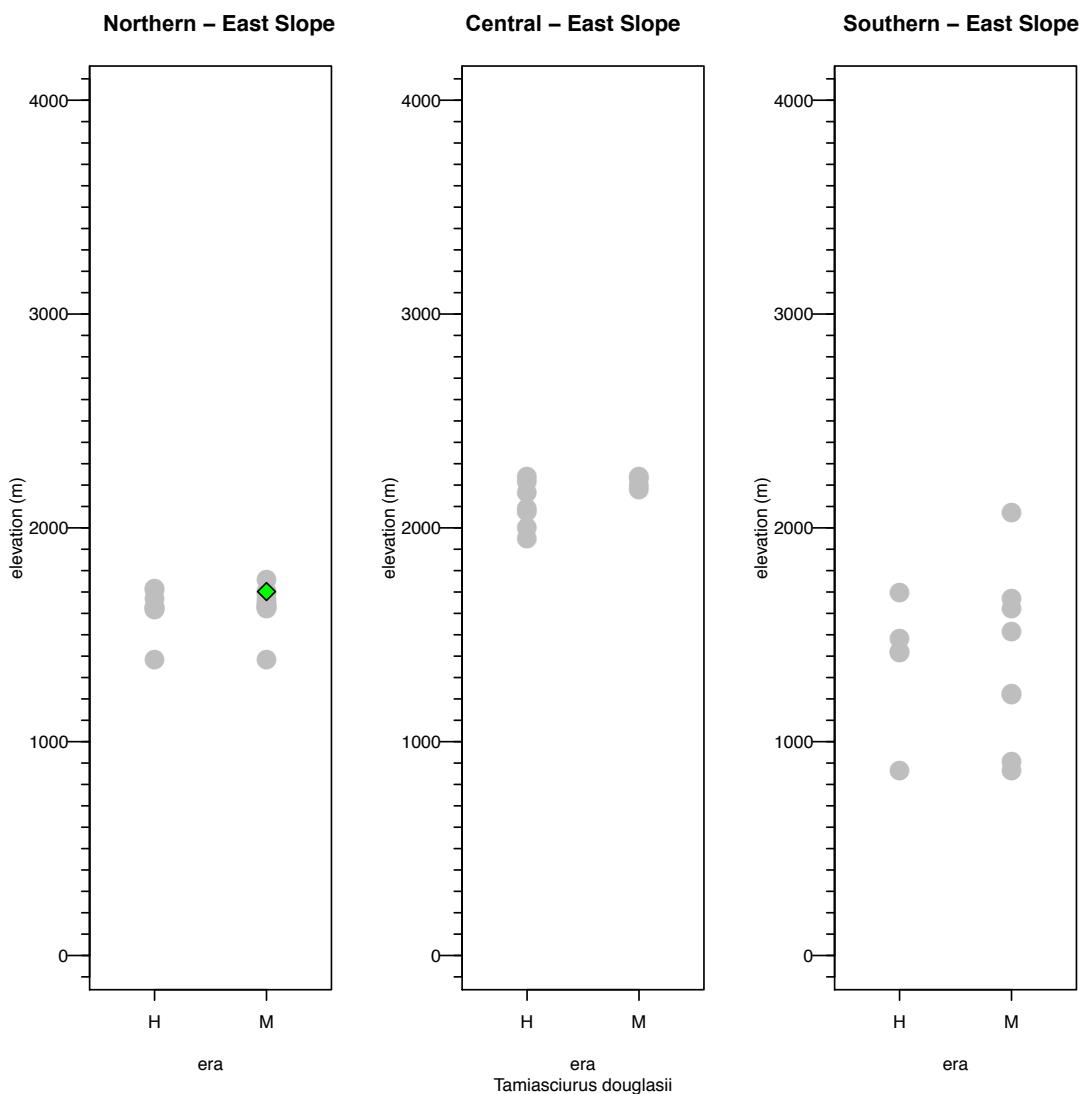


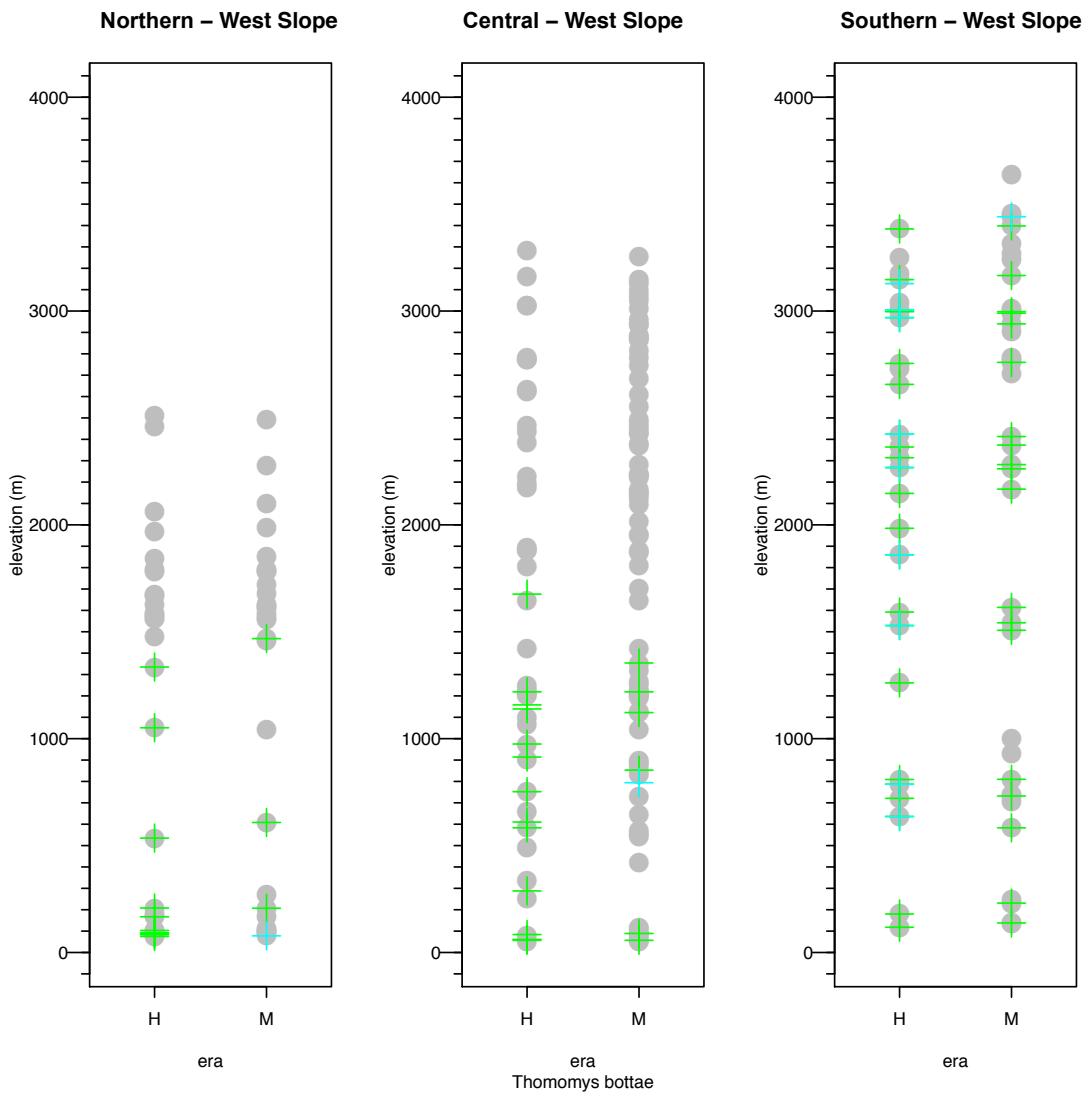


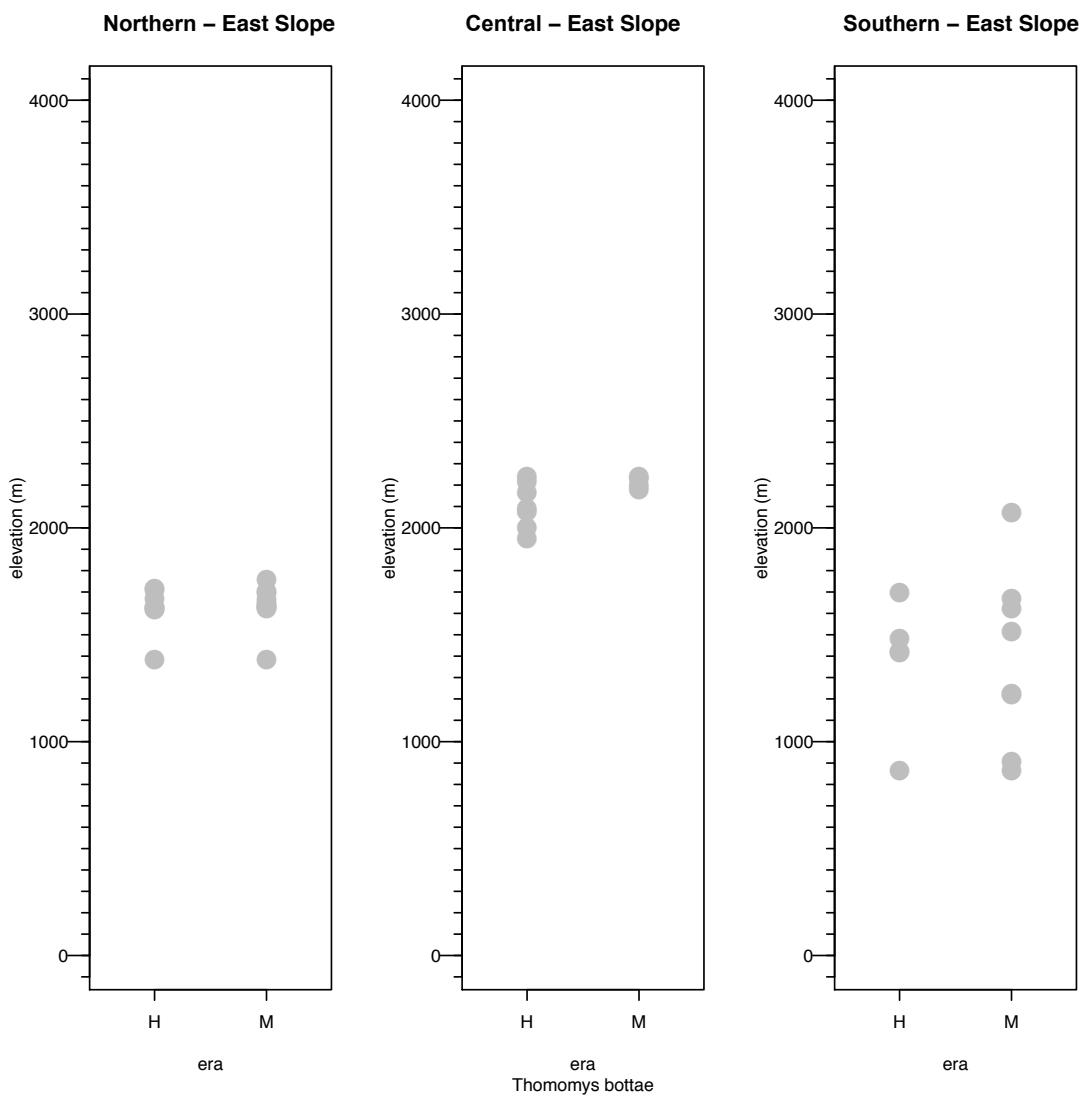


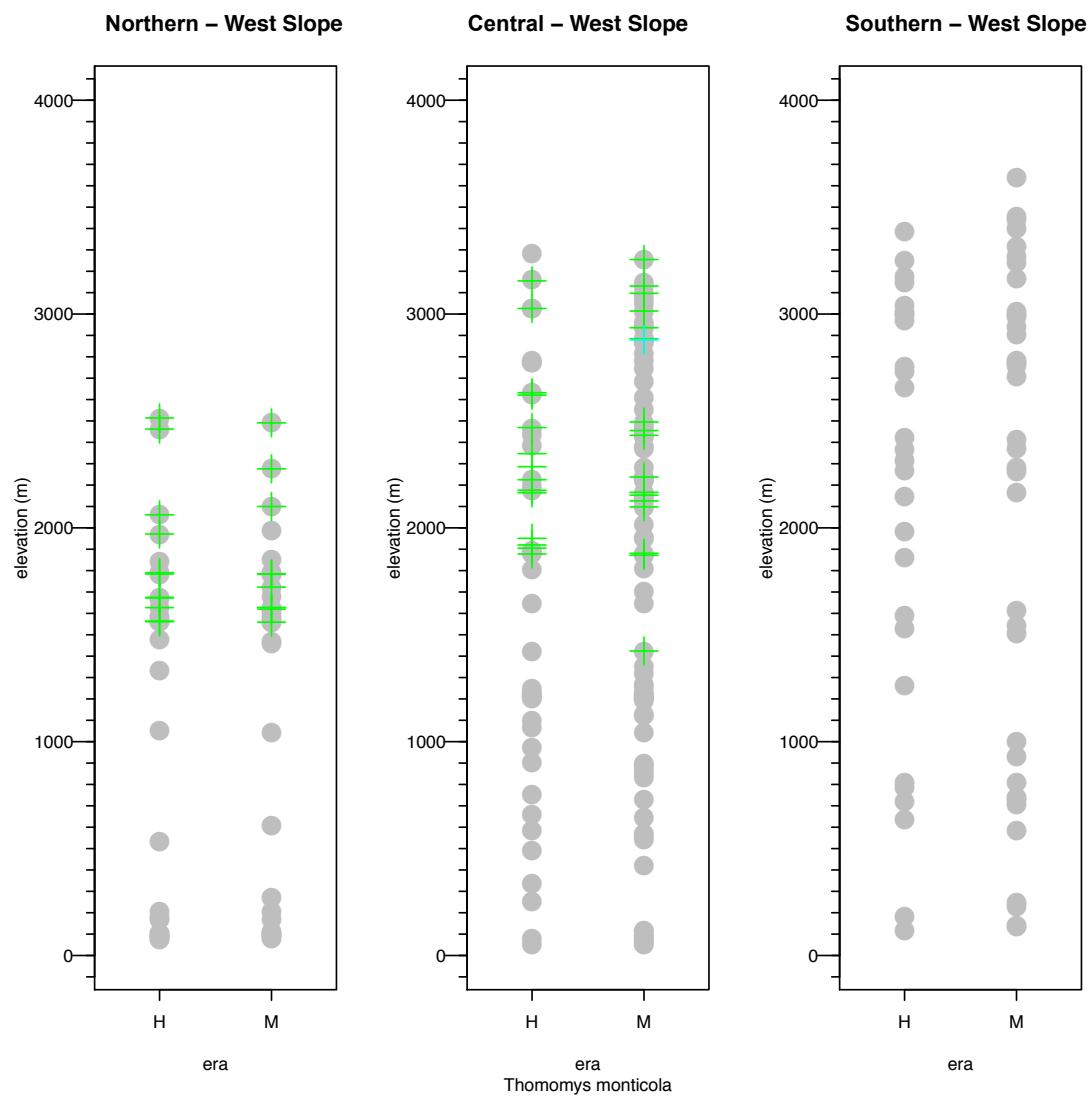


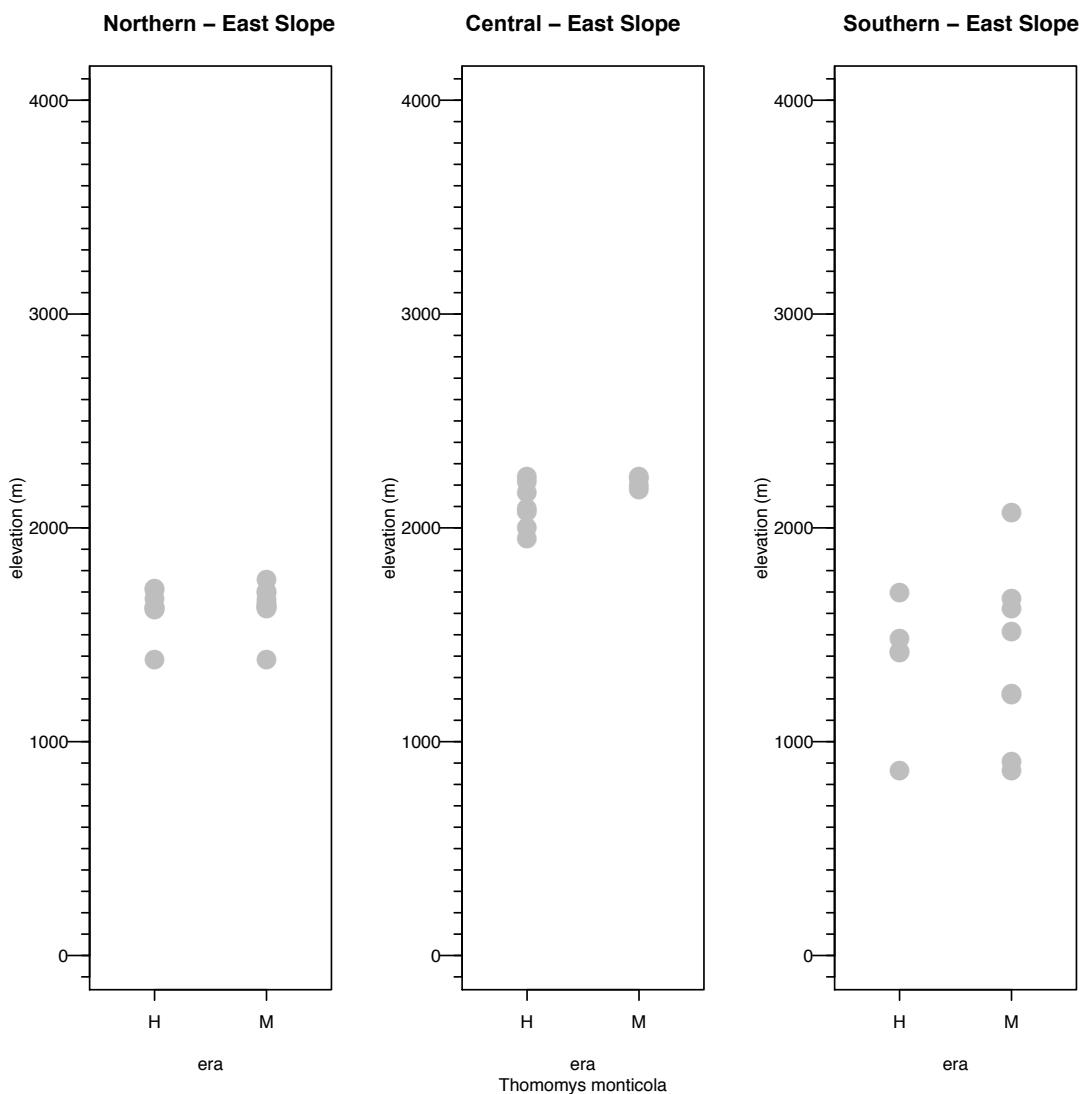


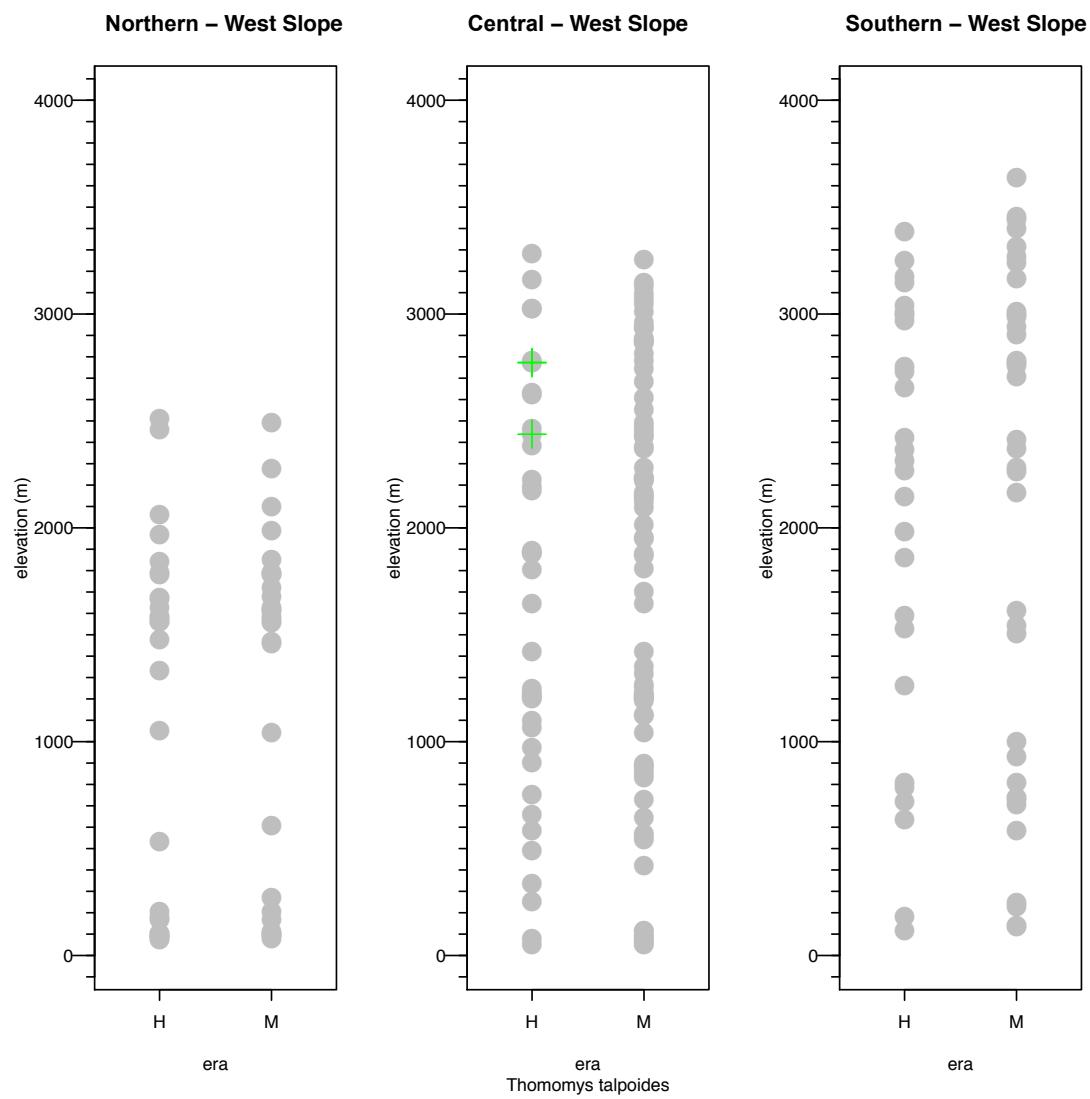


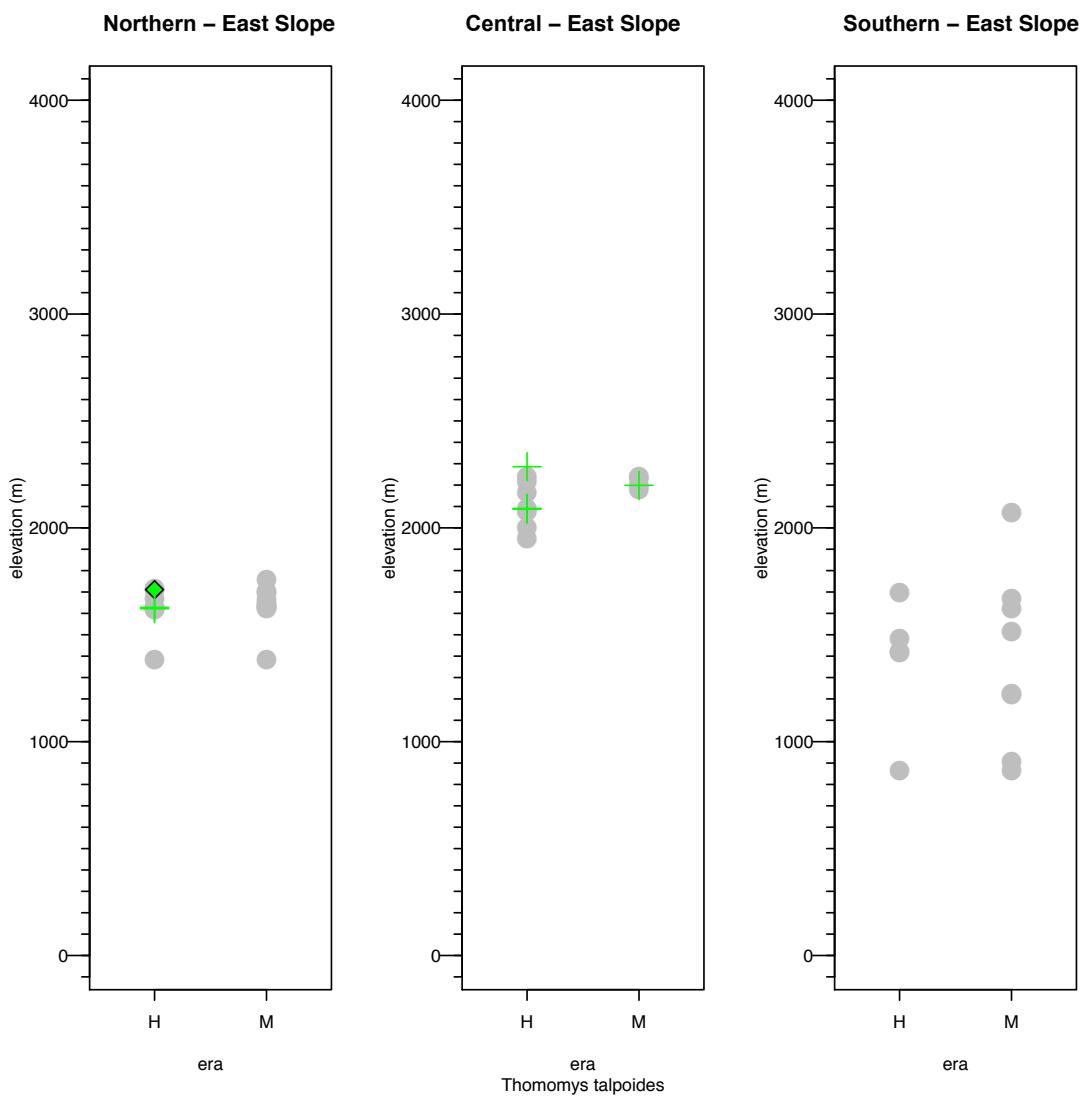


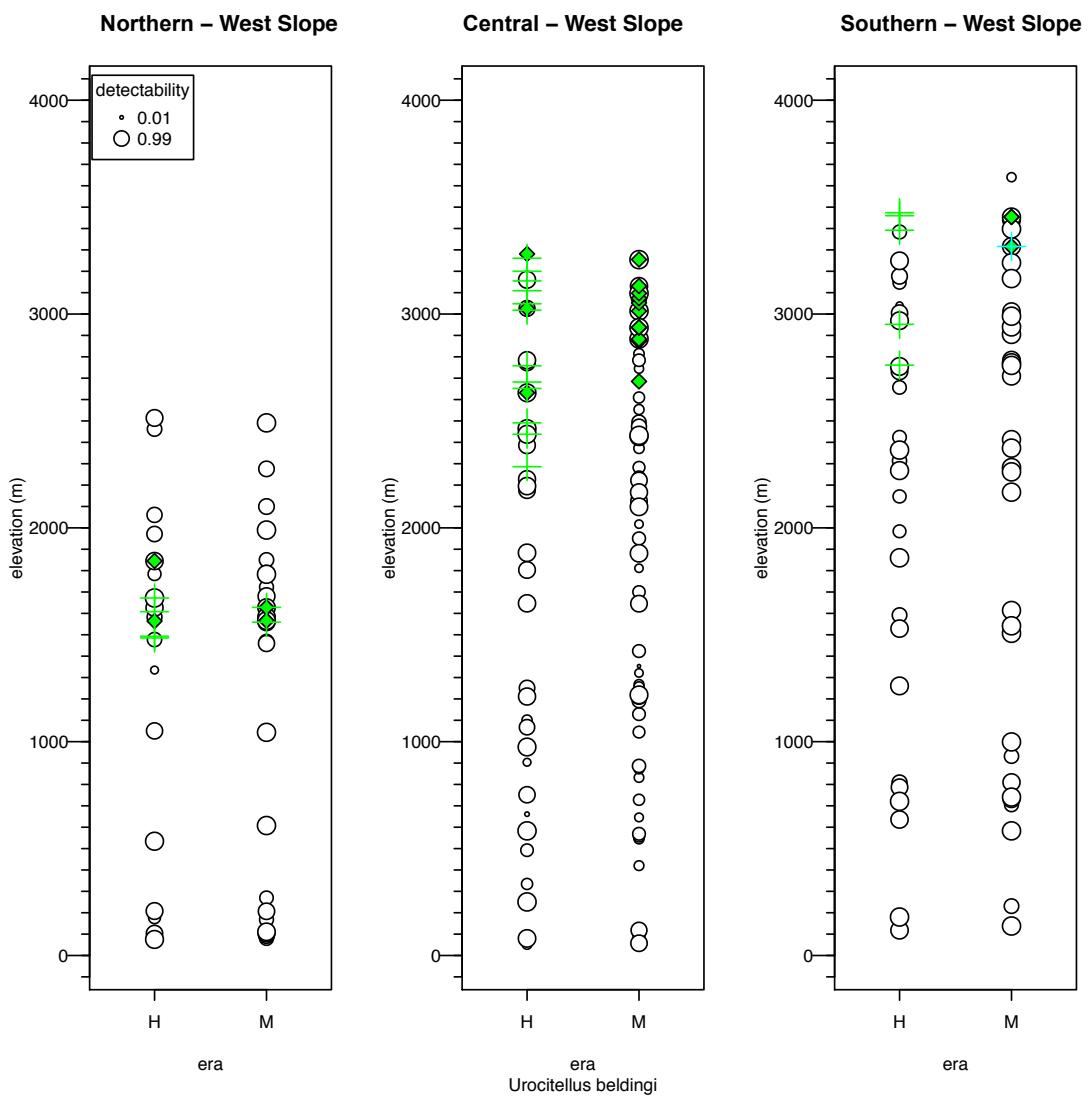


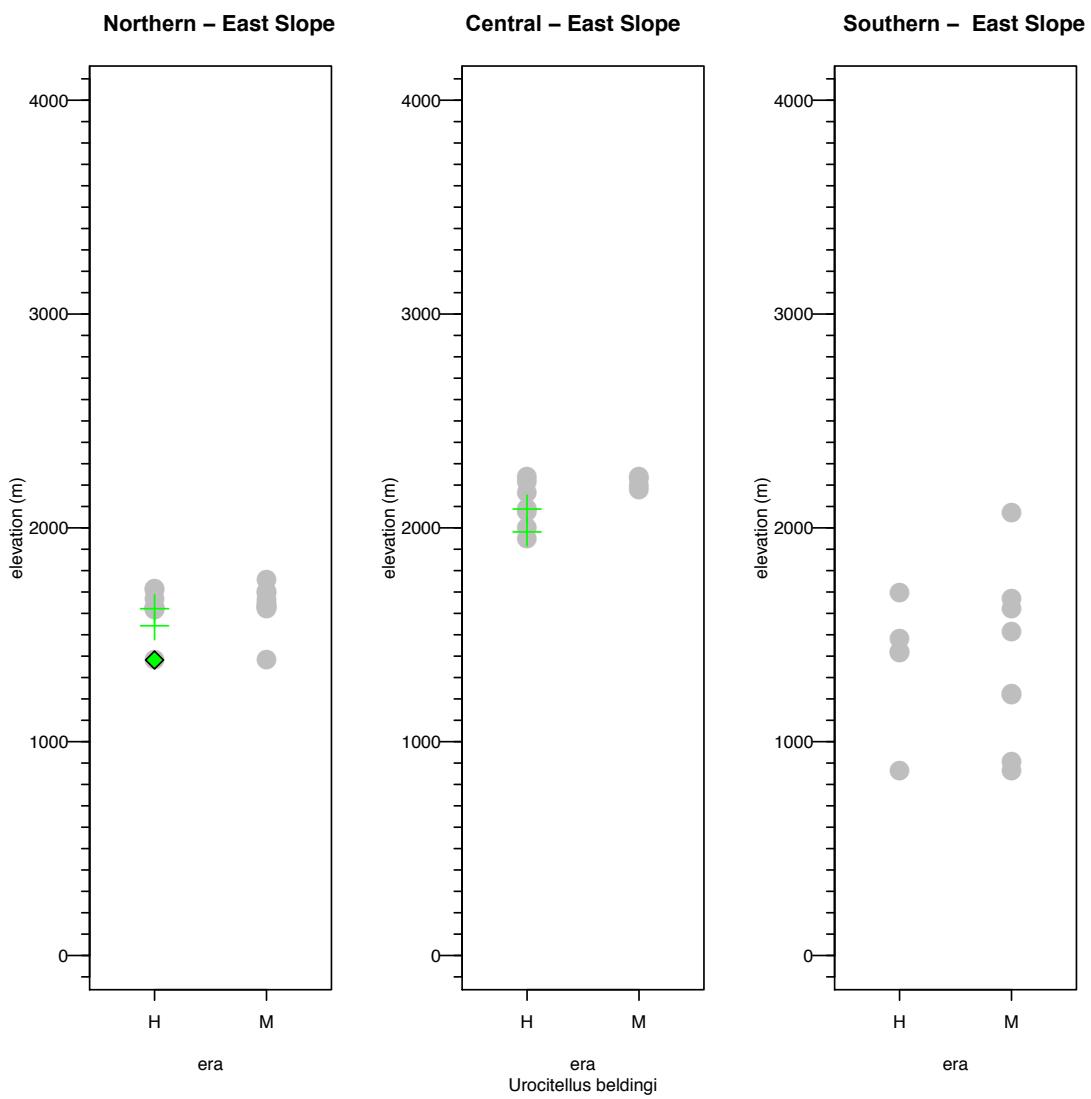


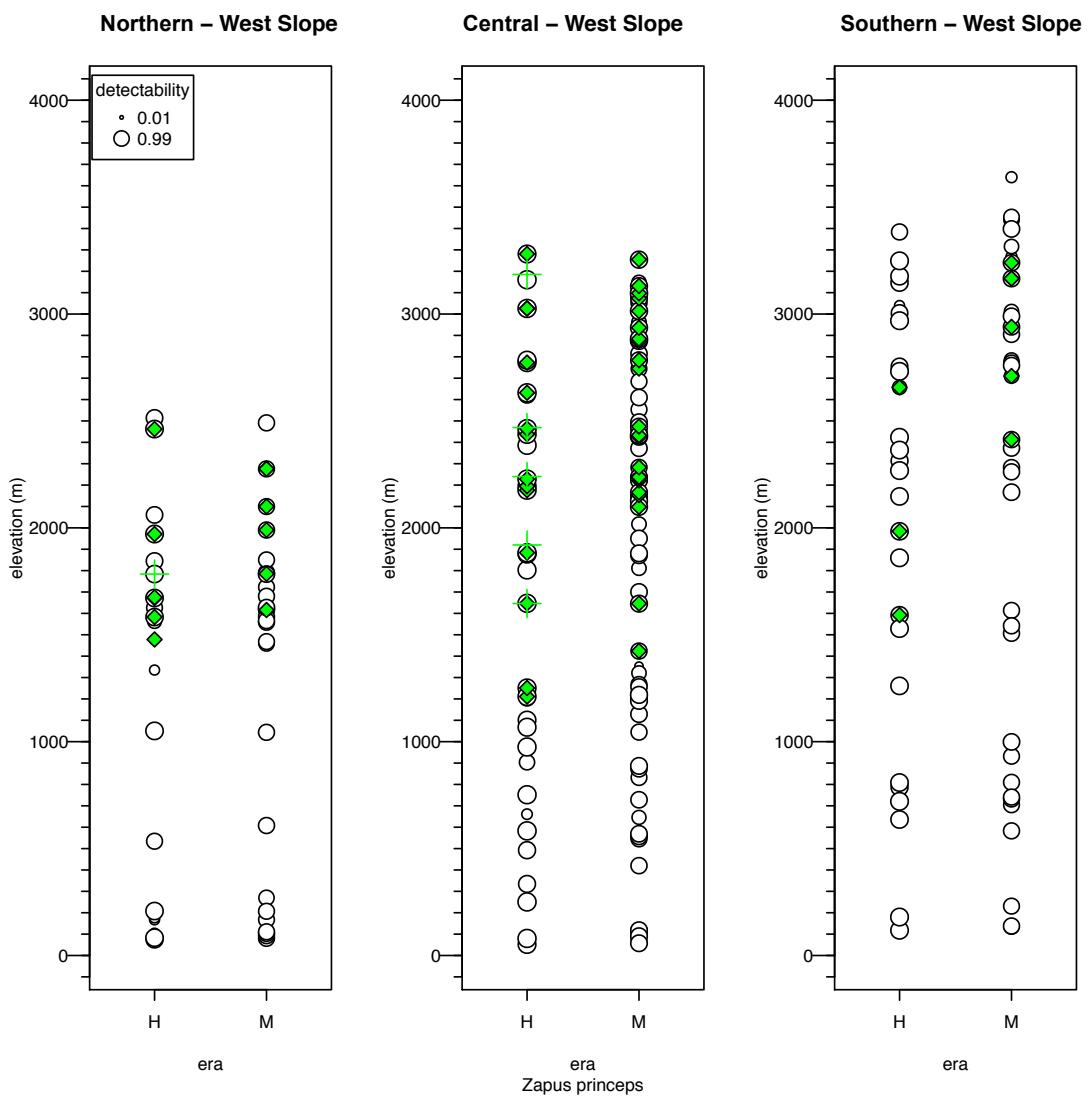


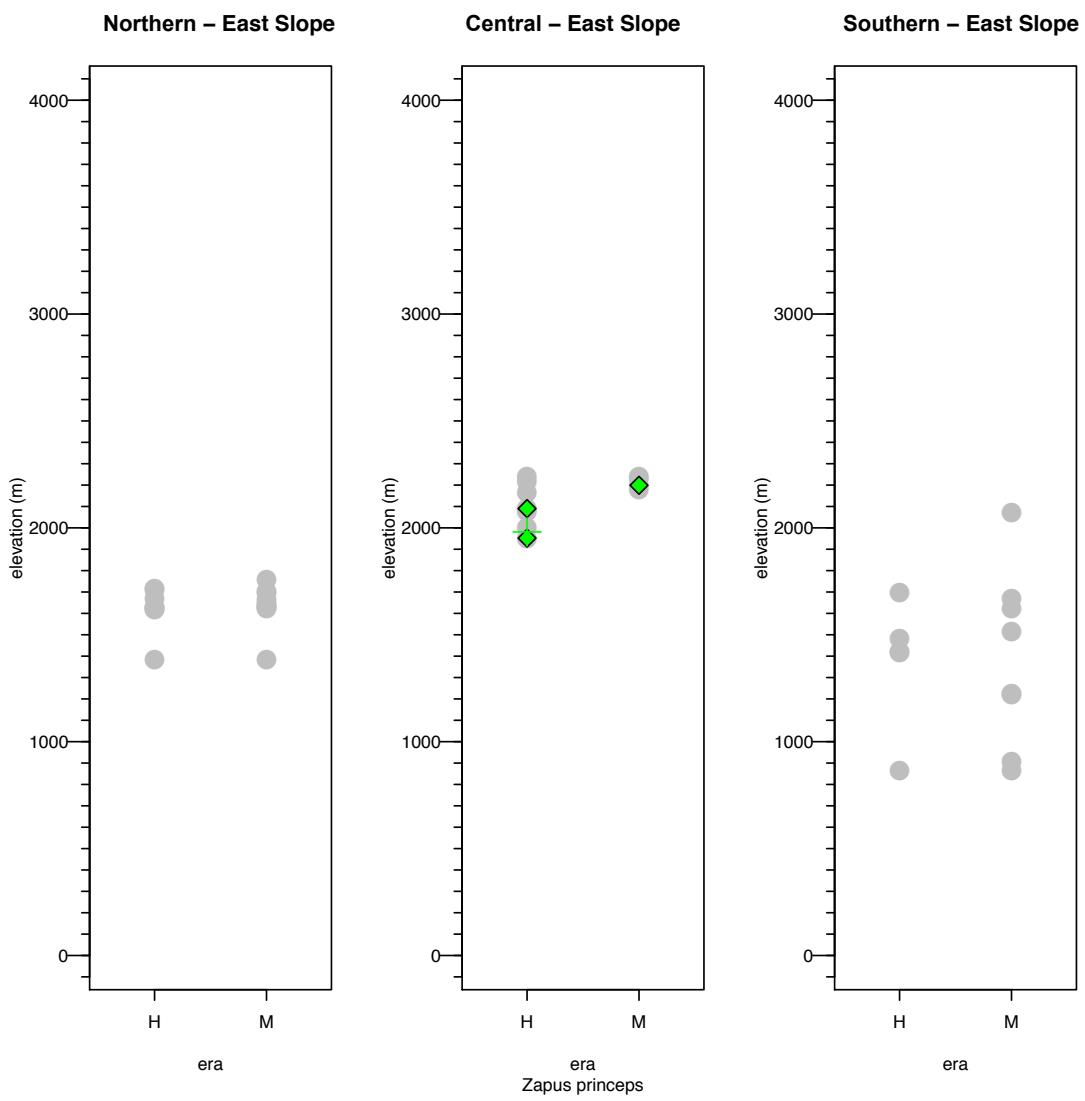


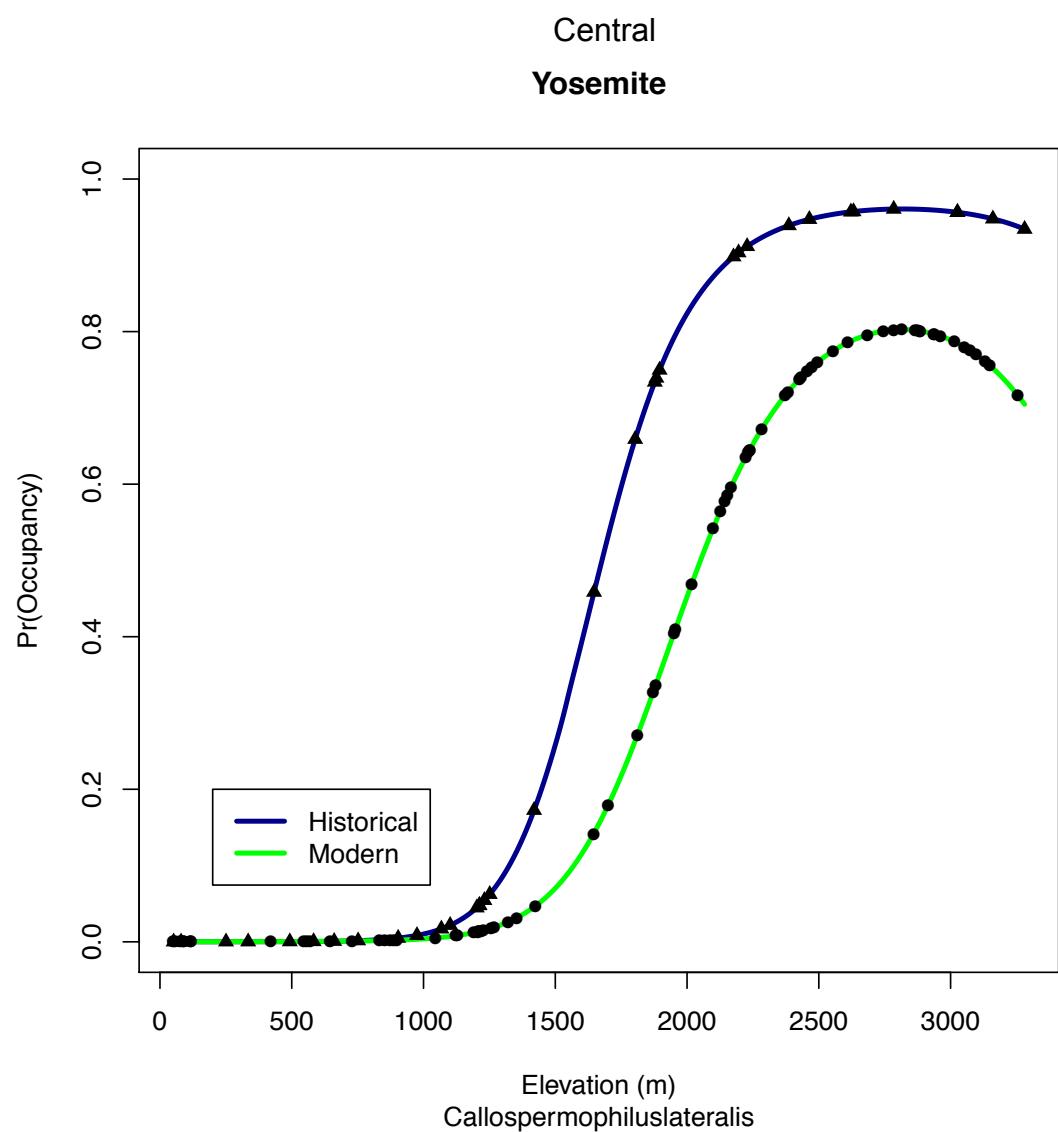






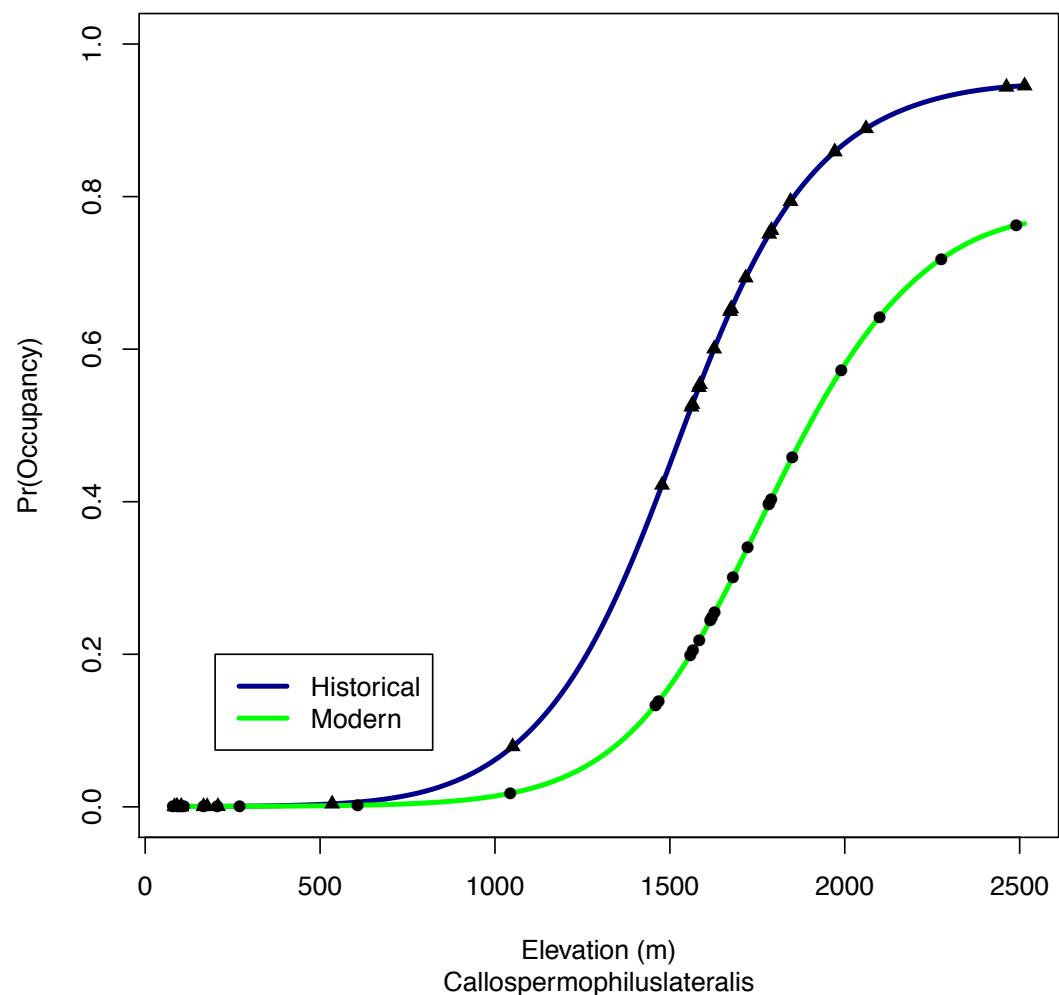






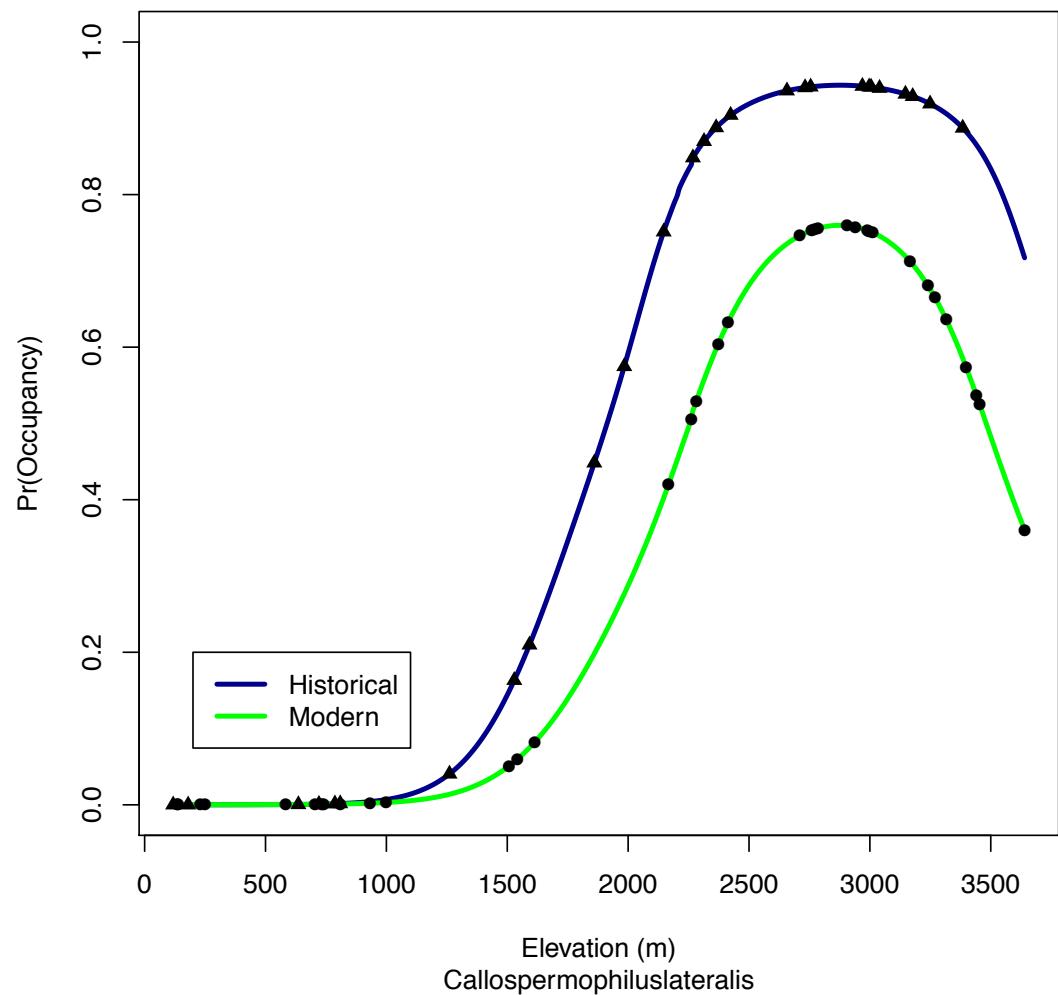
Northern

Lassen

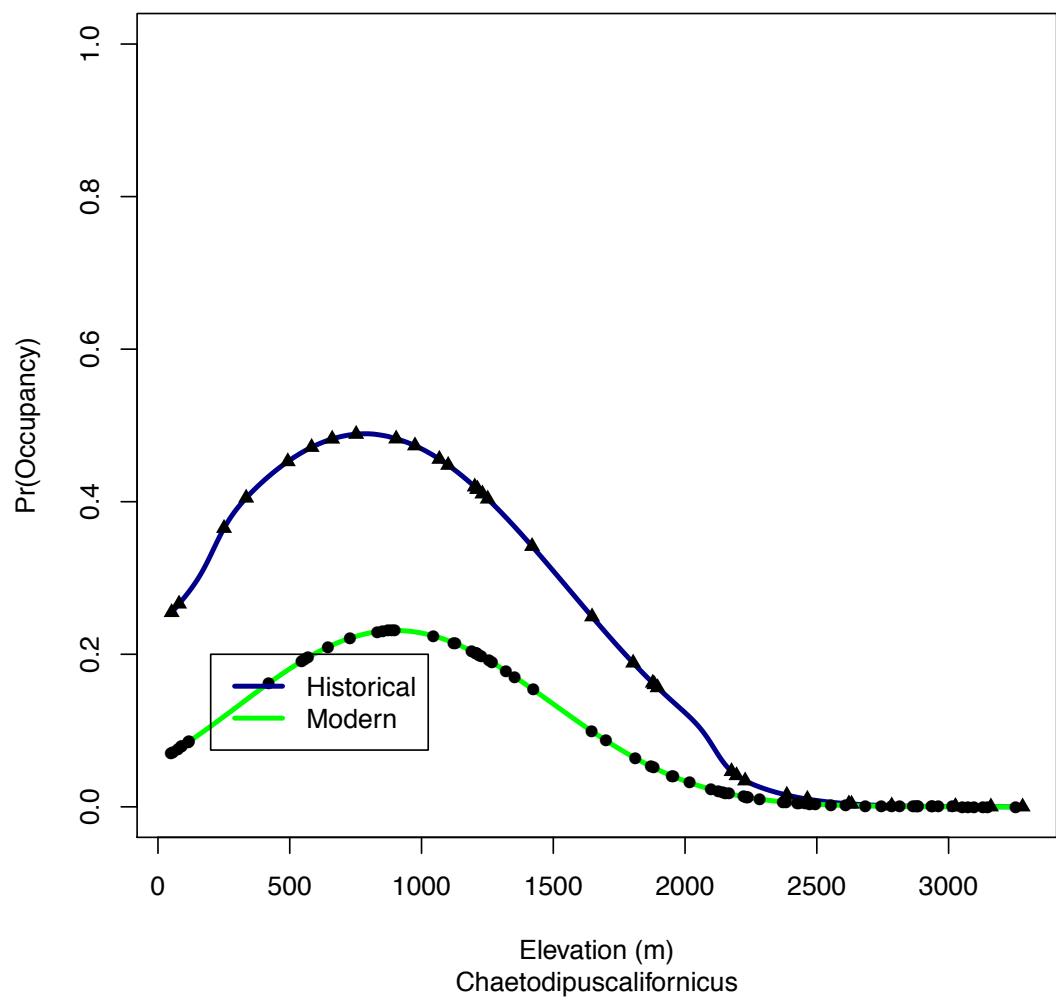


Southern

Sequoia

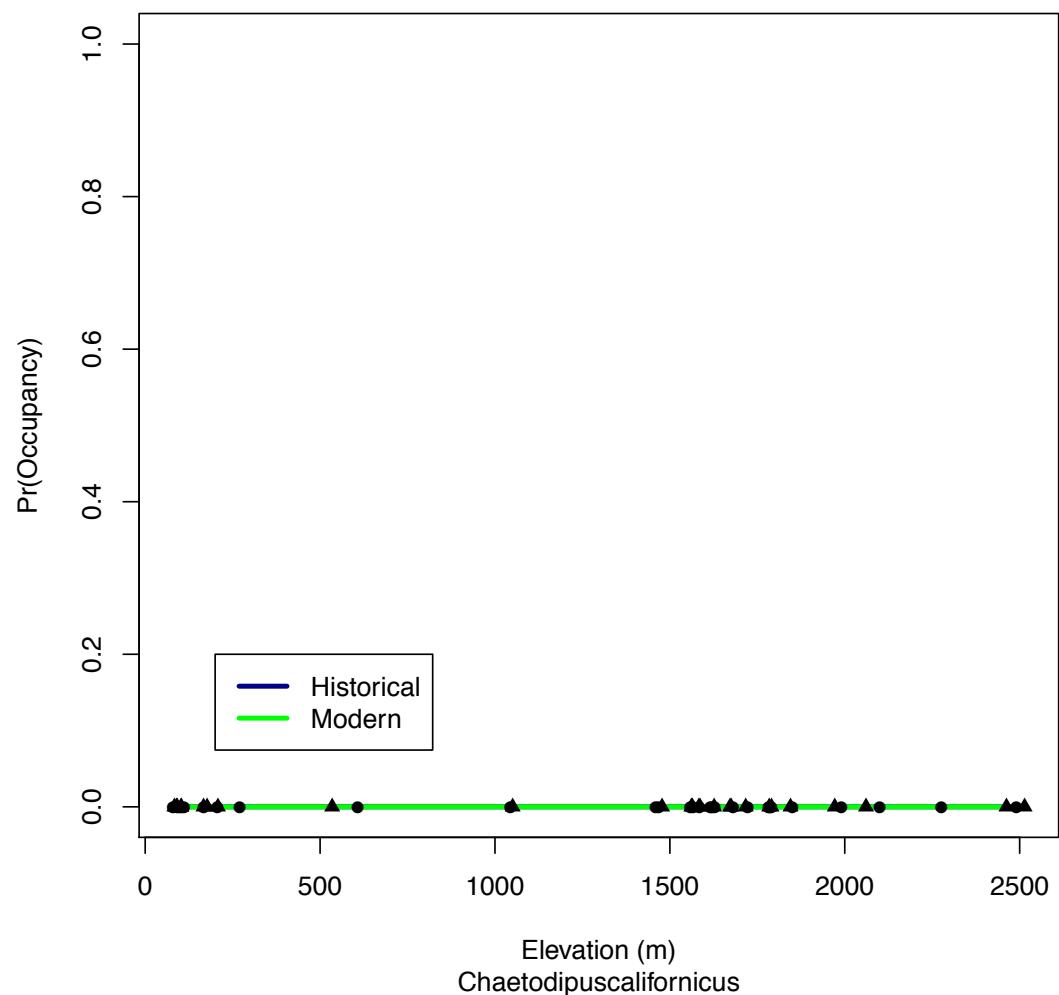


Central
Yosemite



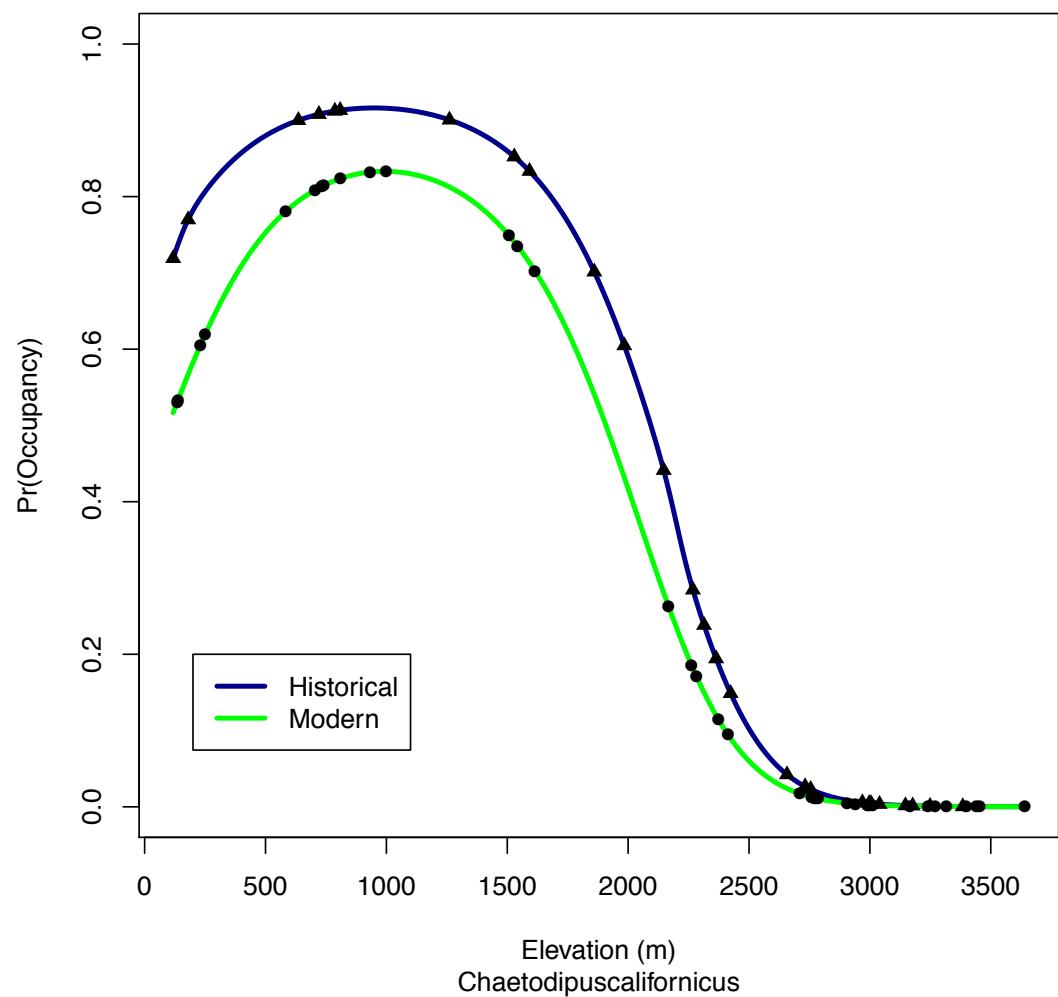
Northern

Lassen

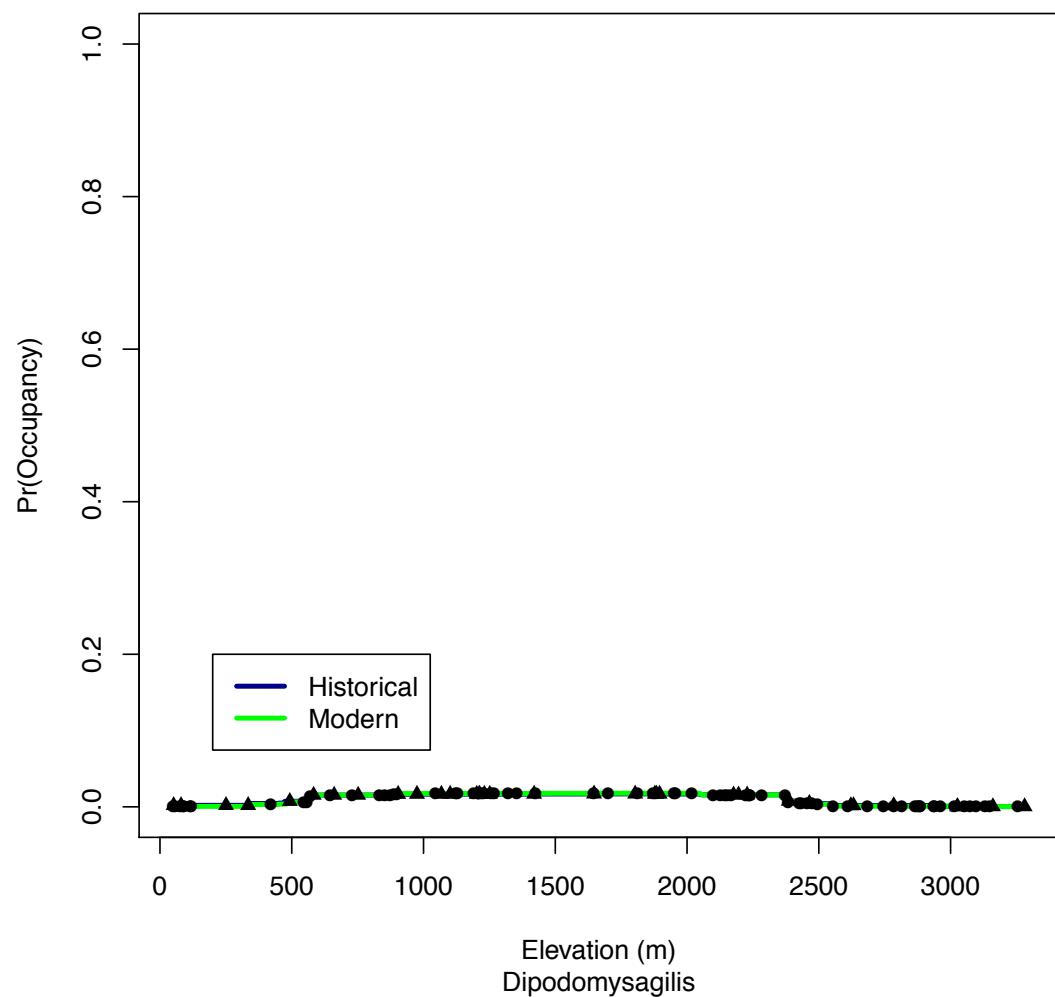


Southern

Sequoia

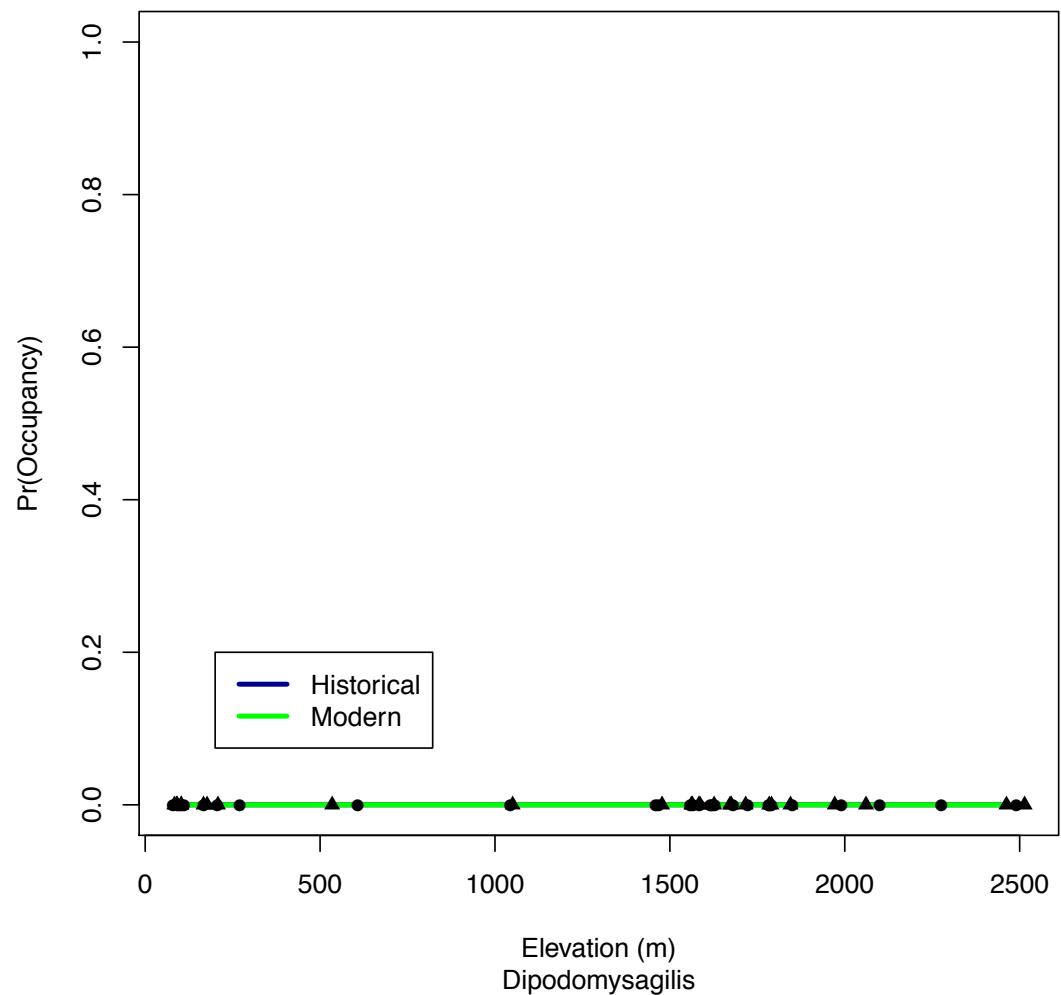


Central
Yosemite



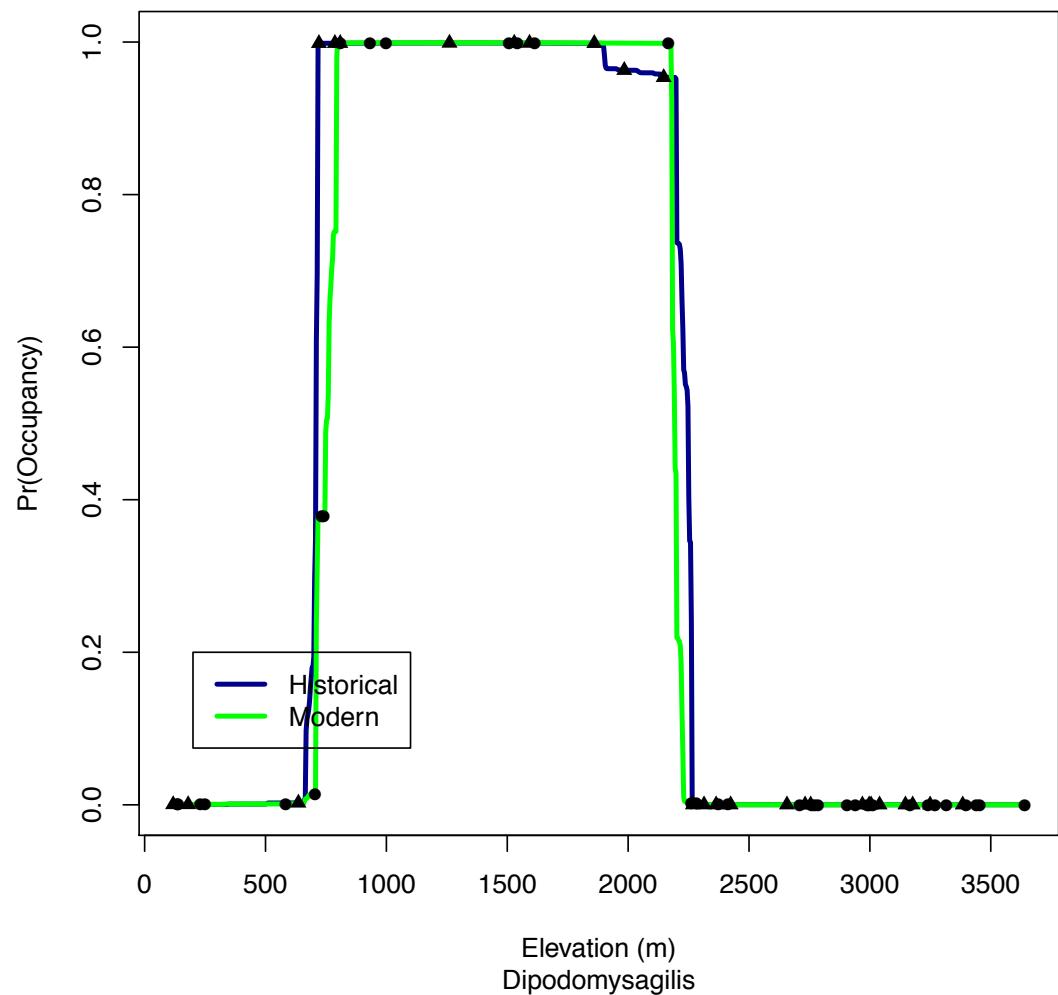
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Lassen

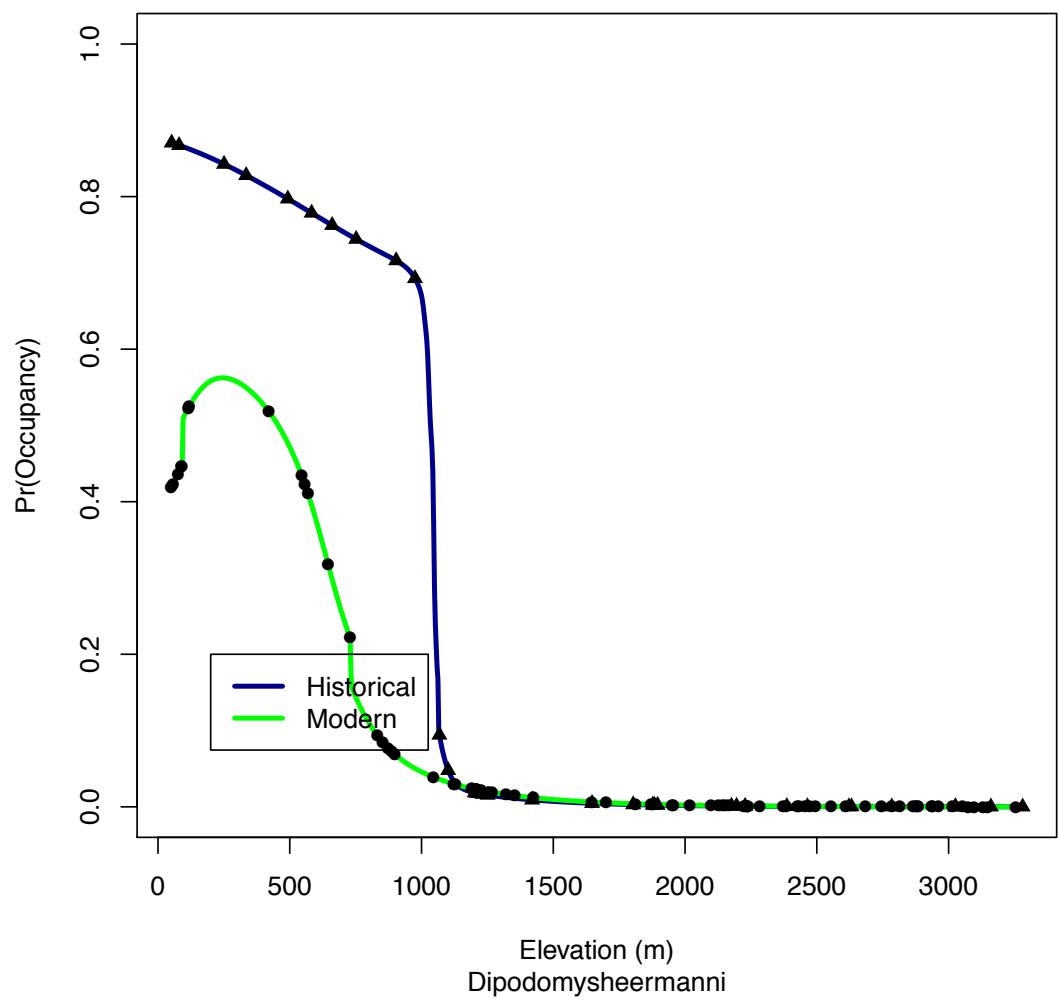


Southern

Sequoia

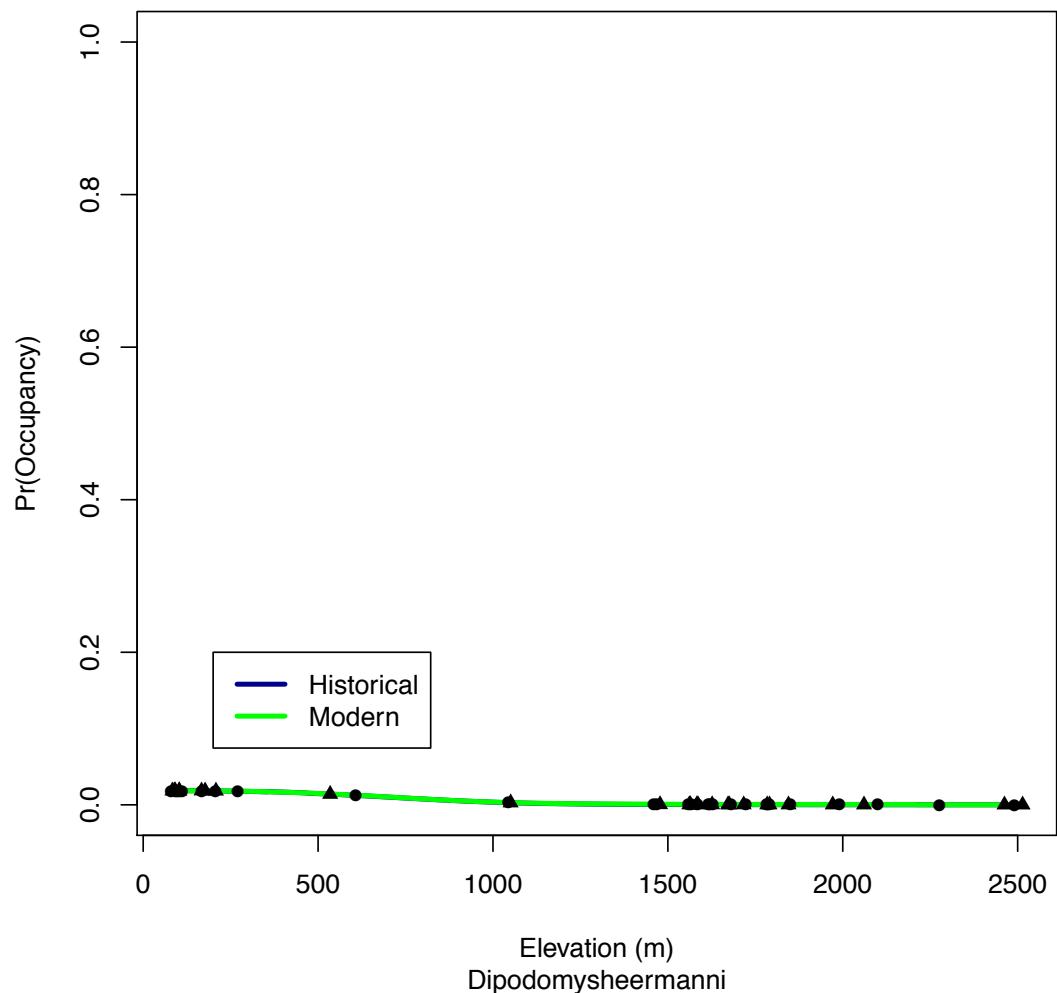


Central
Yosemite



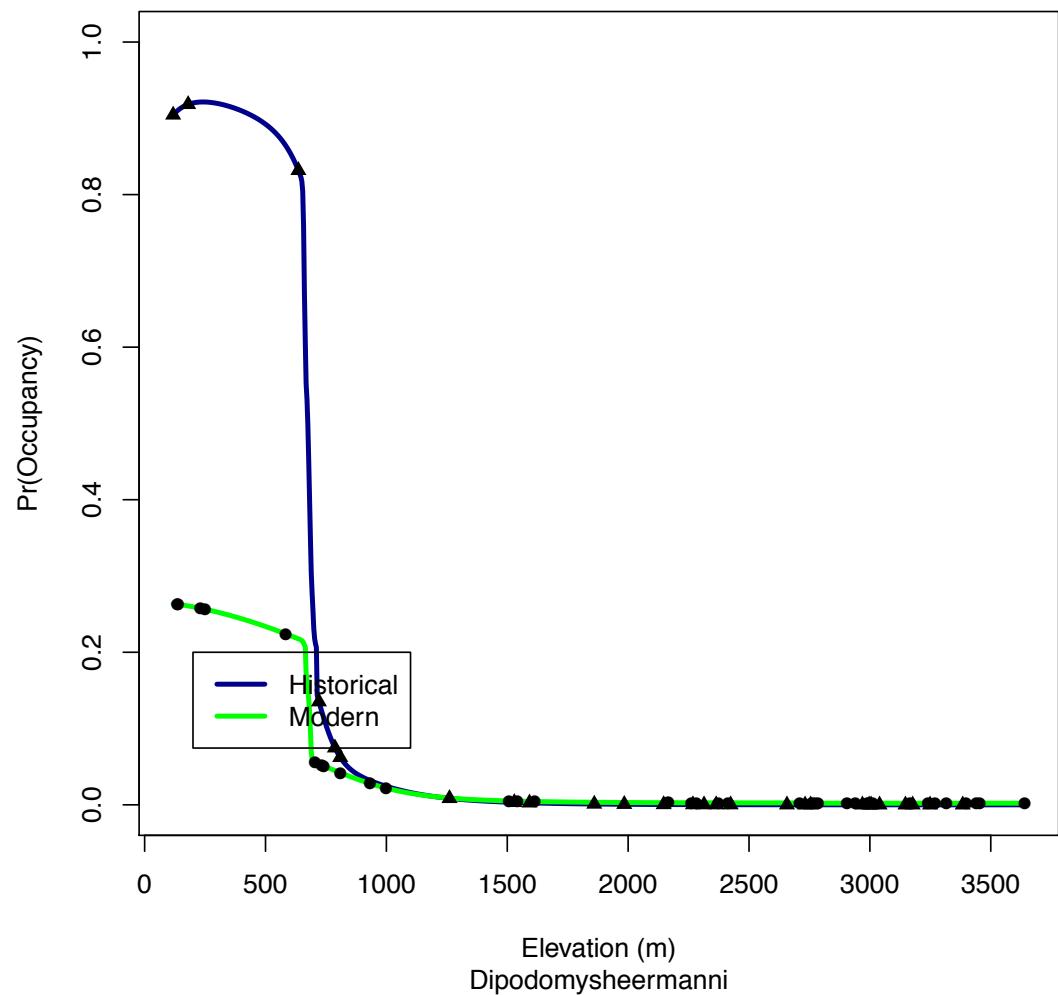
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Lassen



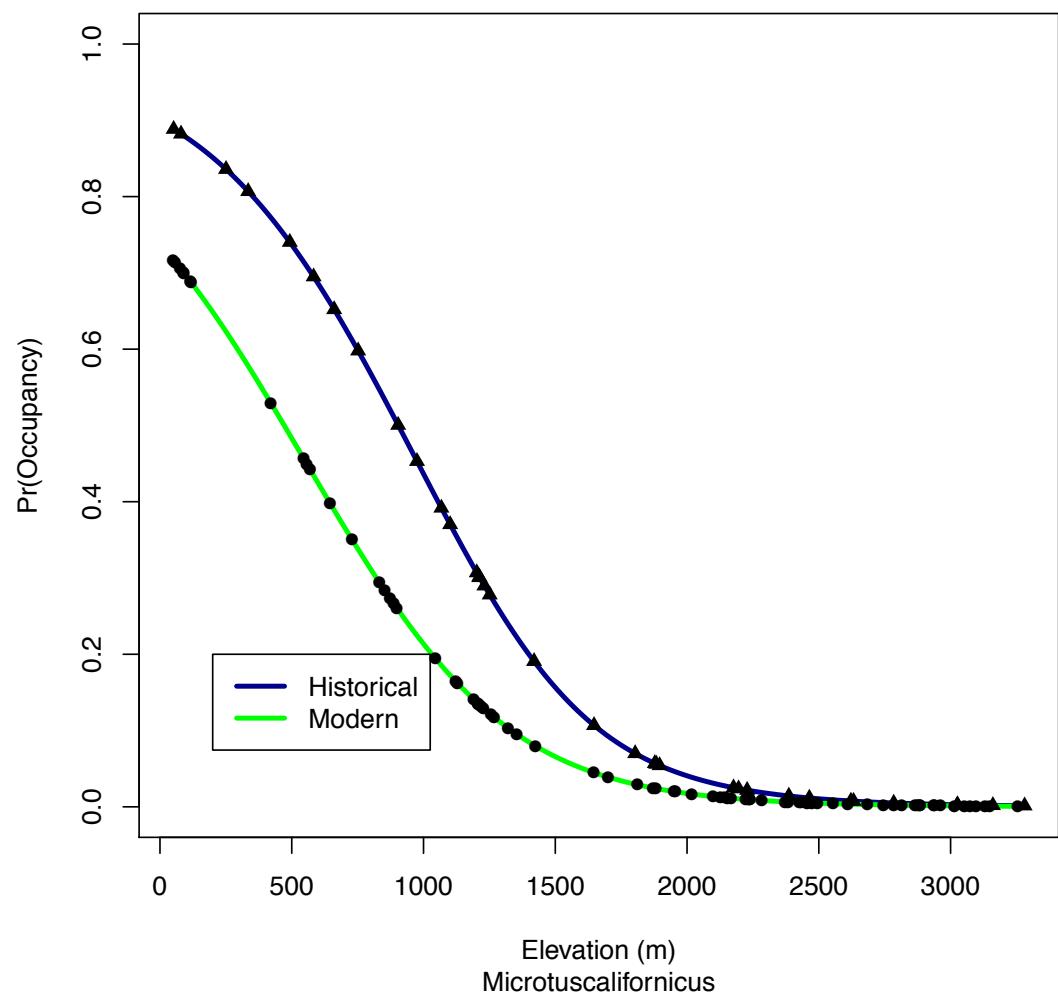
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Sequoia



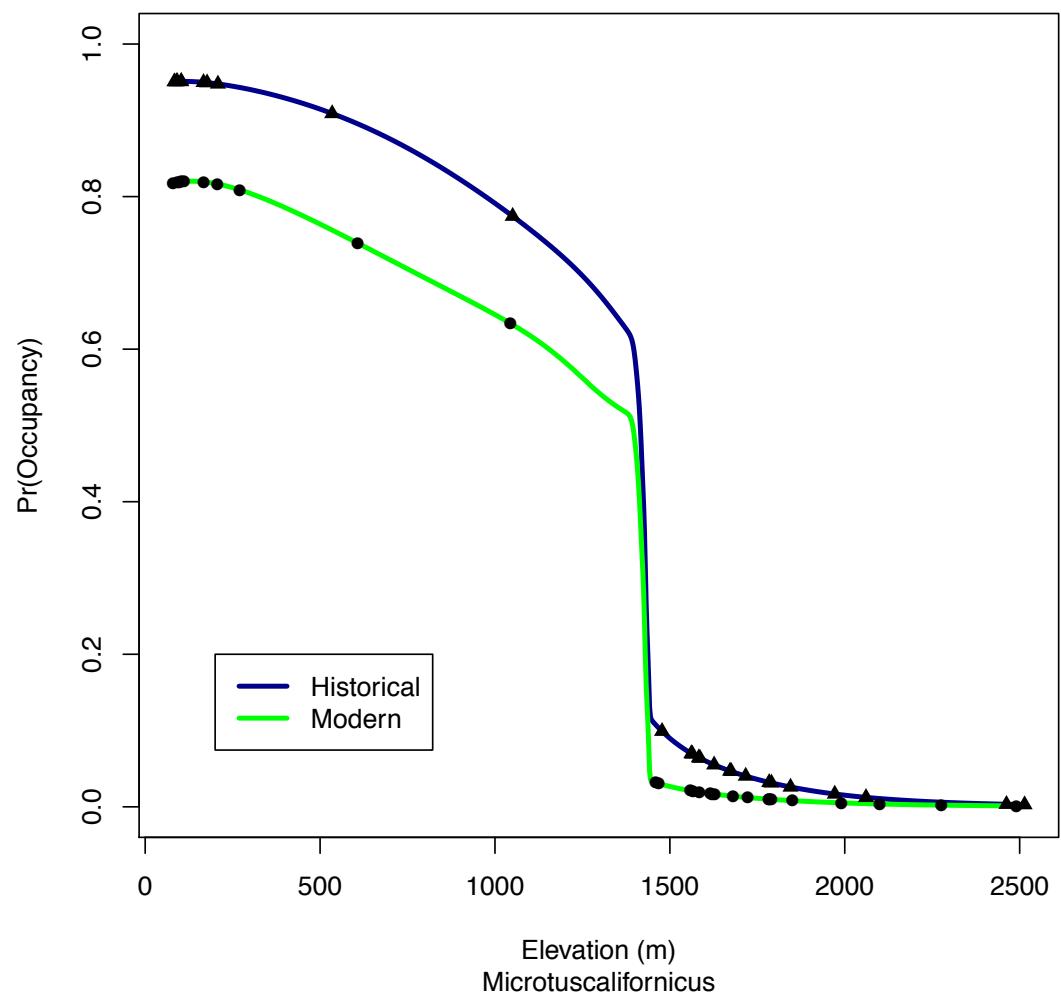
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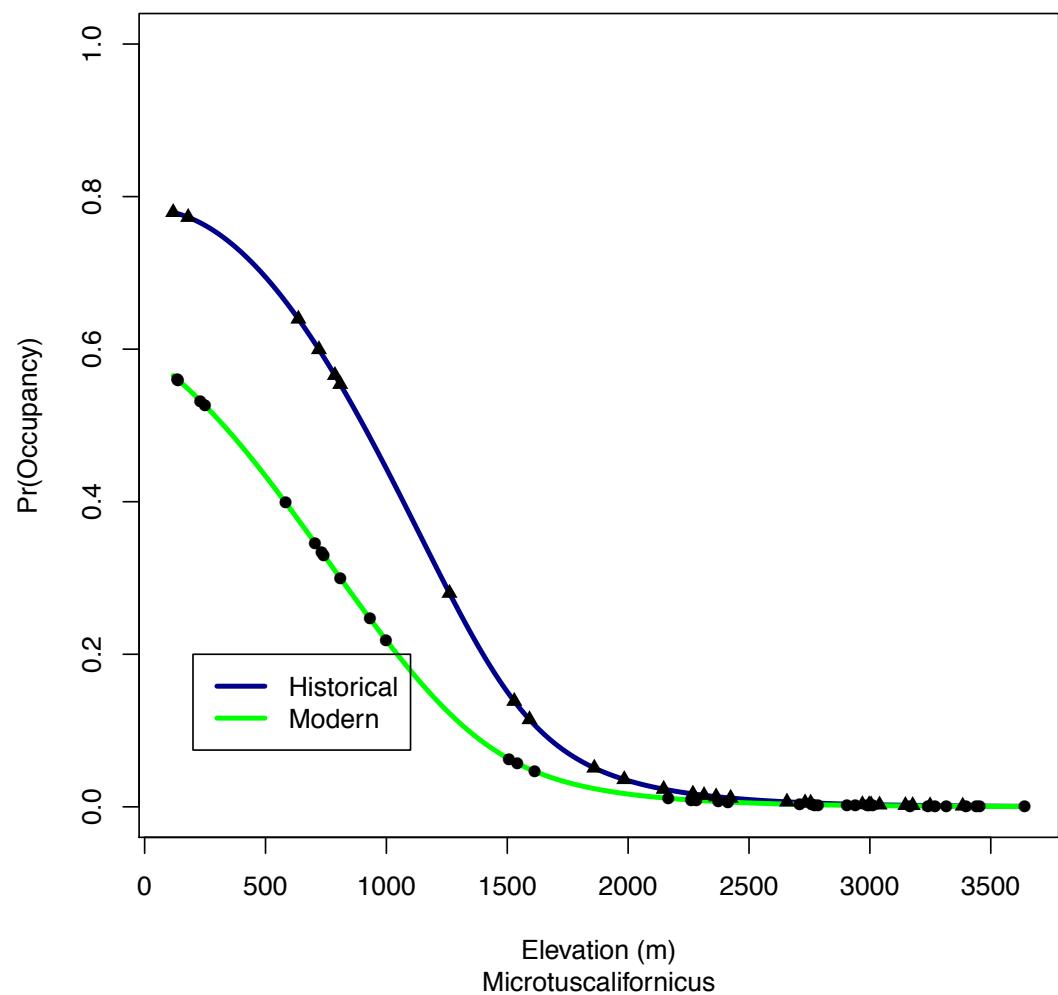
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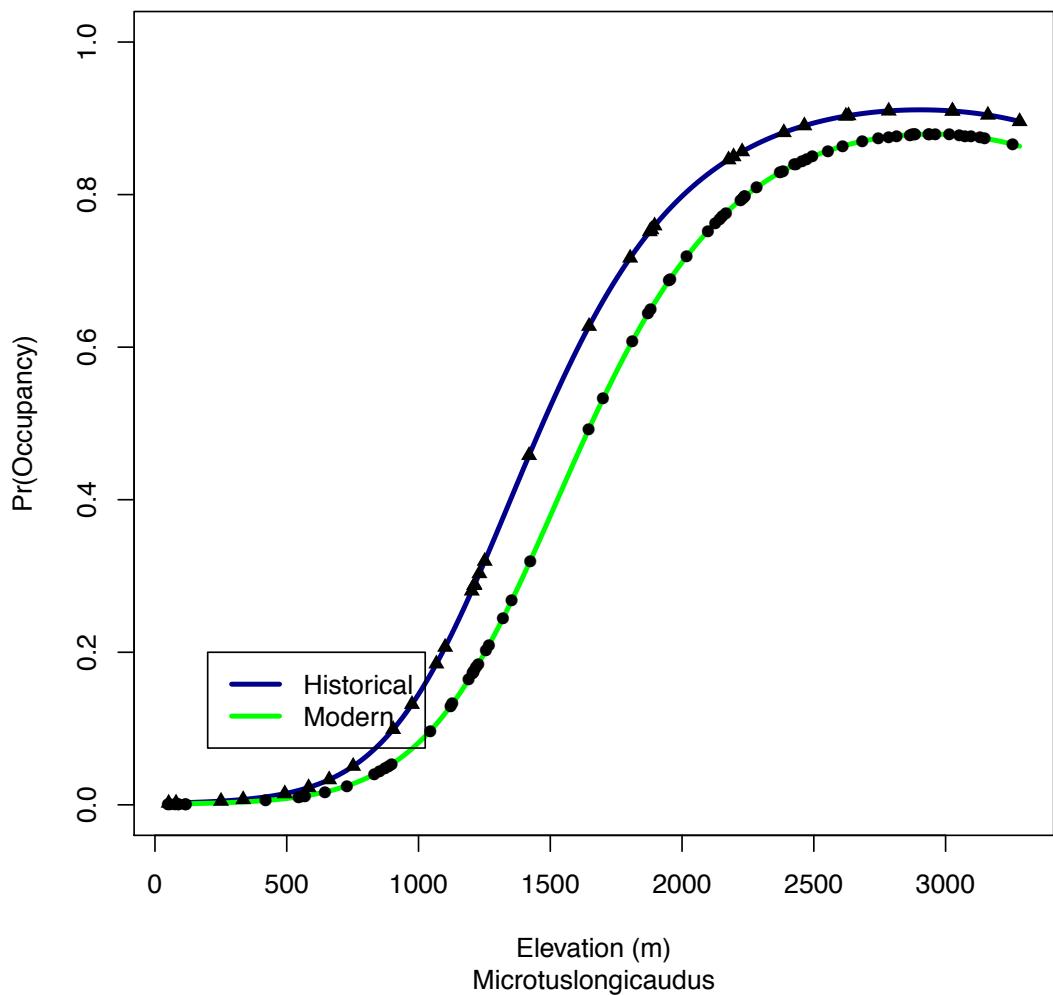


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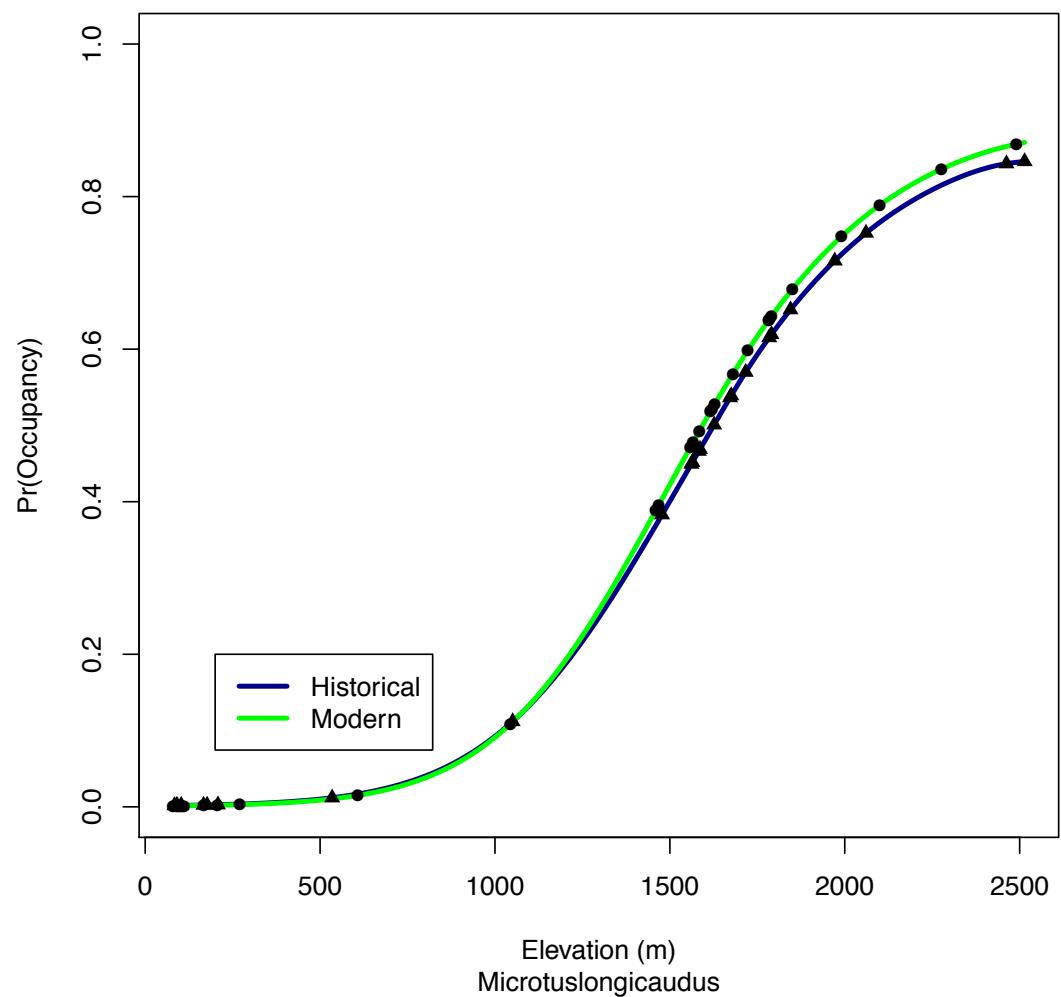


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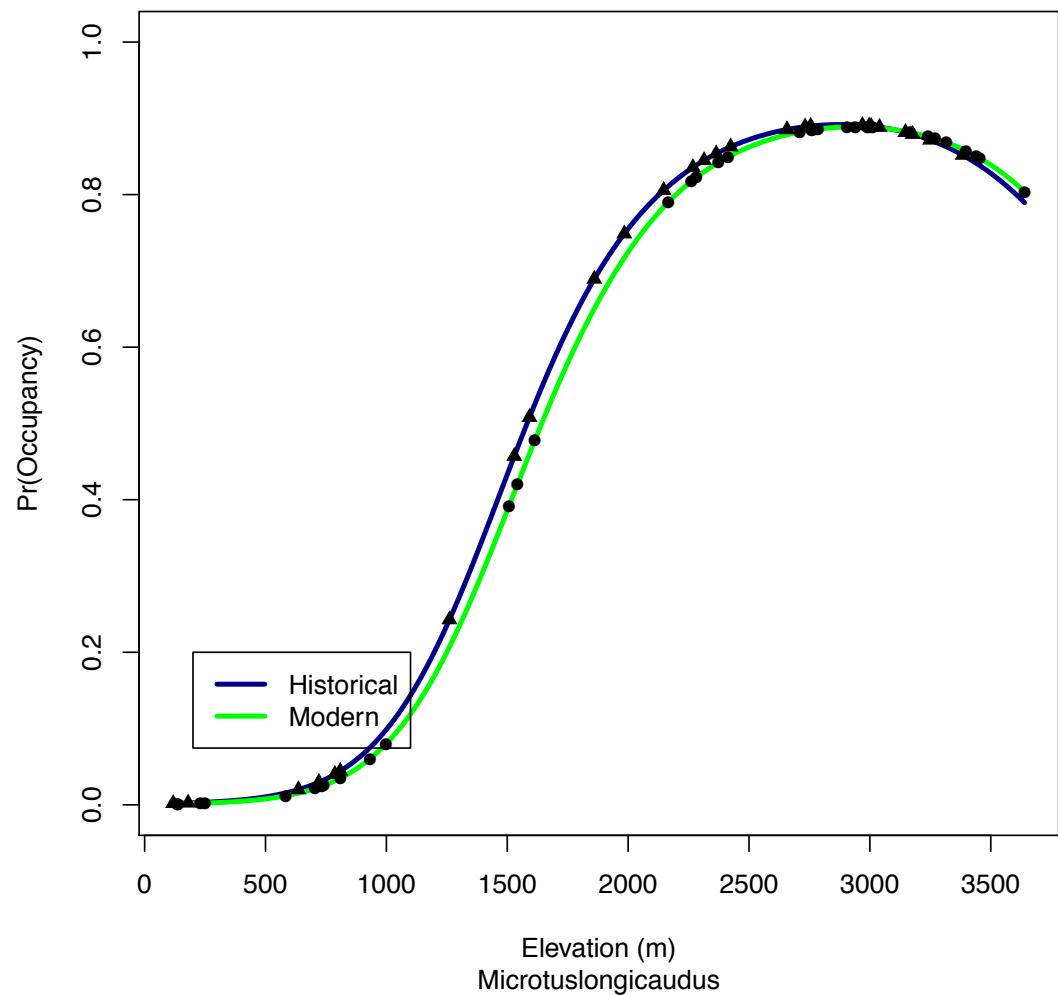
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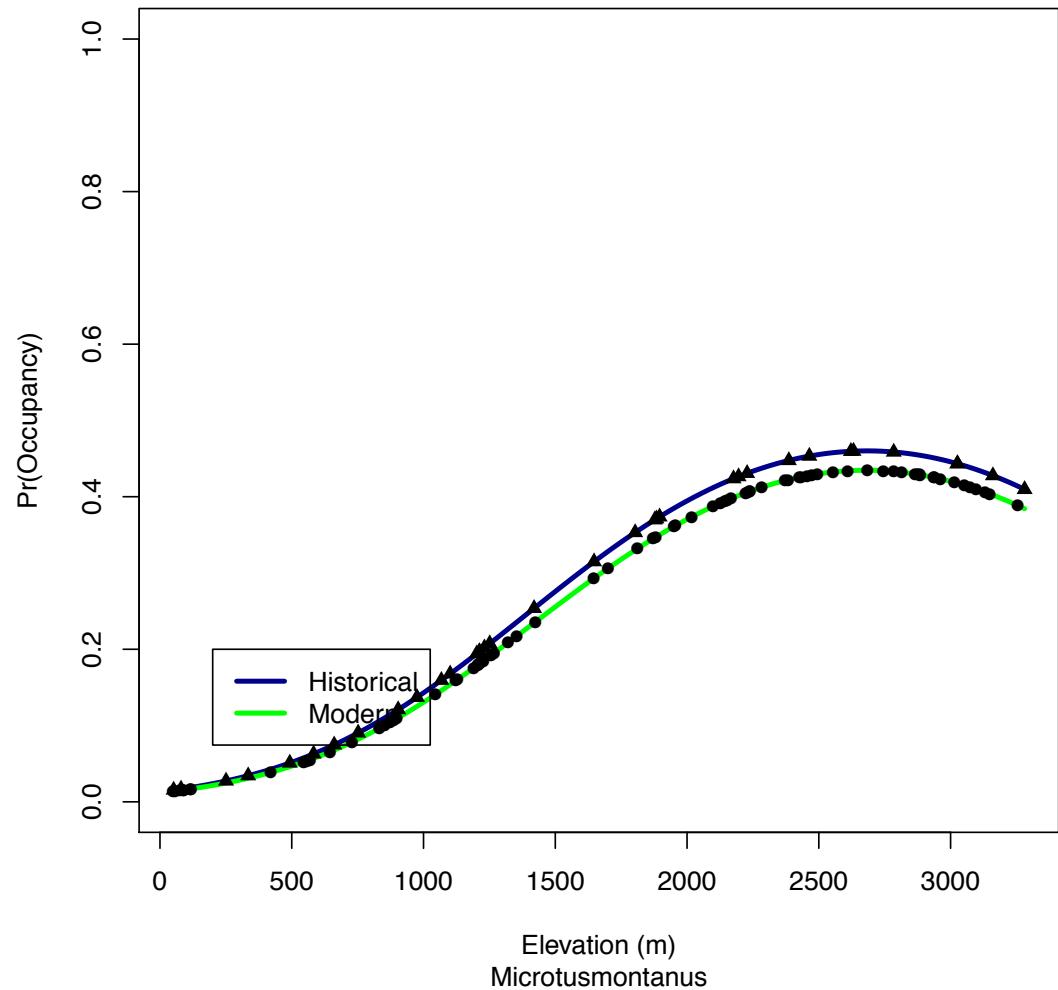


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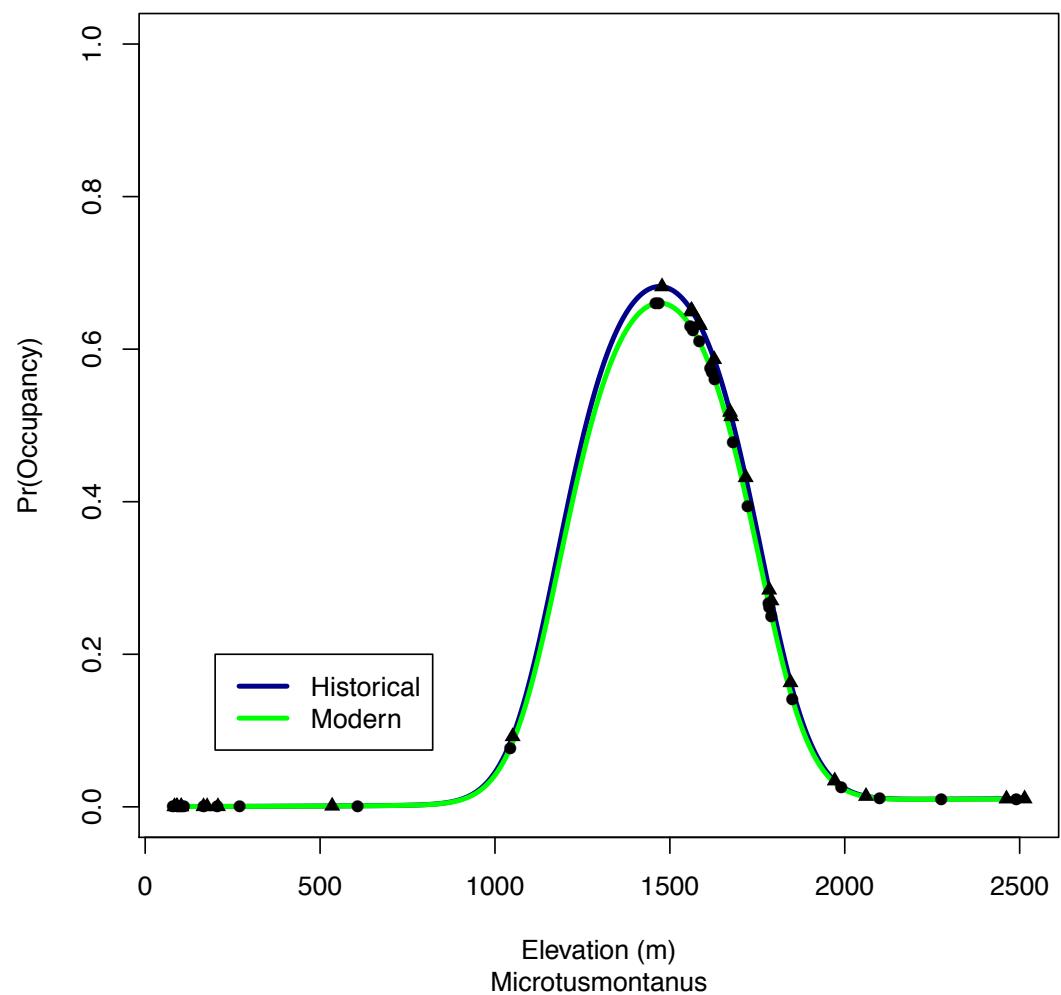


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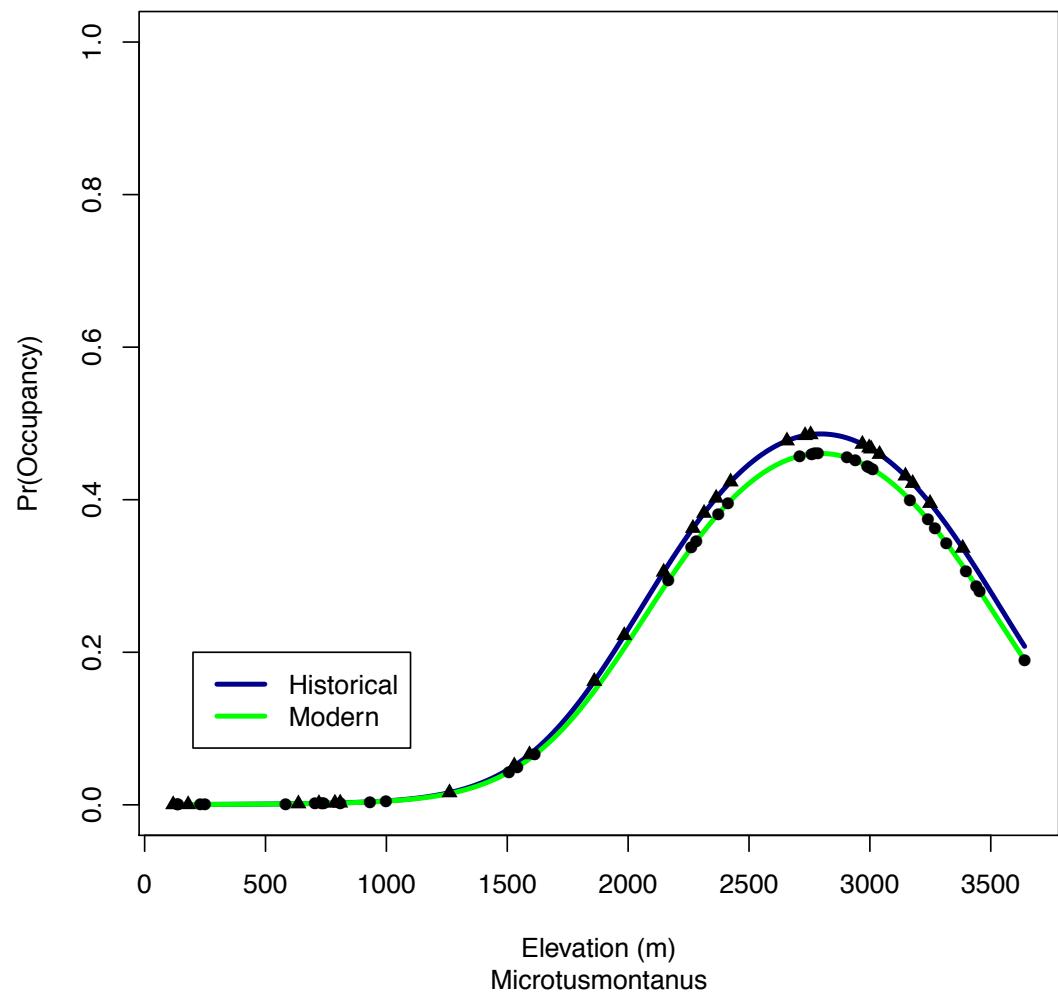
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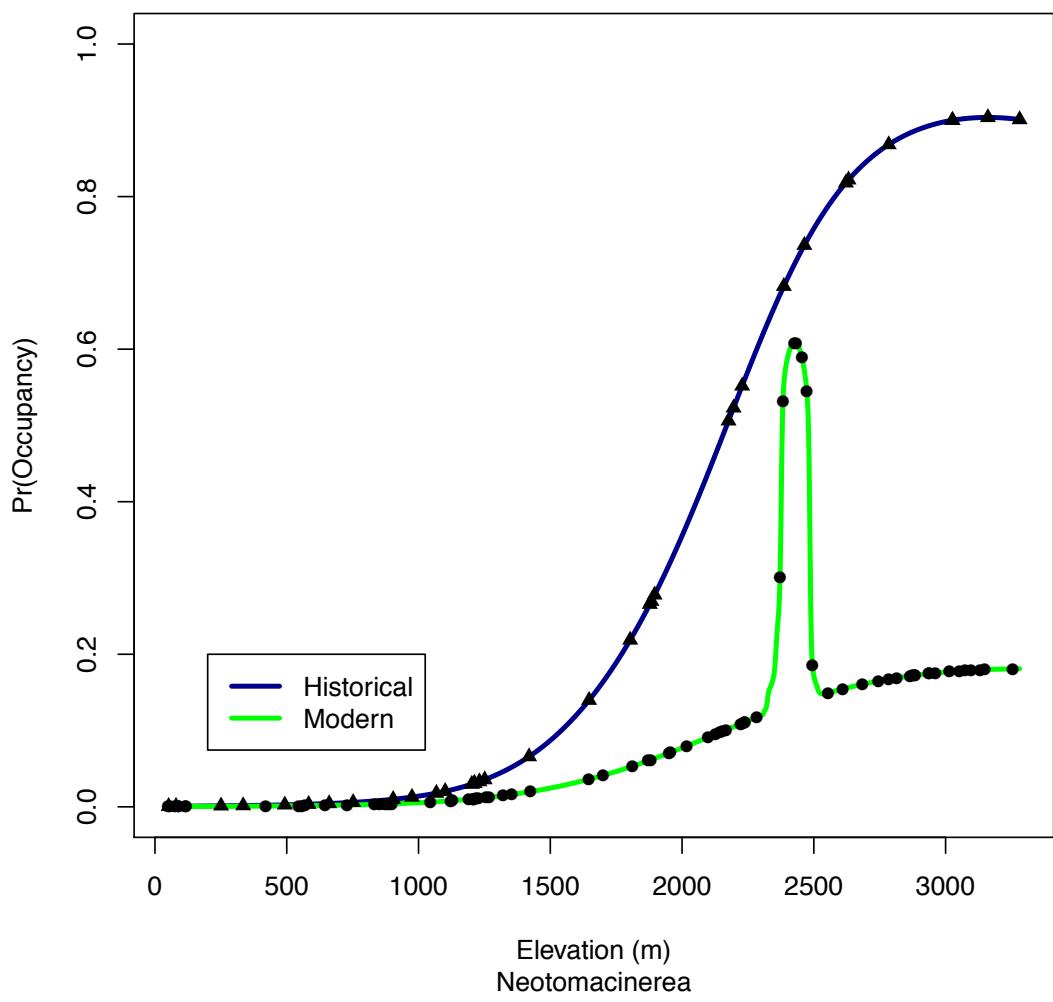


Southern

Sequoia

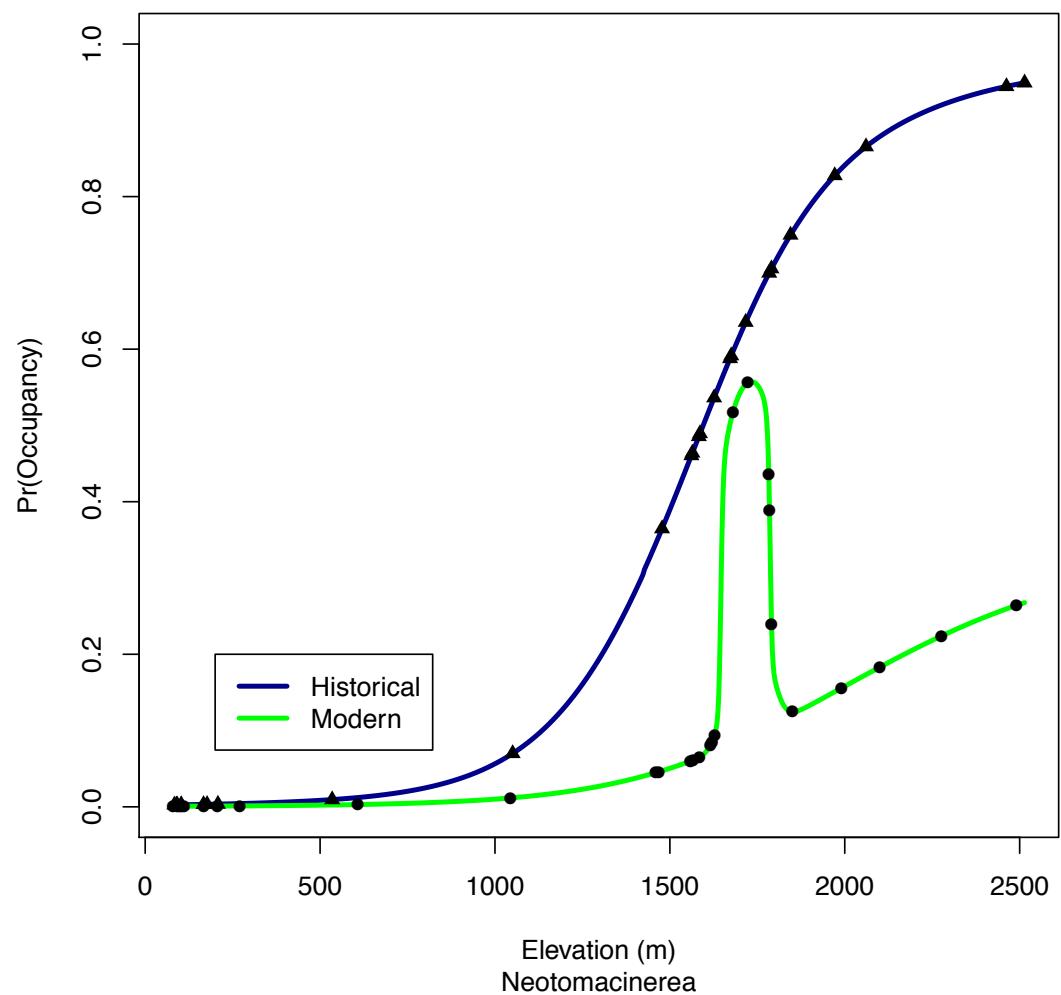


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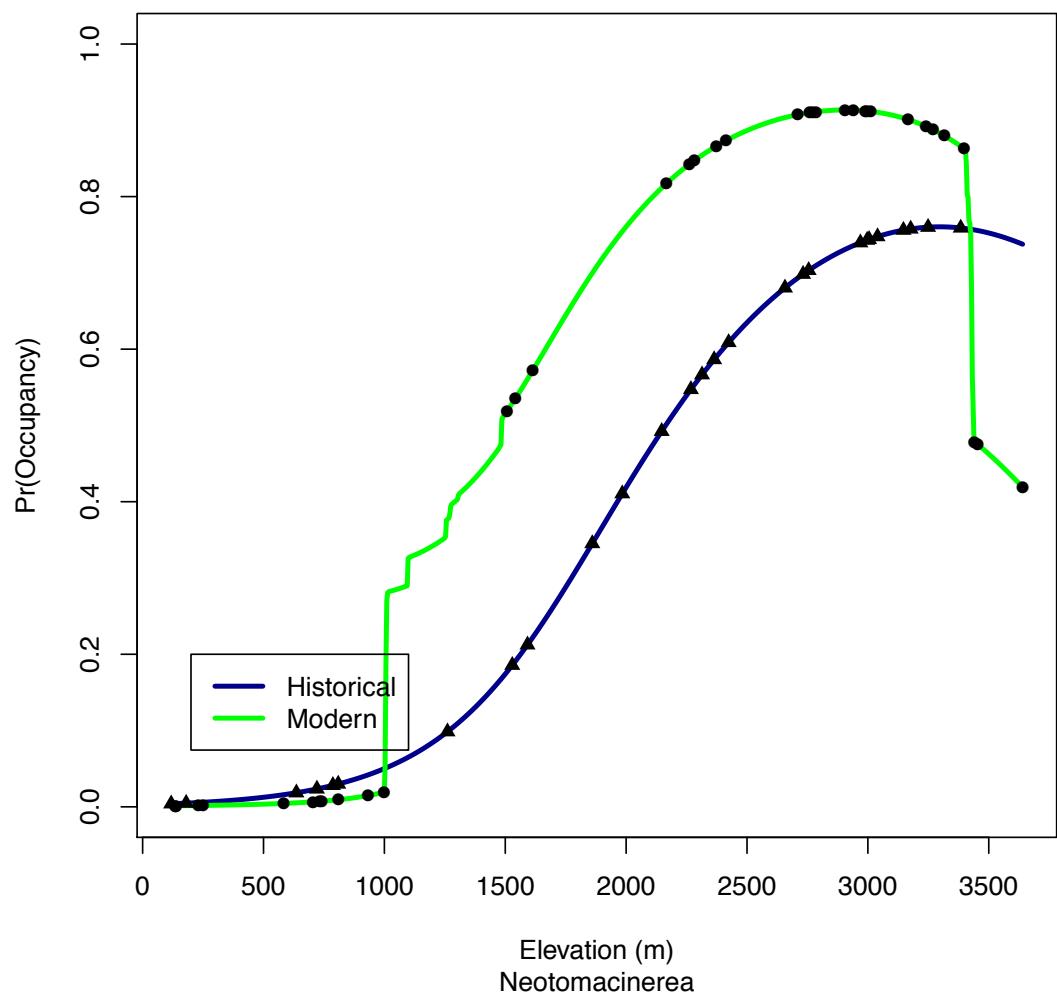
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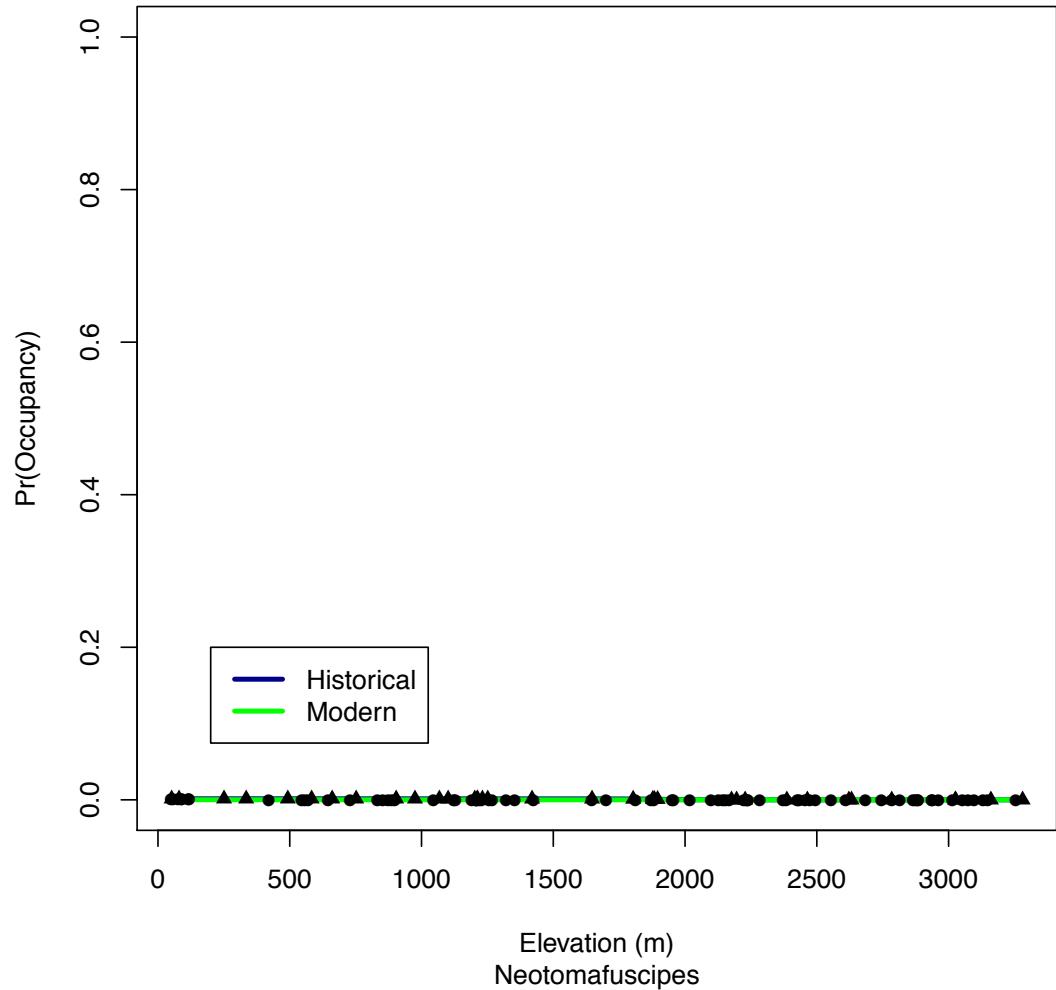


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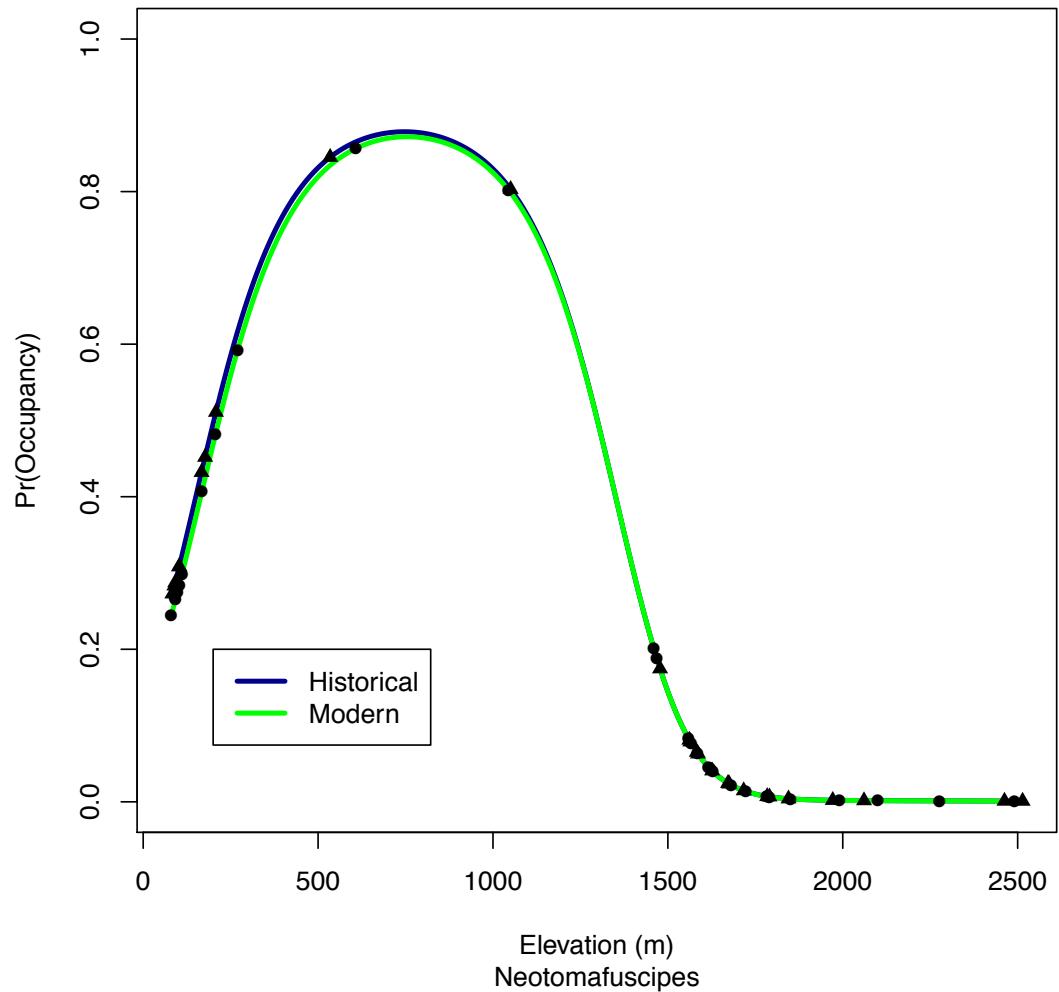


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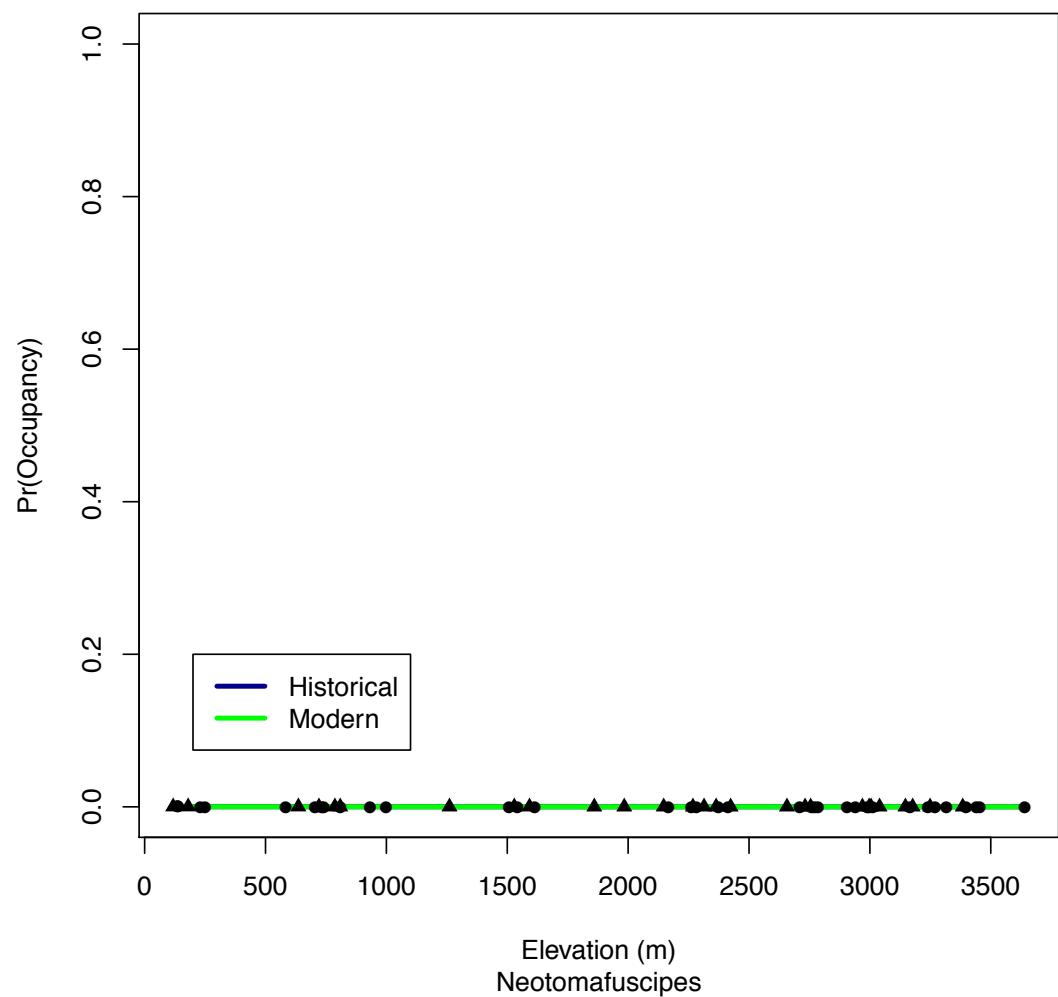
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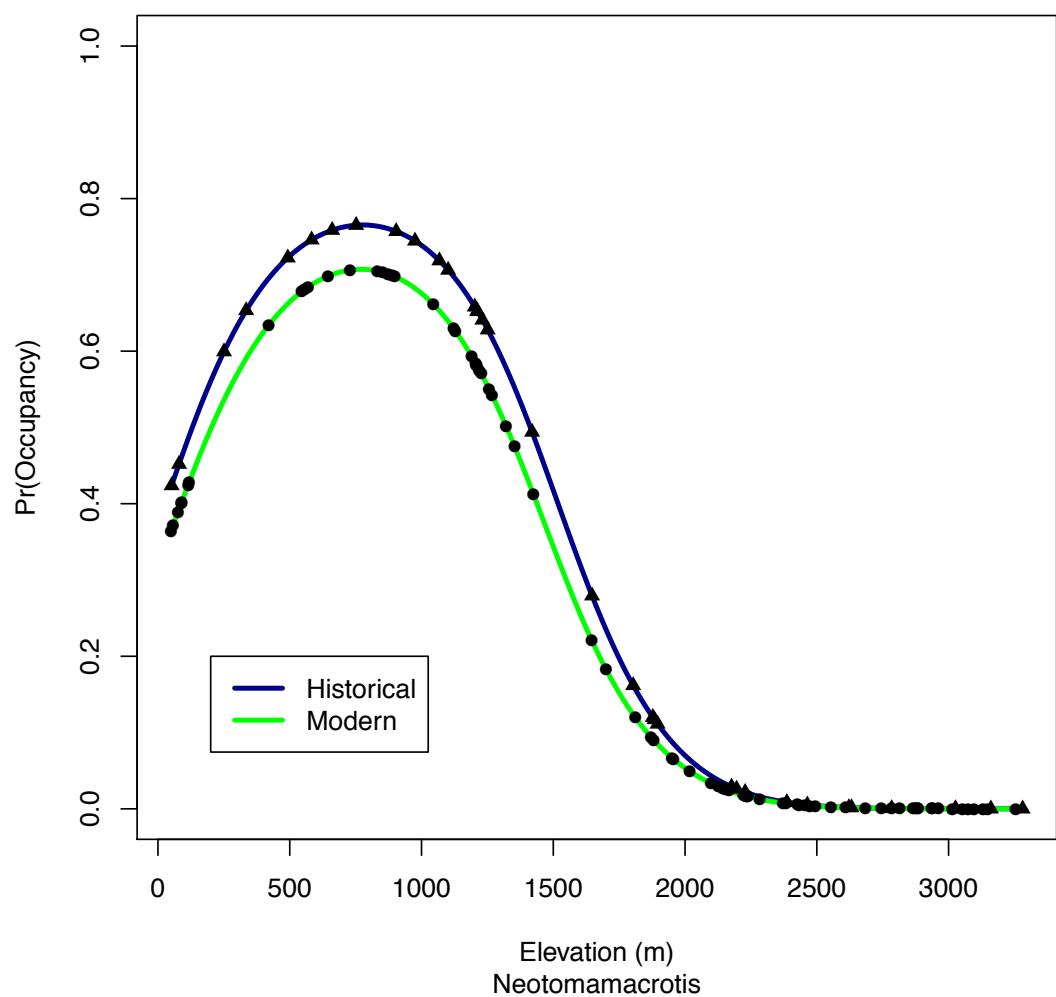


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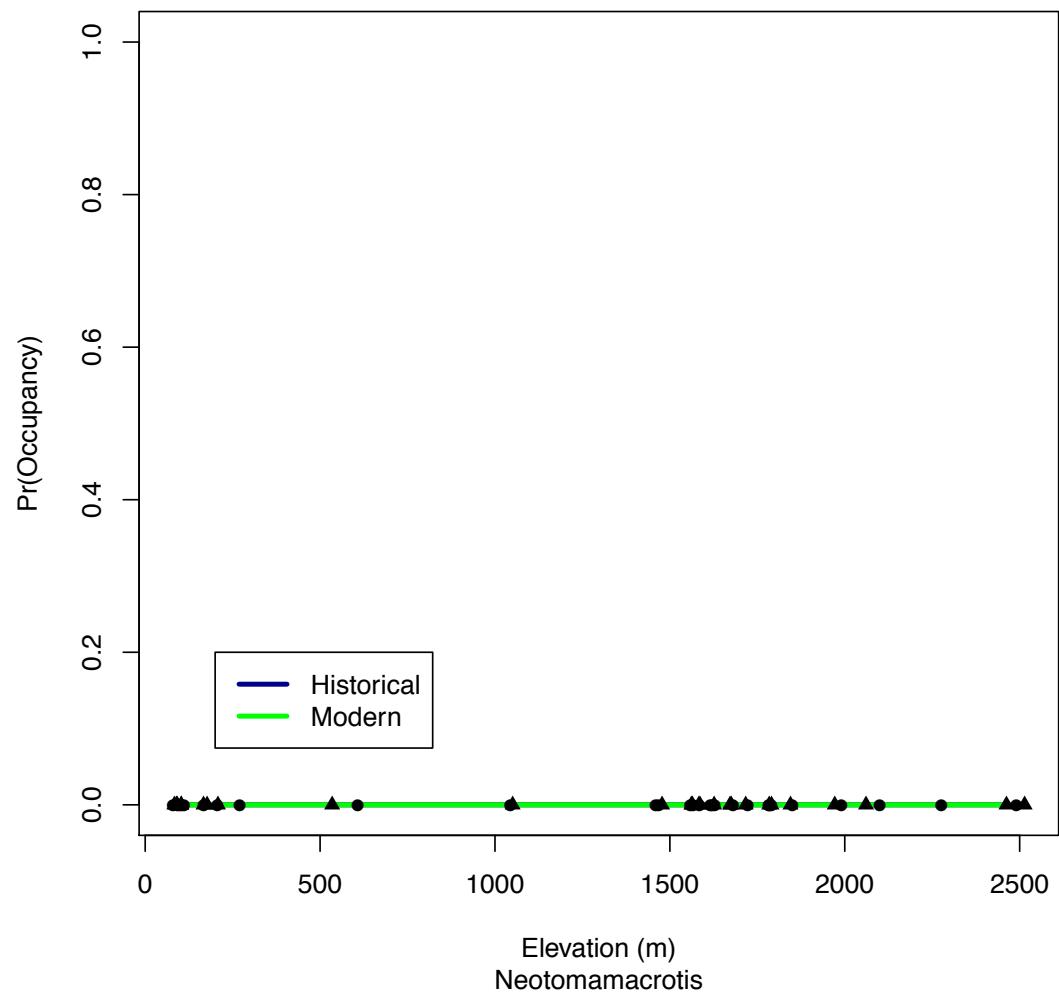


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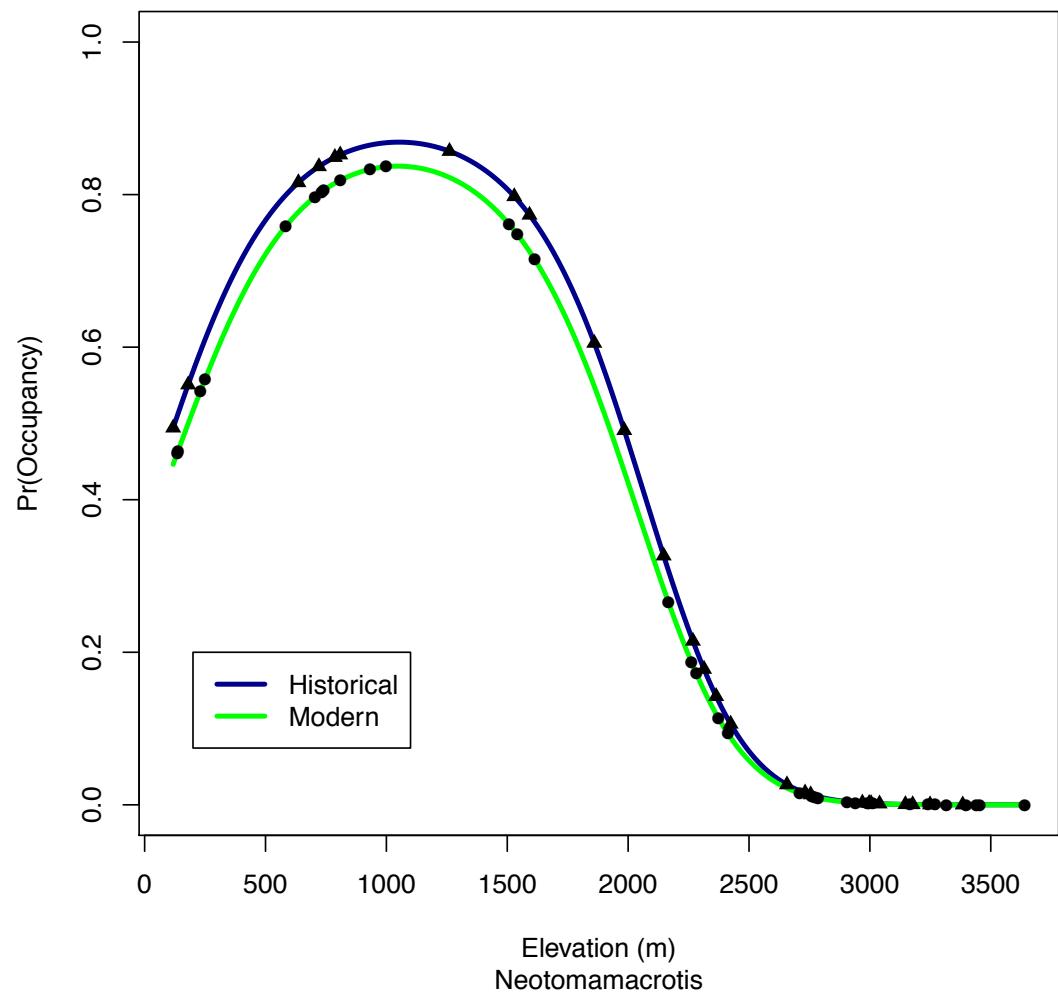
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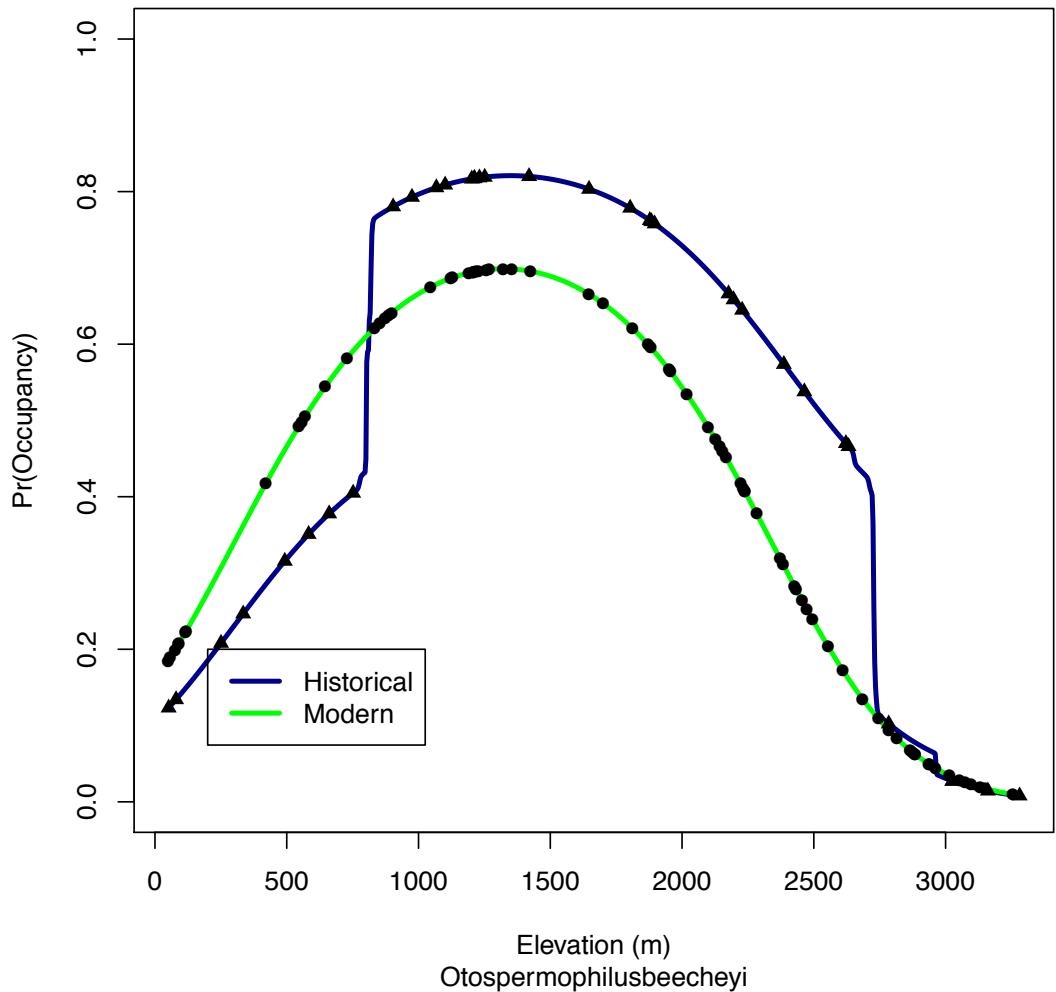
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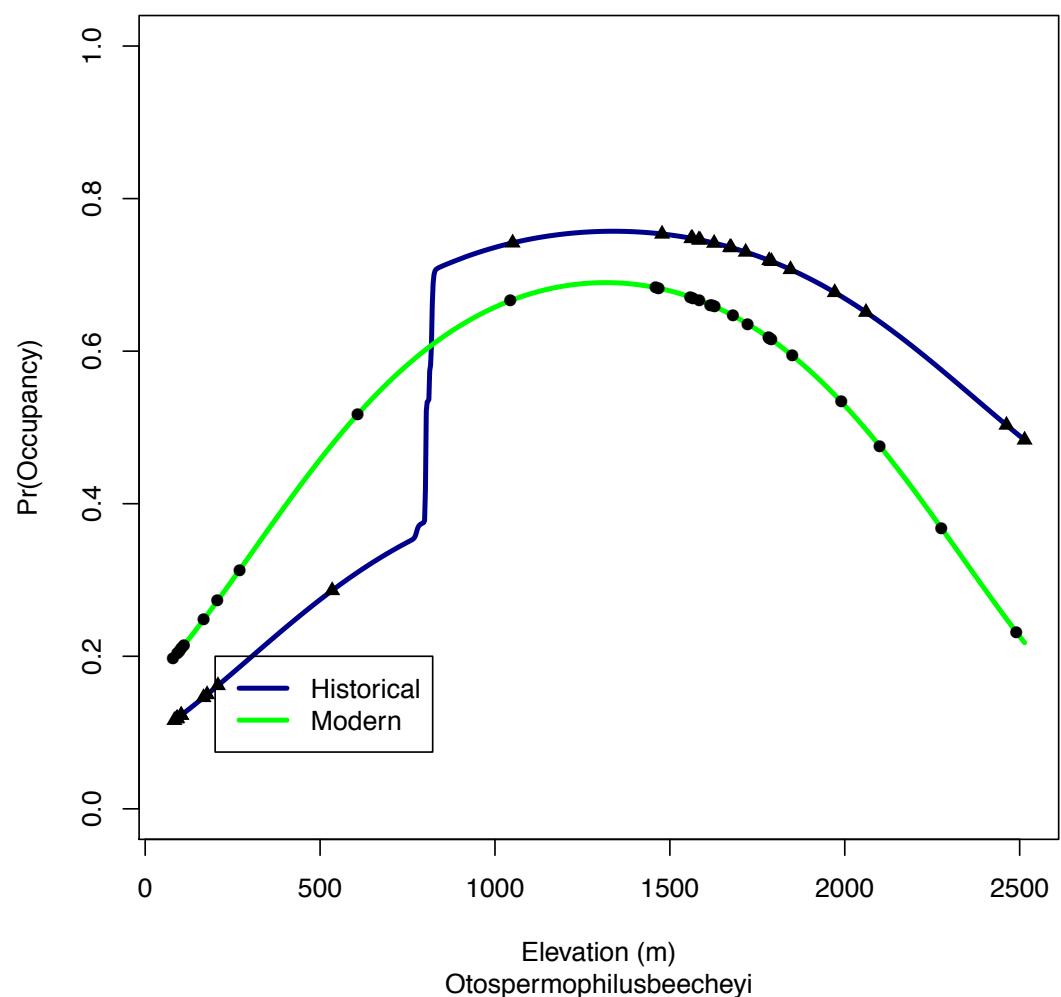
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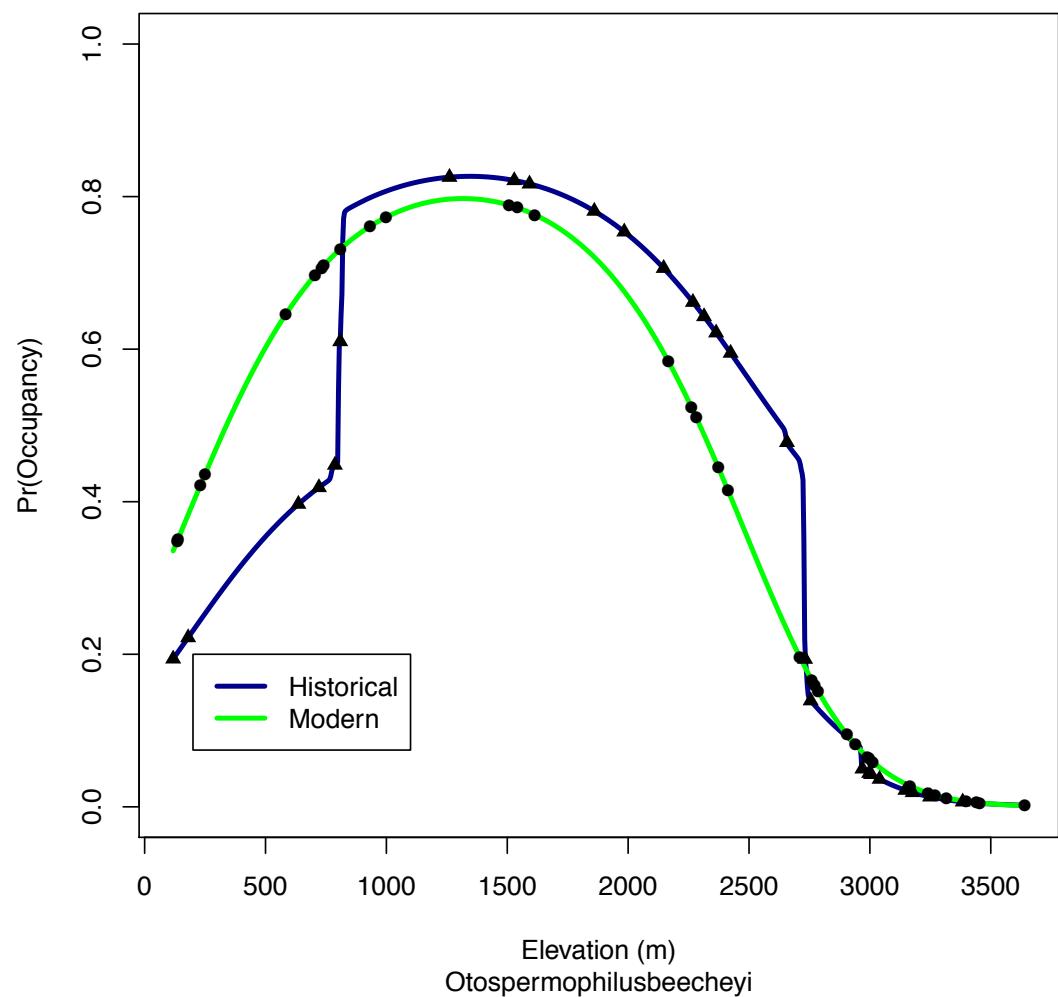
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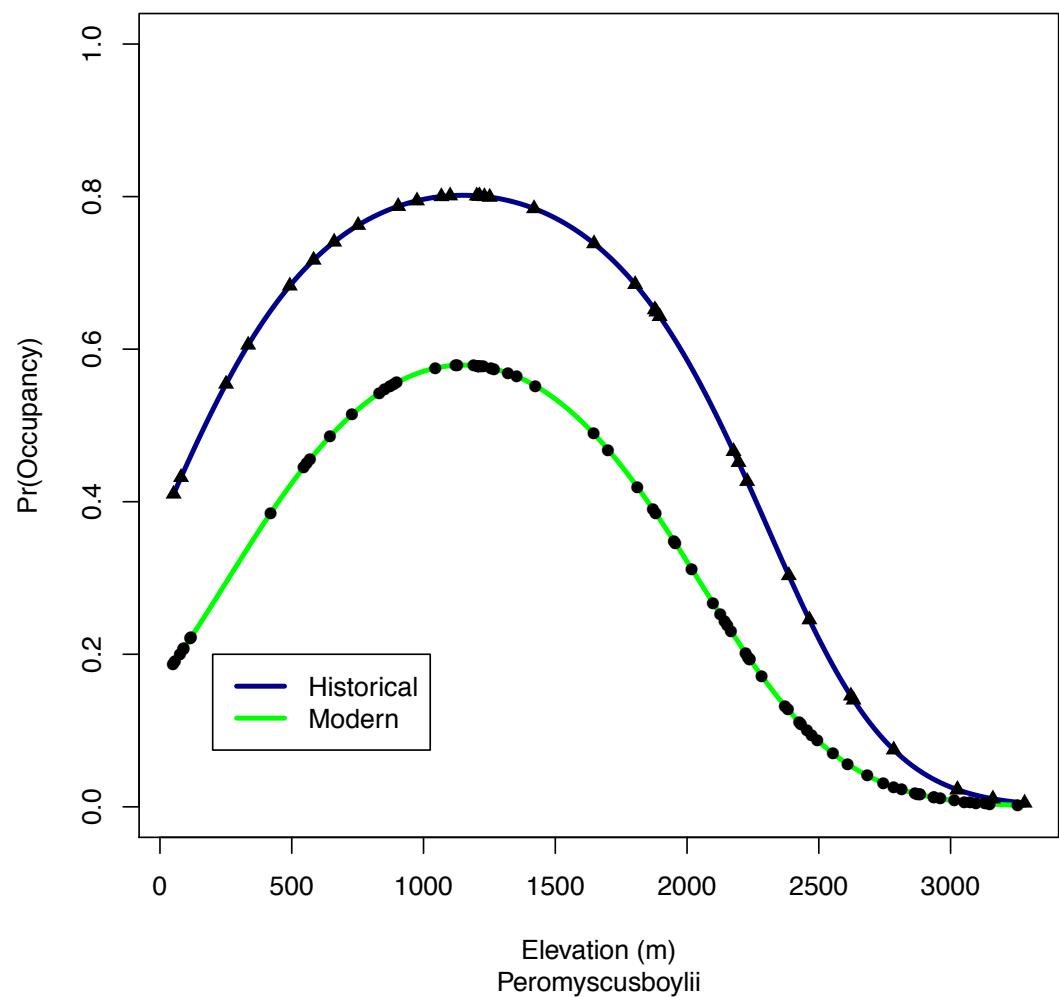
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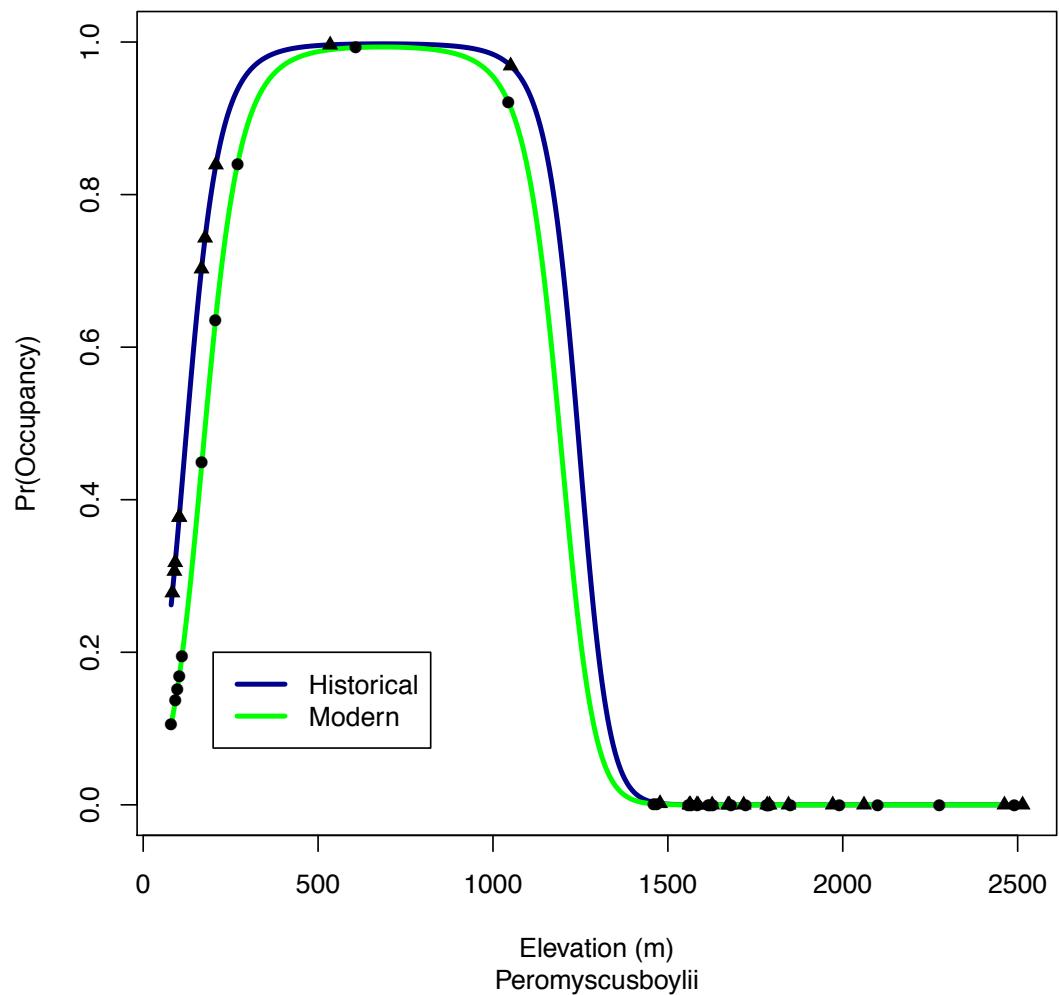
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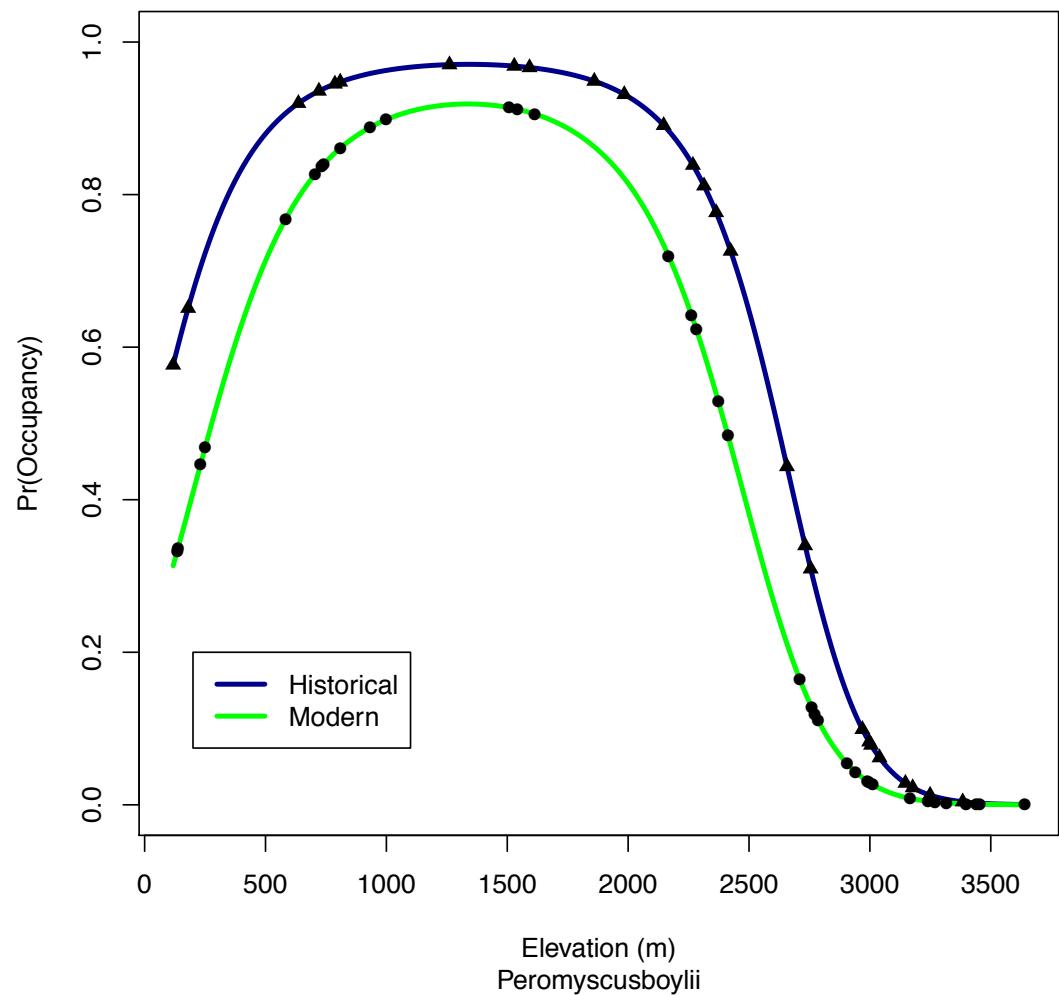
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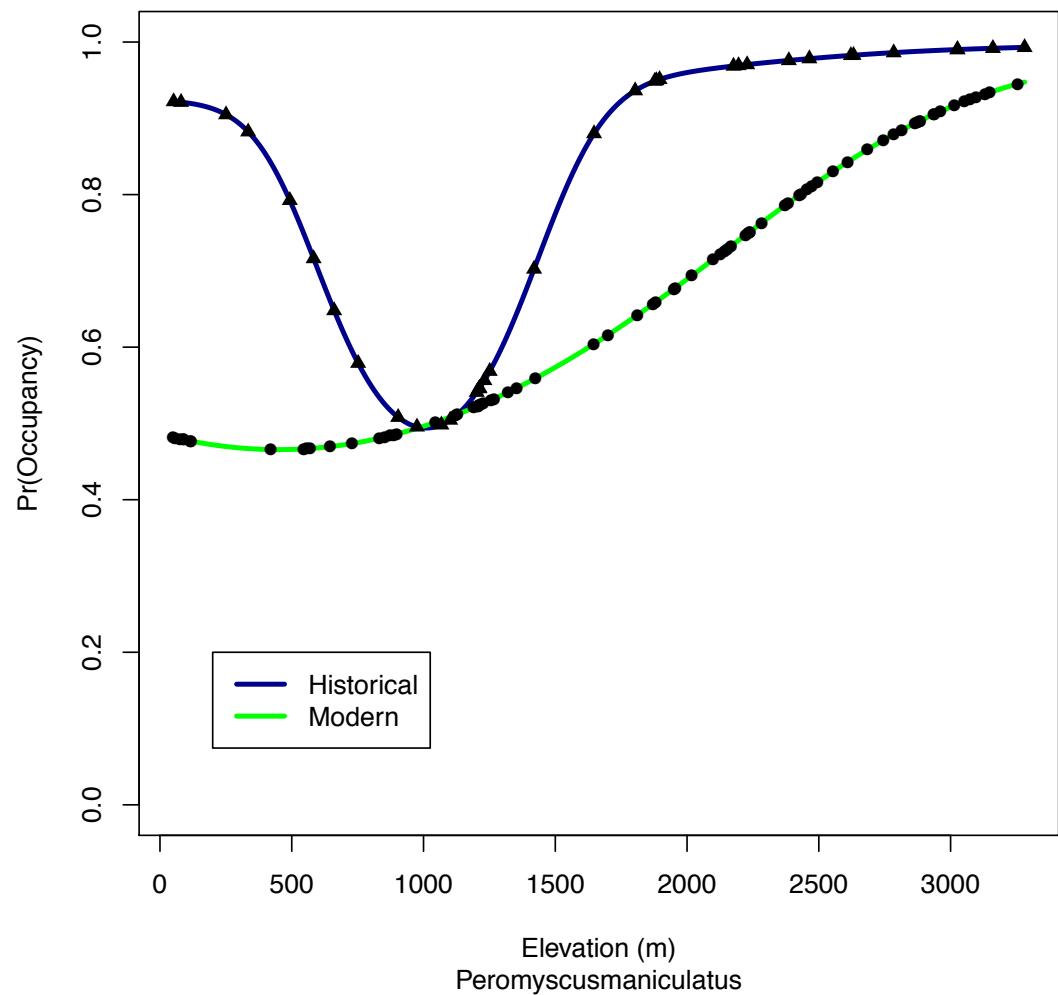
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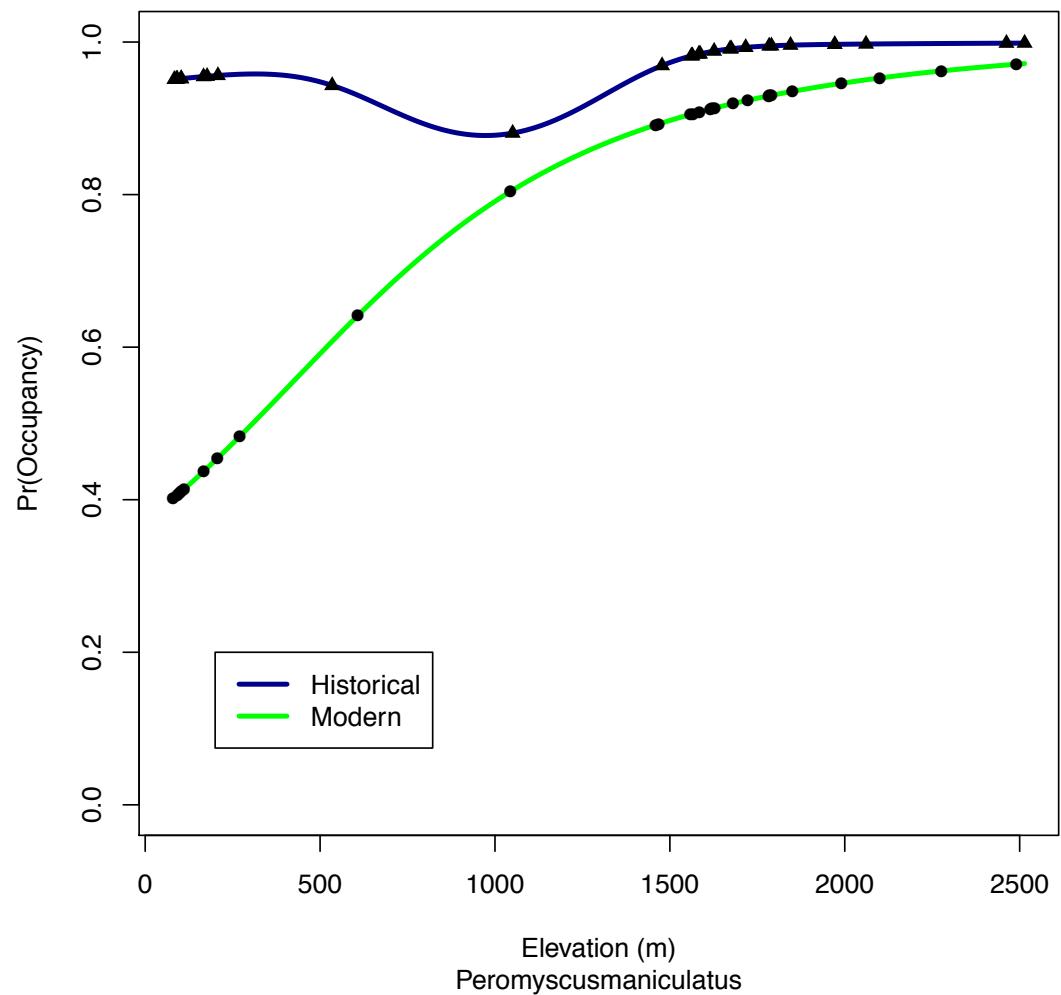
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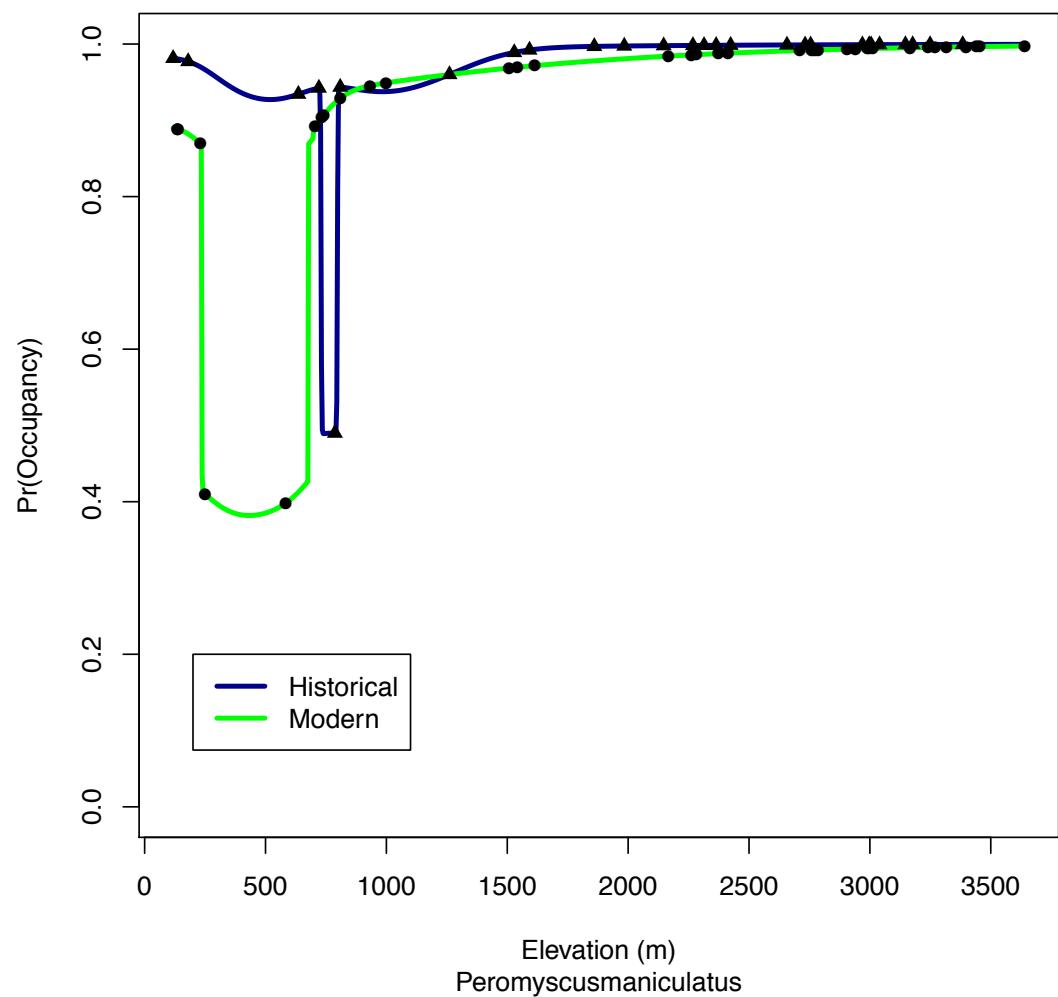
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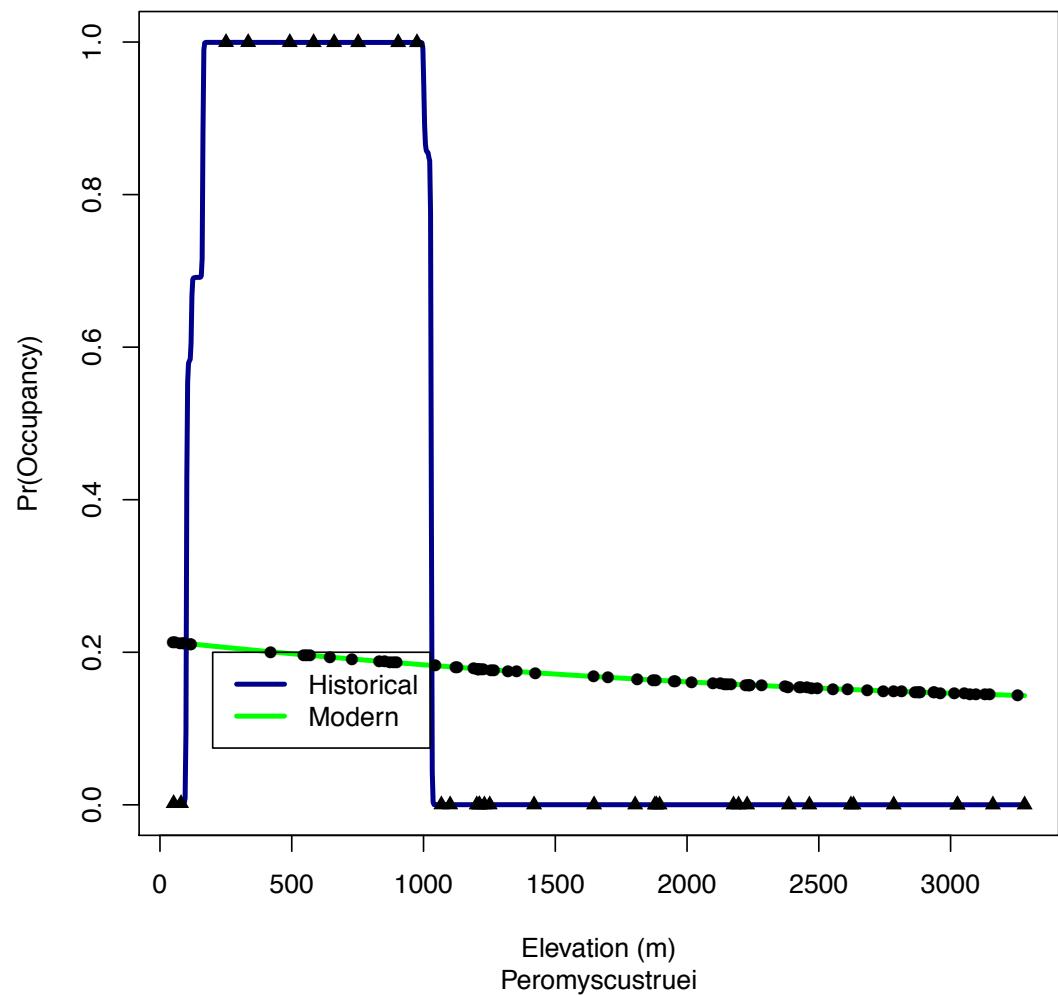
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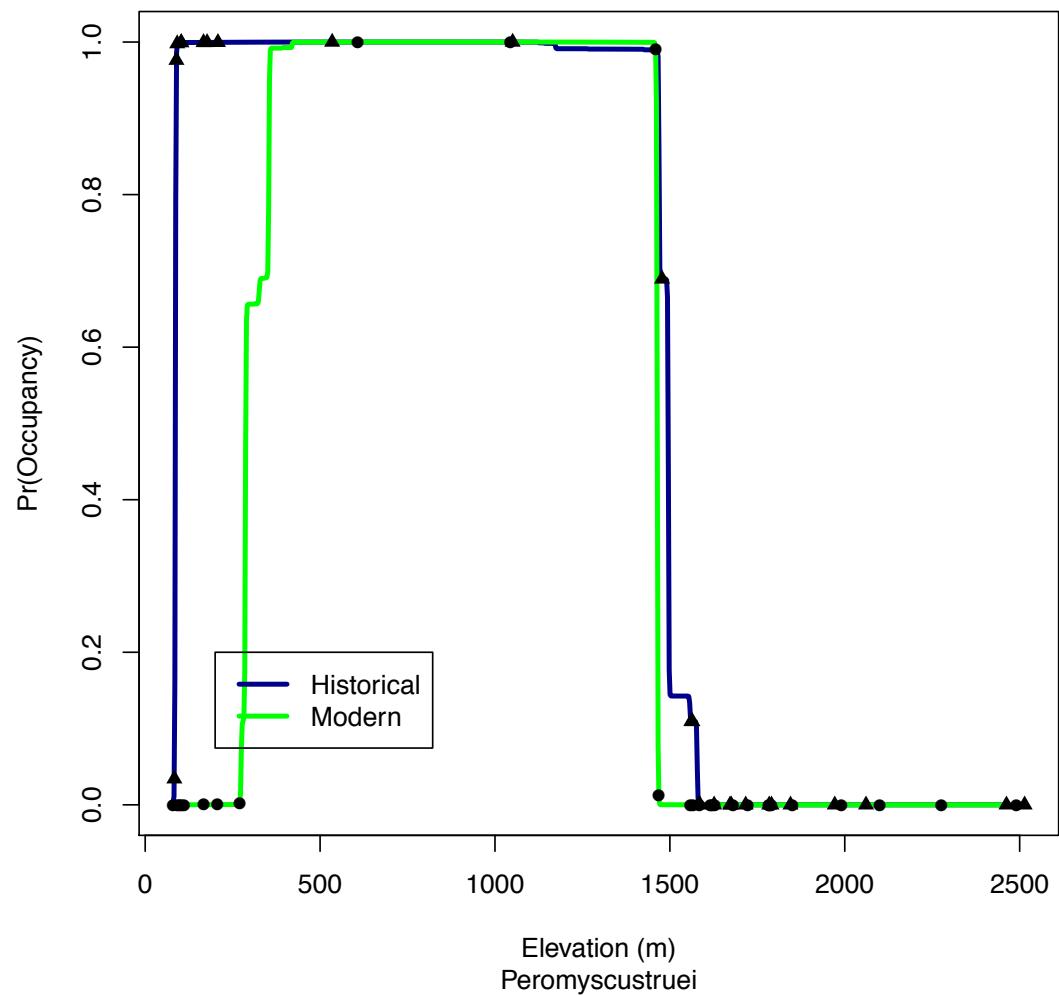
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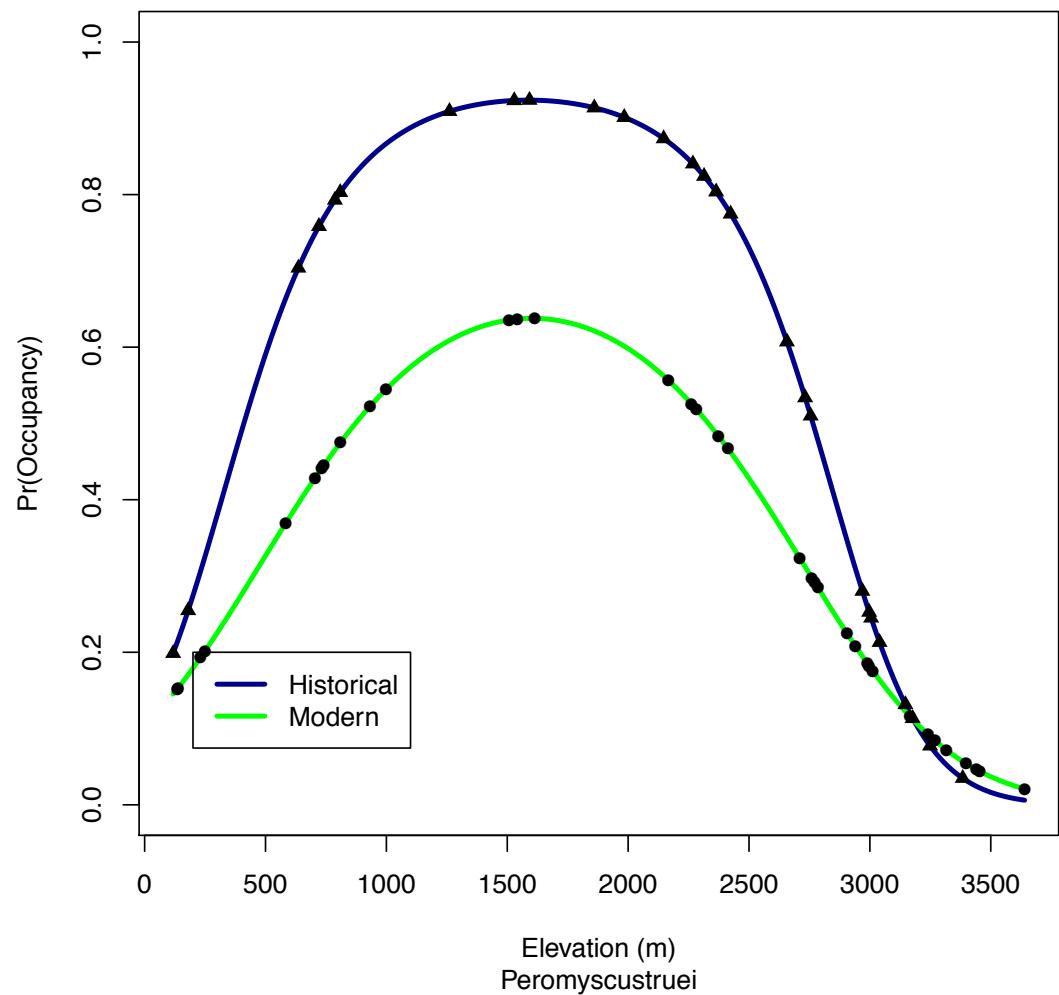
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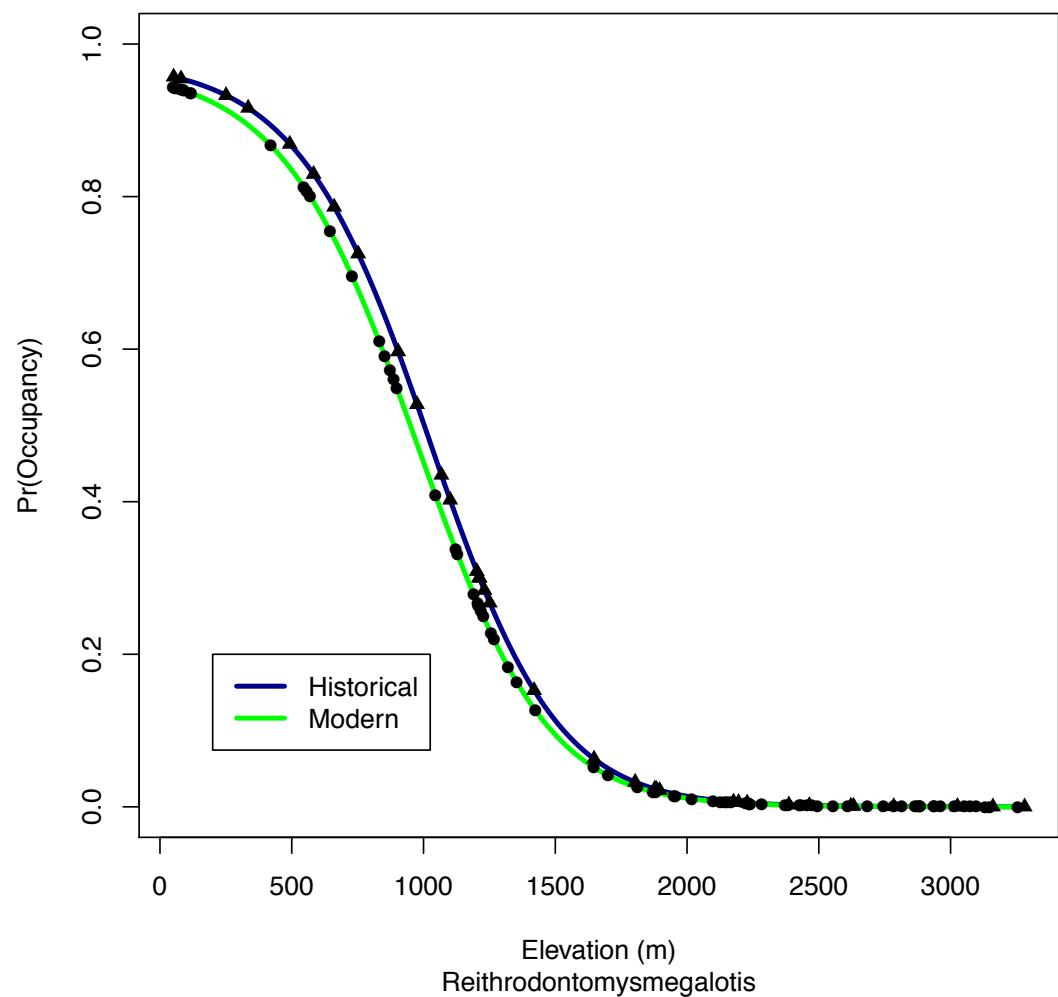
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Central

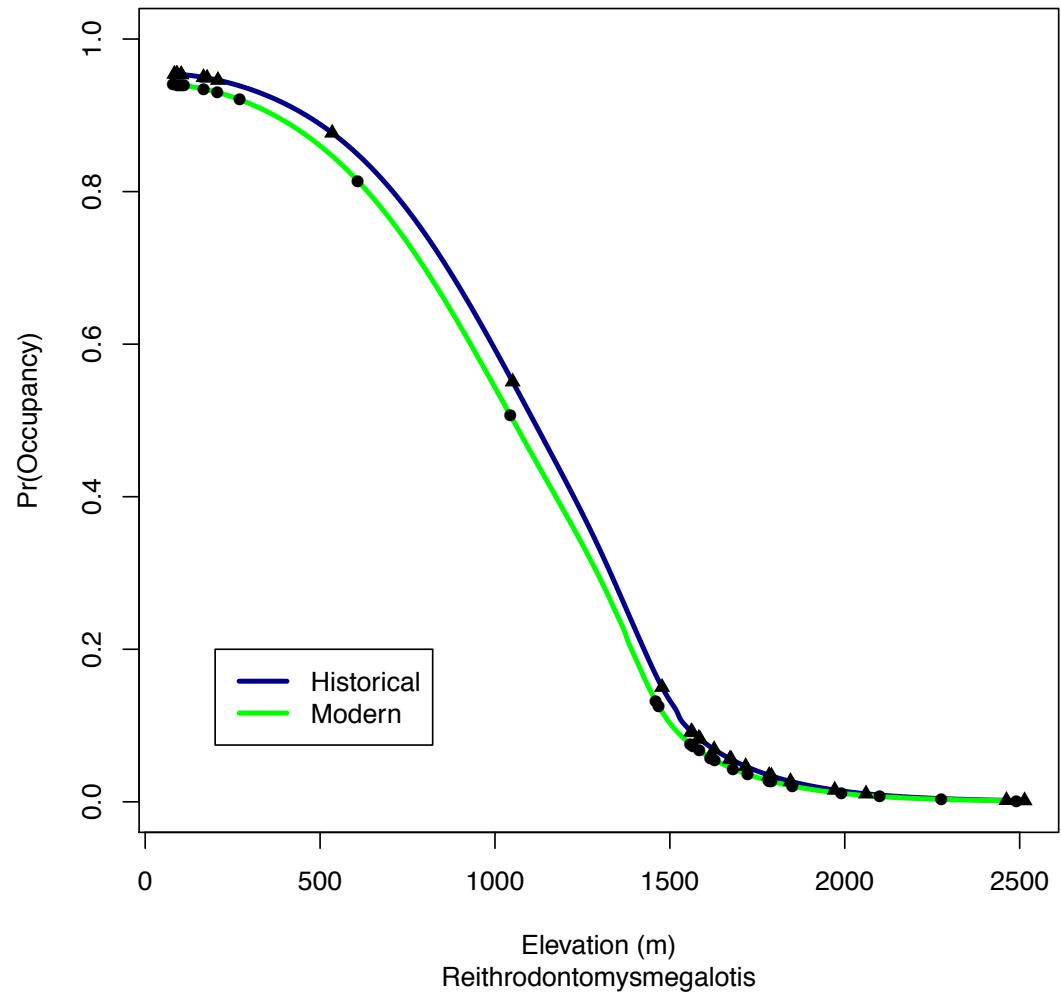
Yosemite



Elevation (m)
Reithrodontomysmegalotis

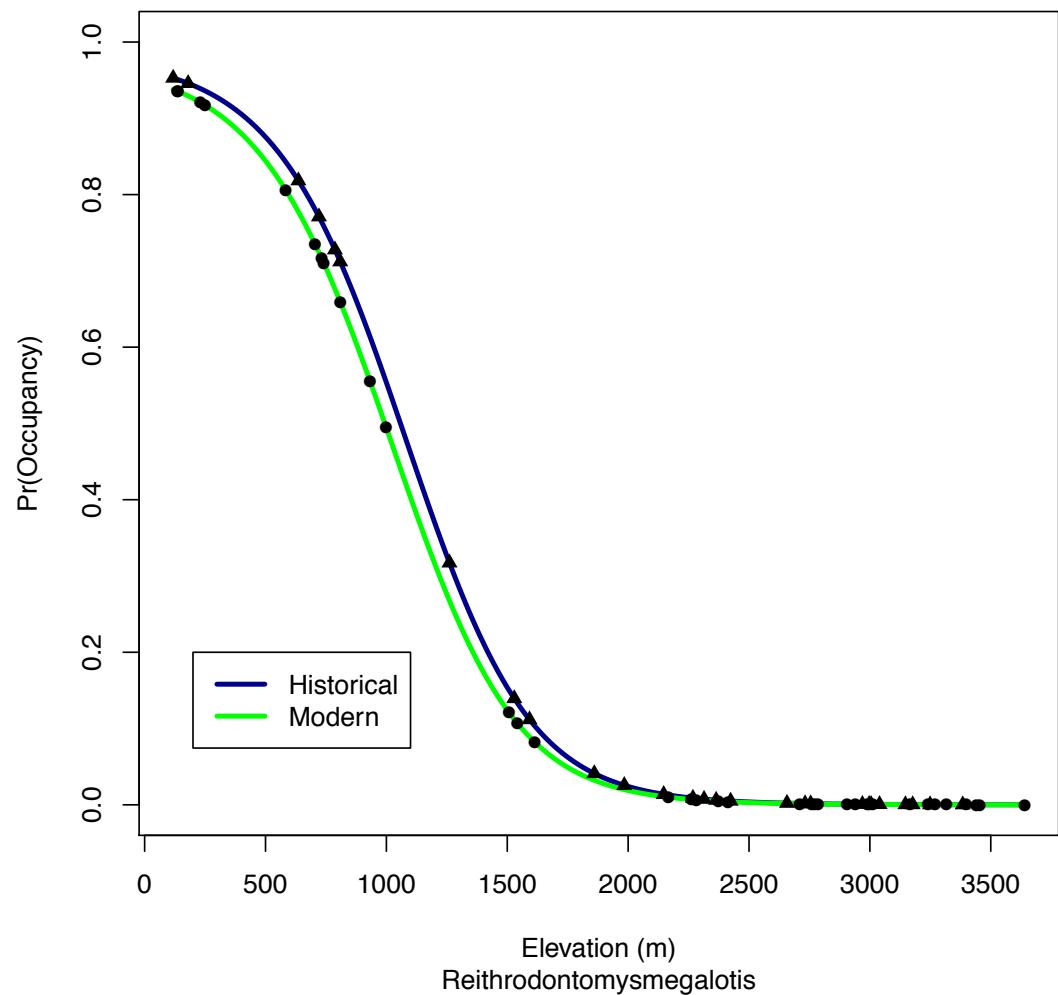
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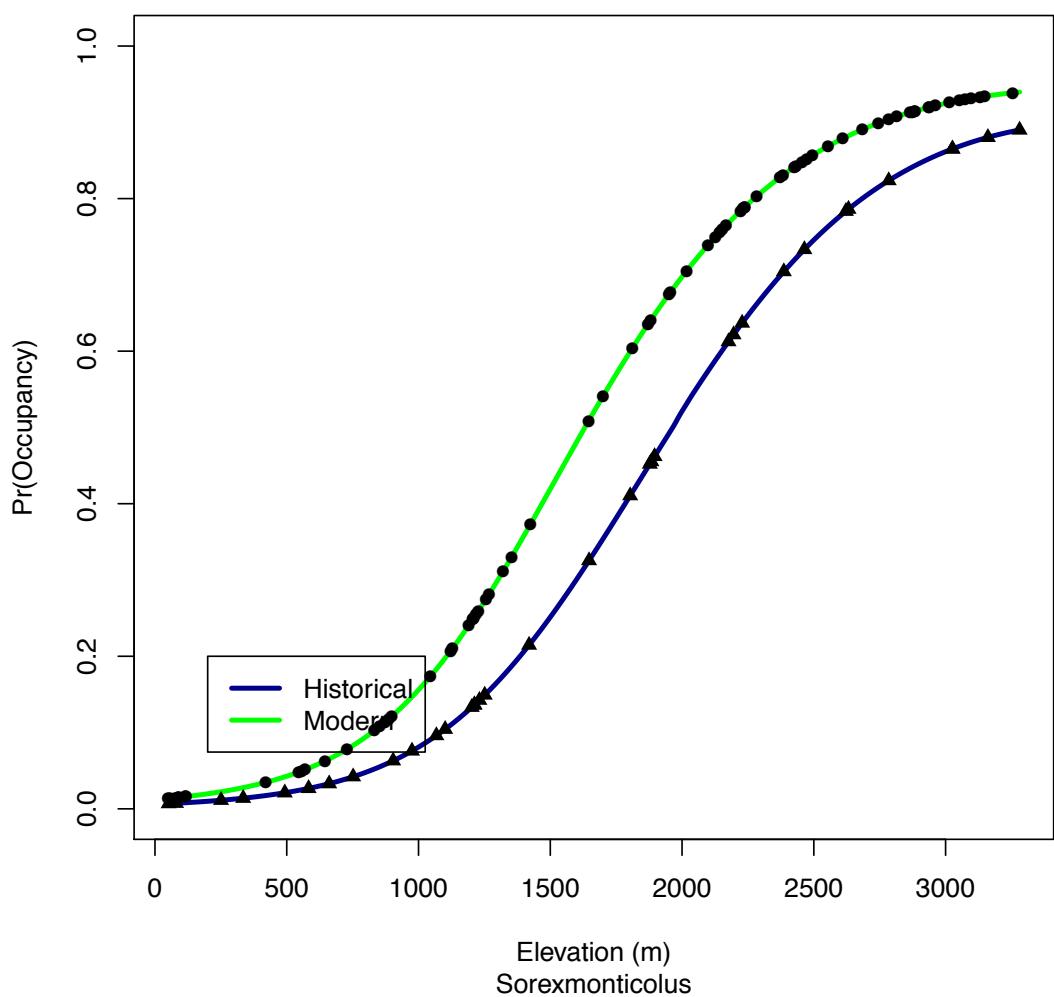


Southern

Sequoia

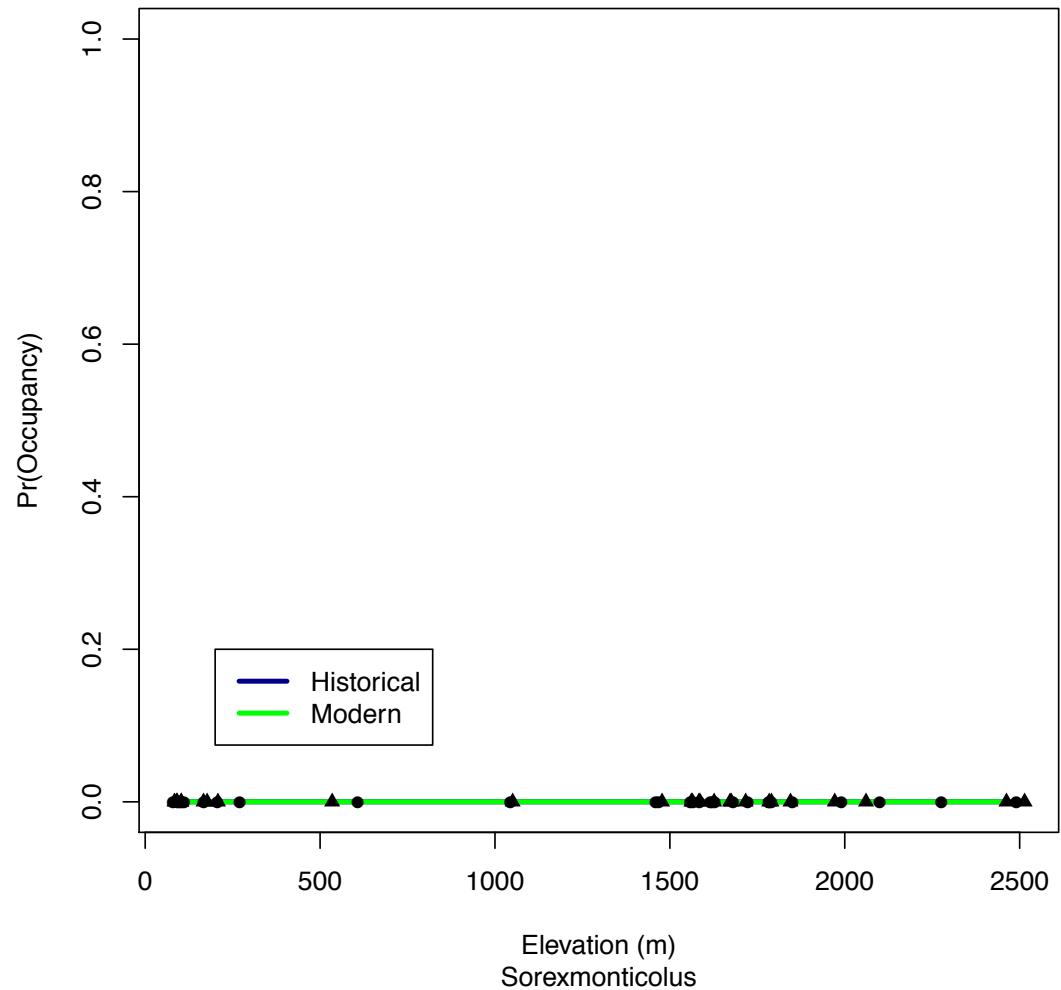


Central
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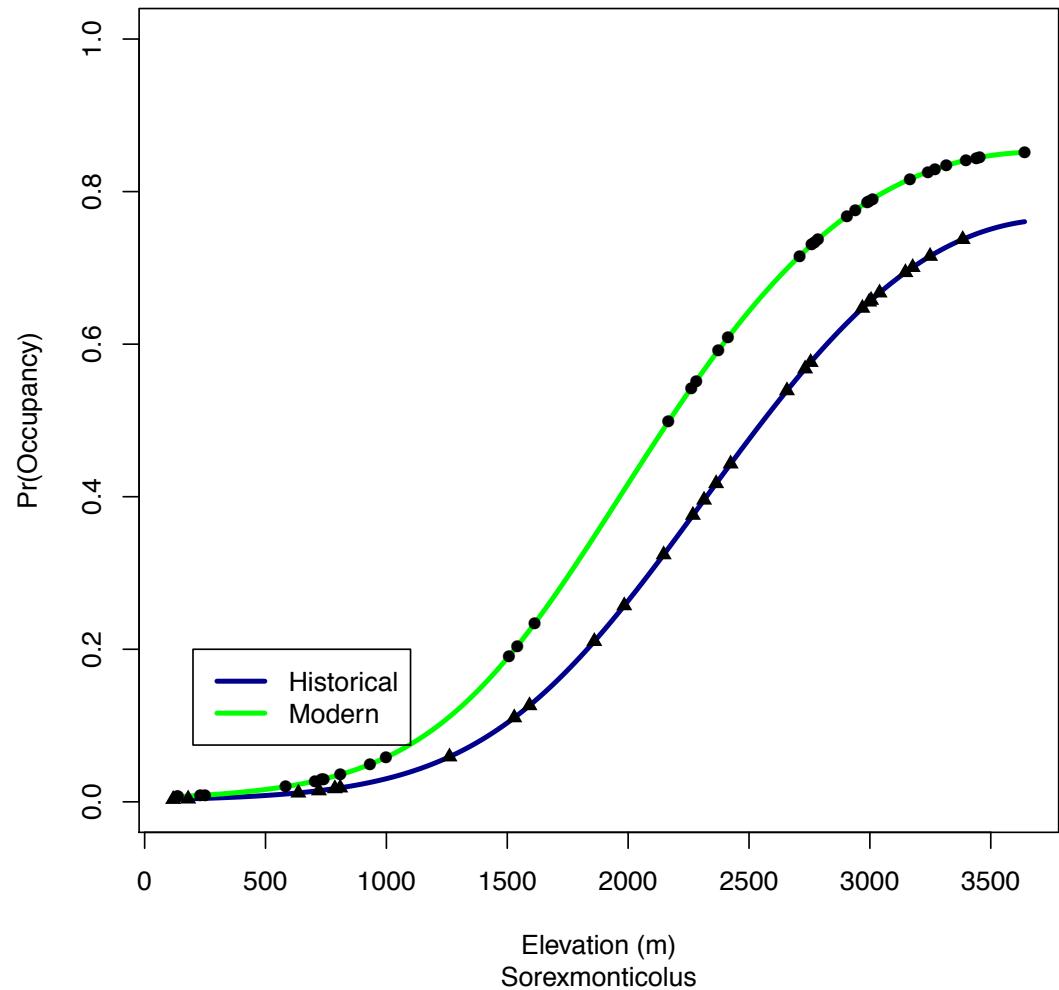
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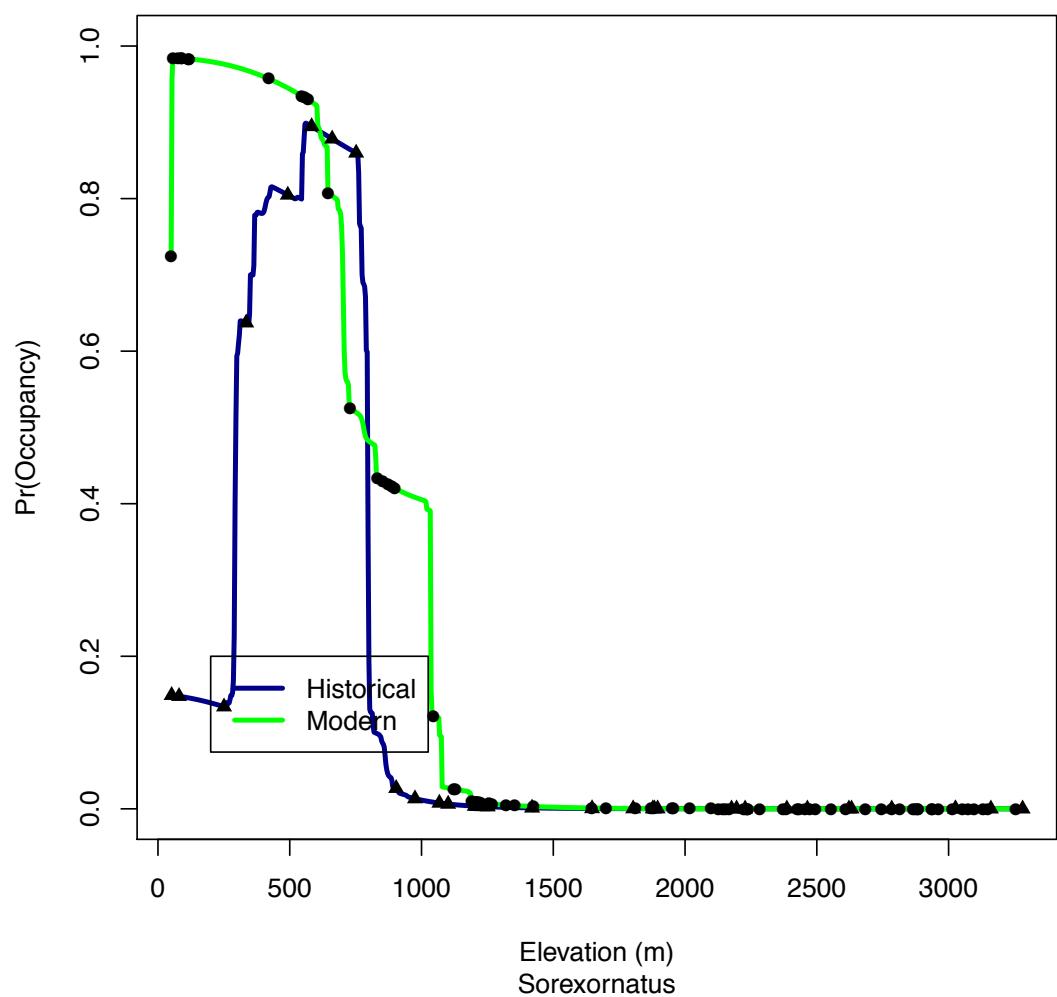


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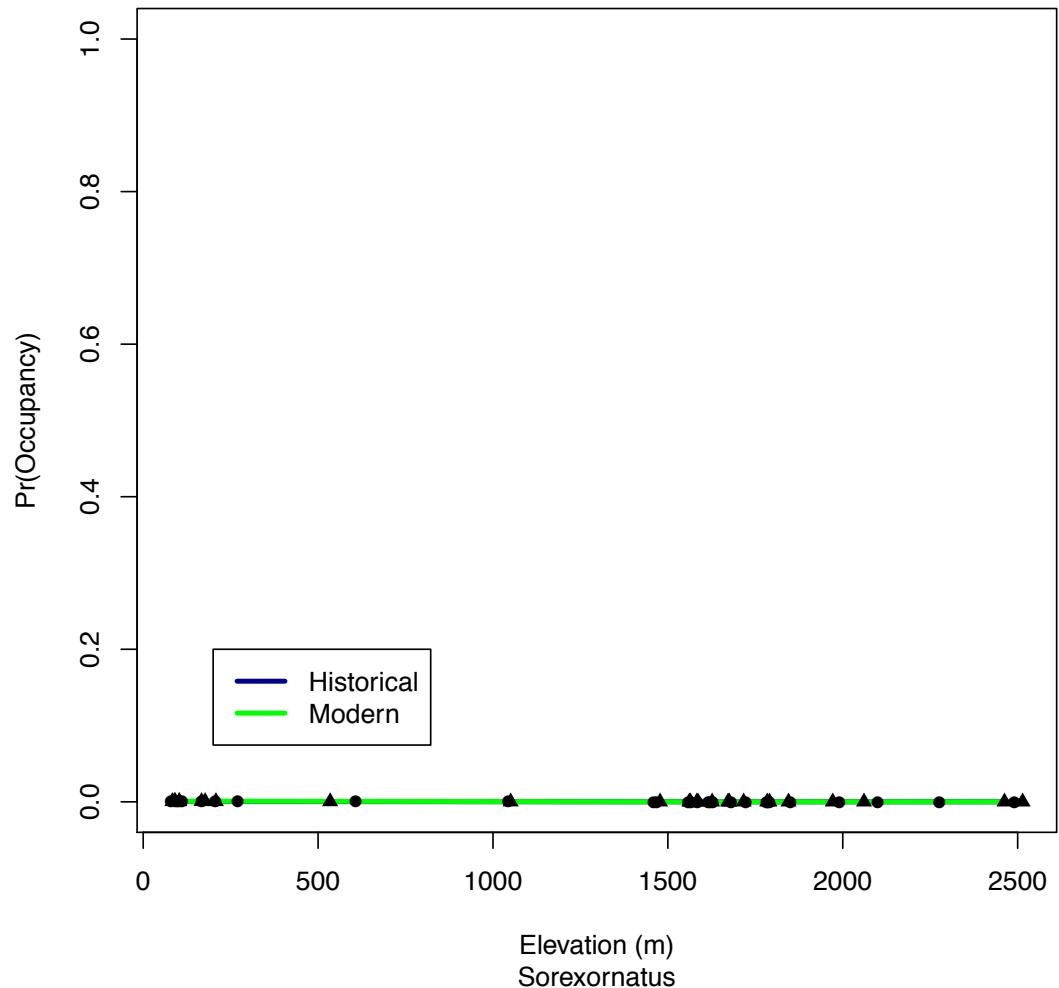
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Central
Yosemite

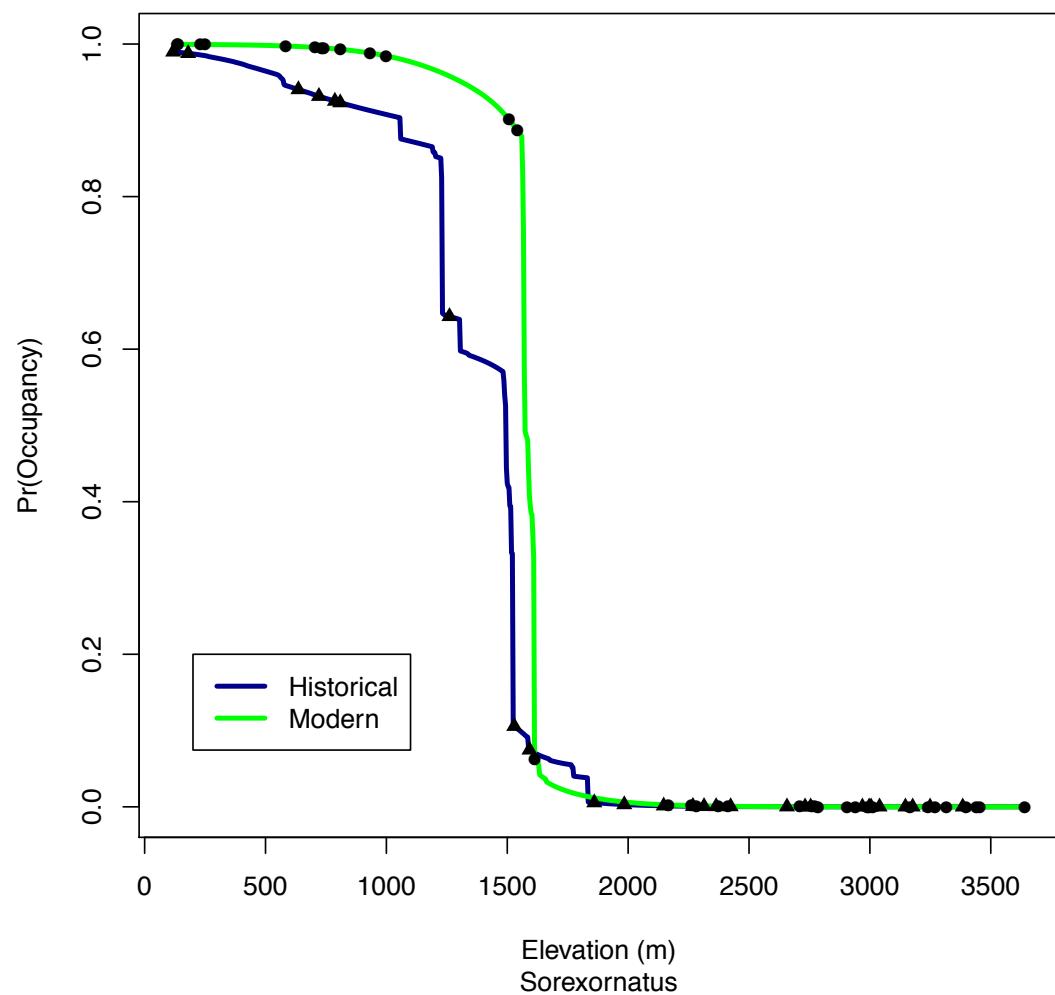


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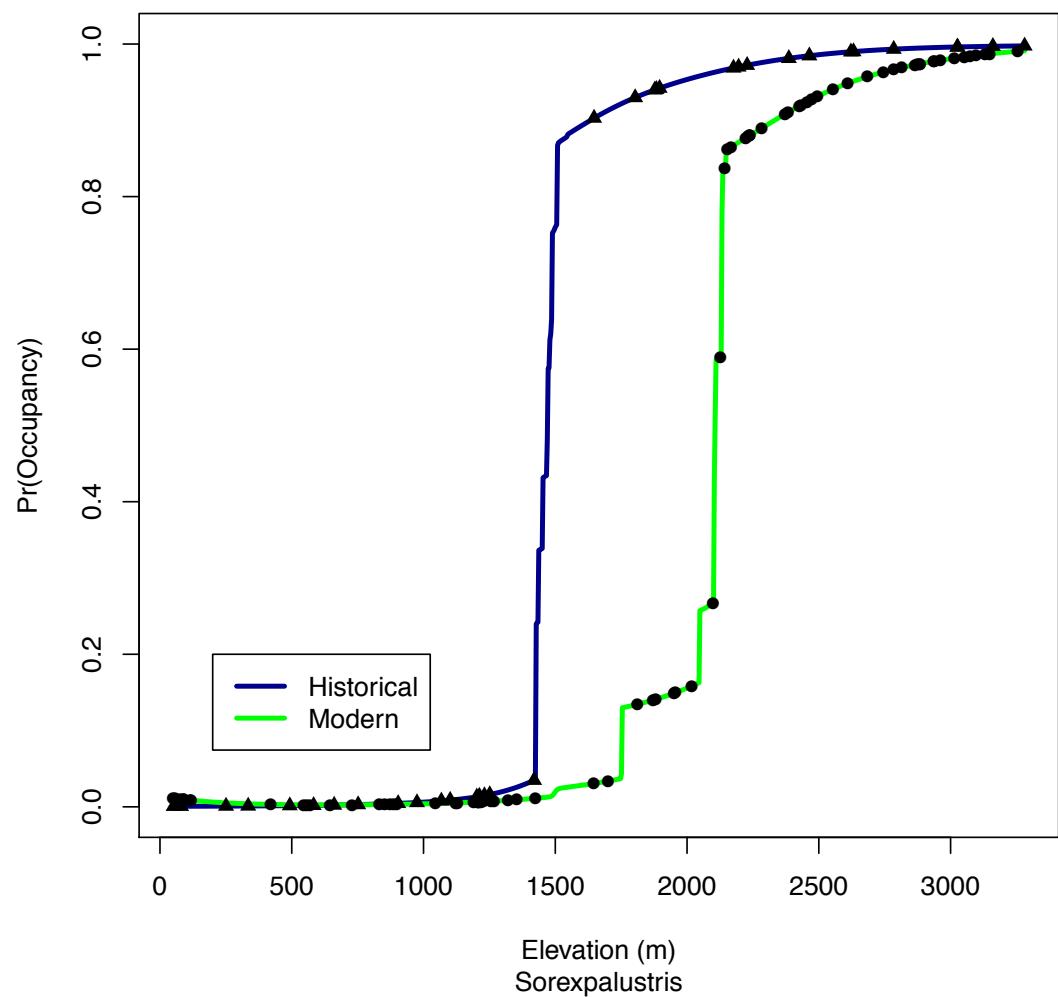
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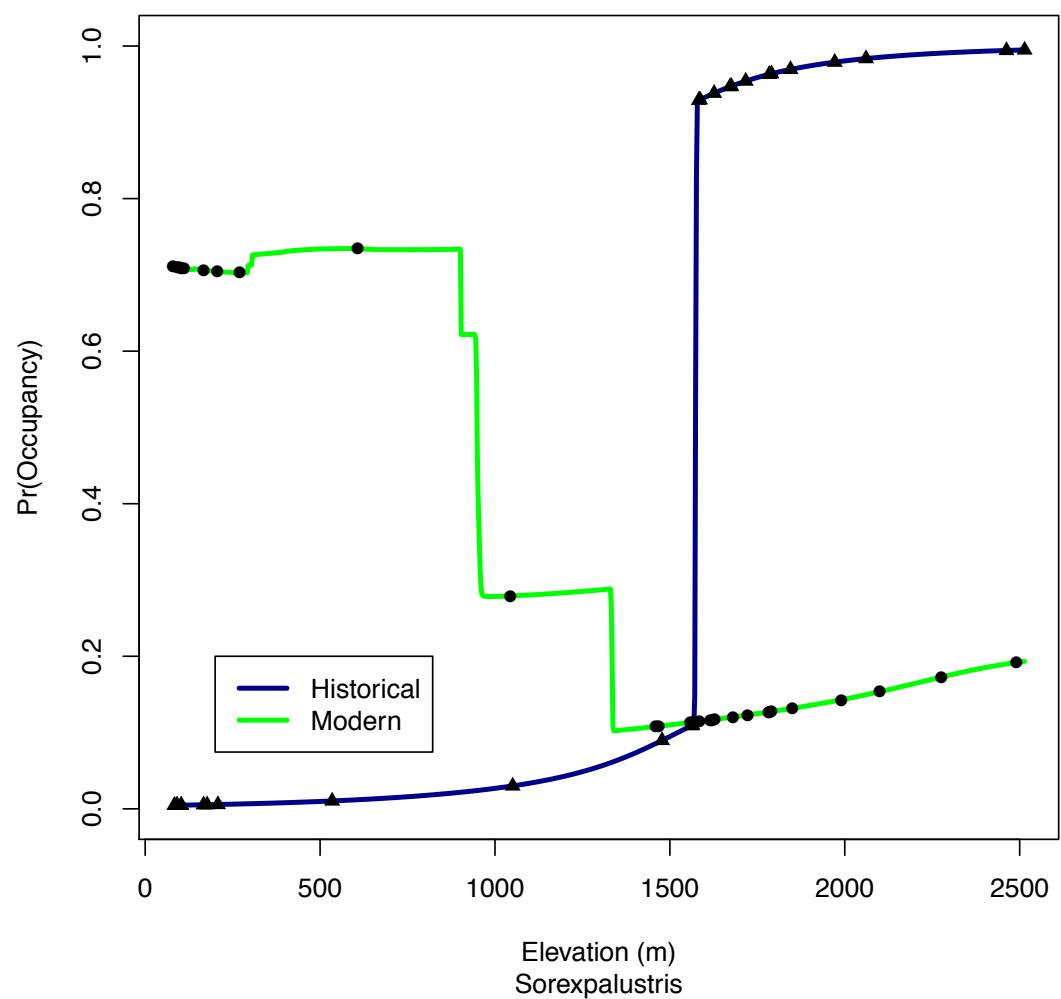
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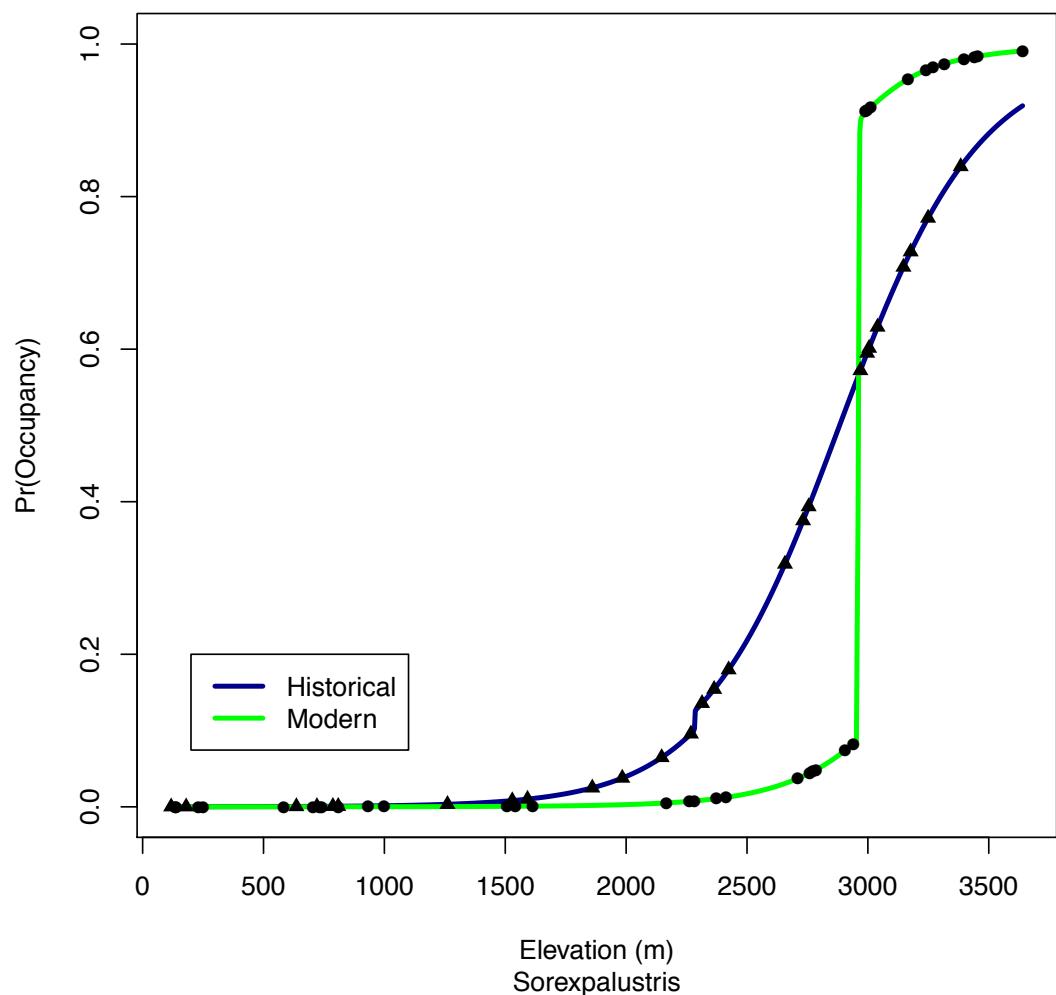
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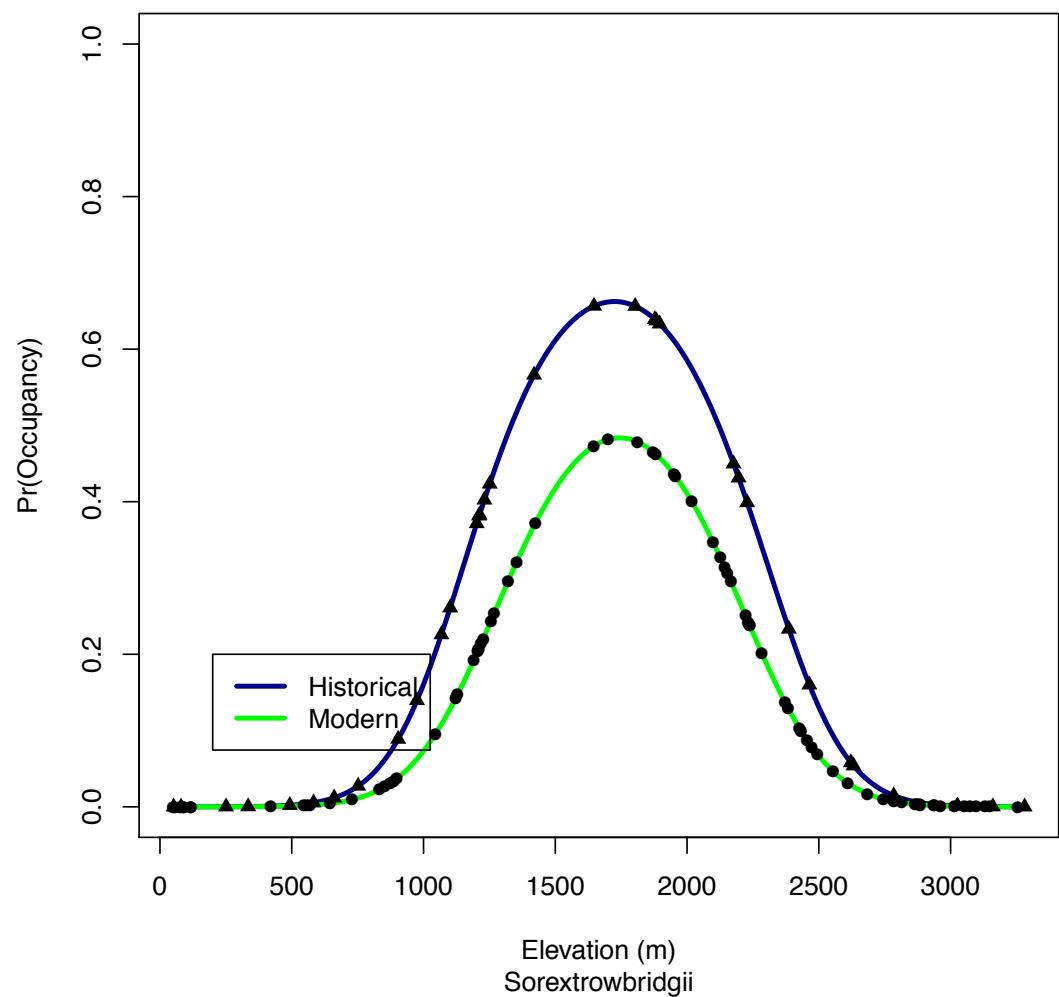
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Sequoia



Central

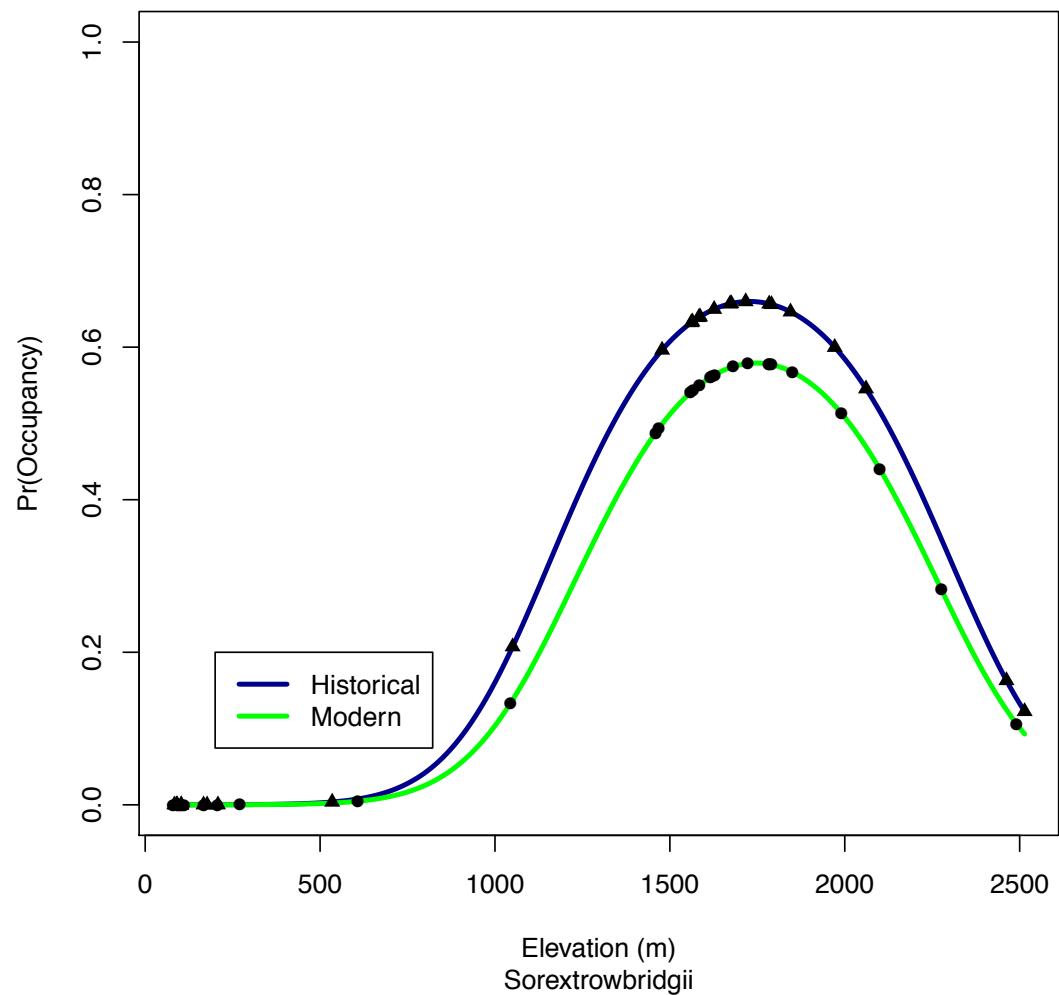
Yosemite



Elevation (m)
Sorex trowbridgii

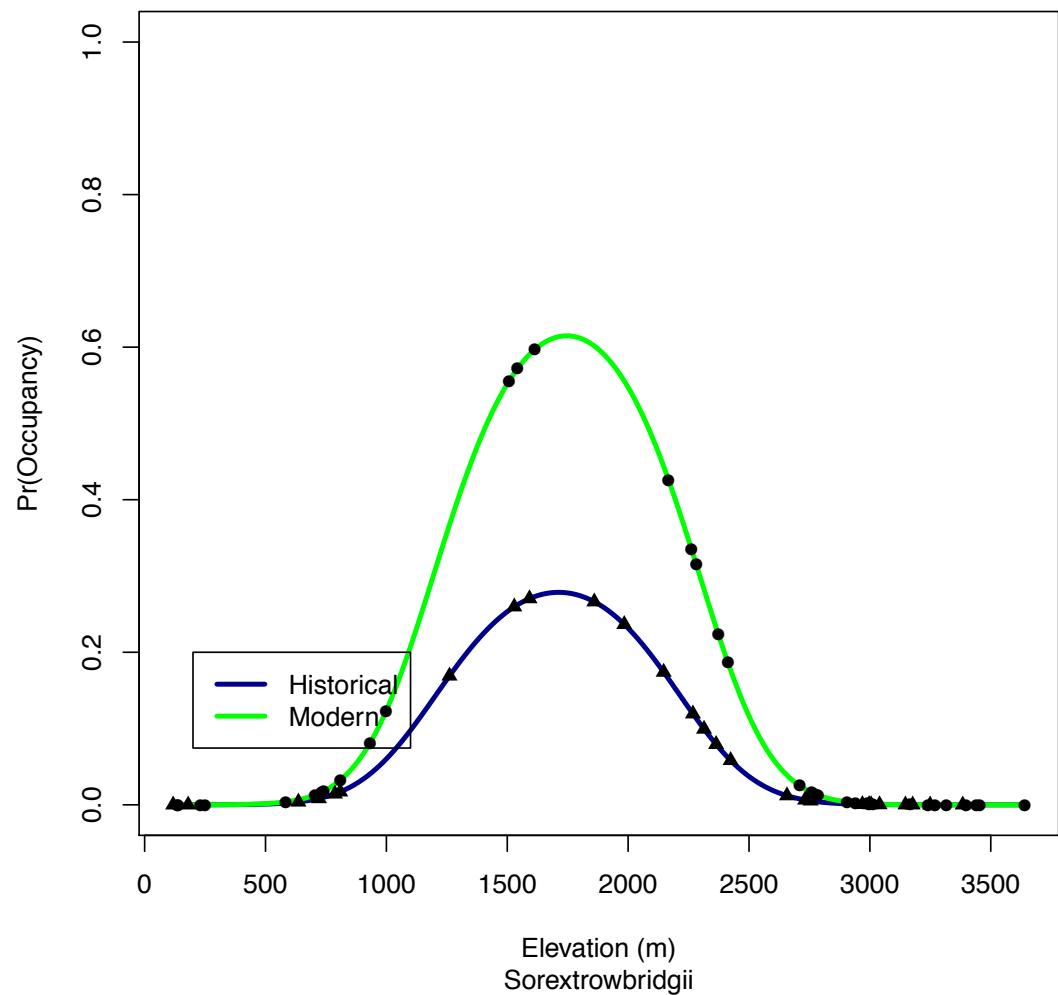
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Lassen



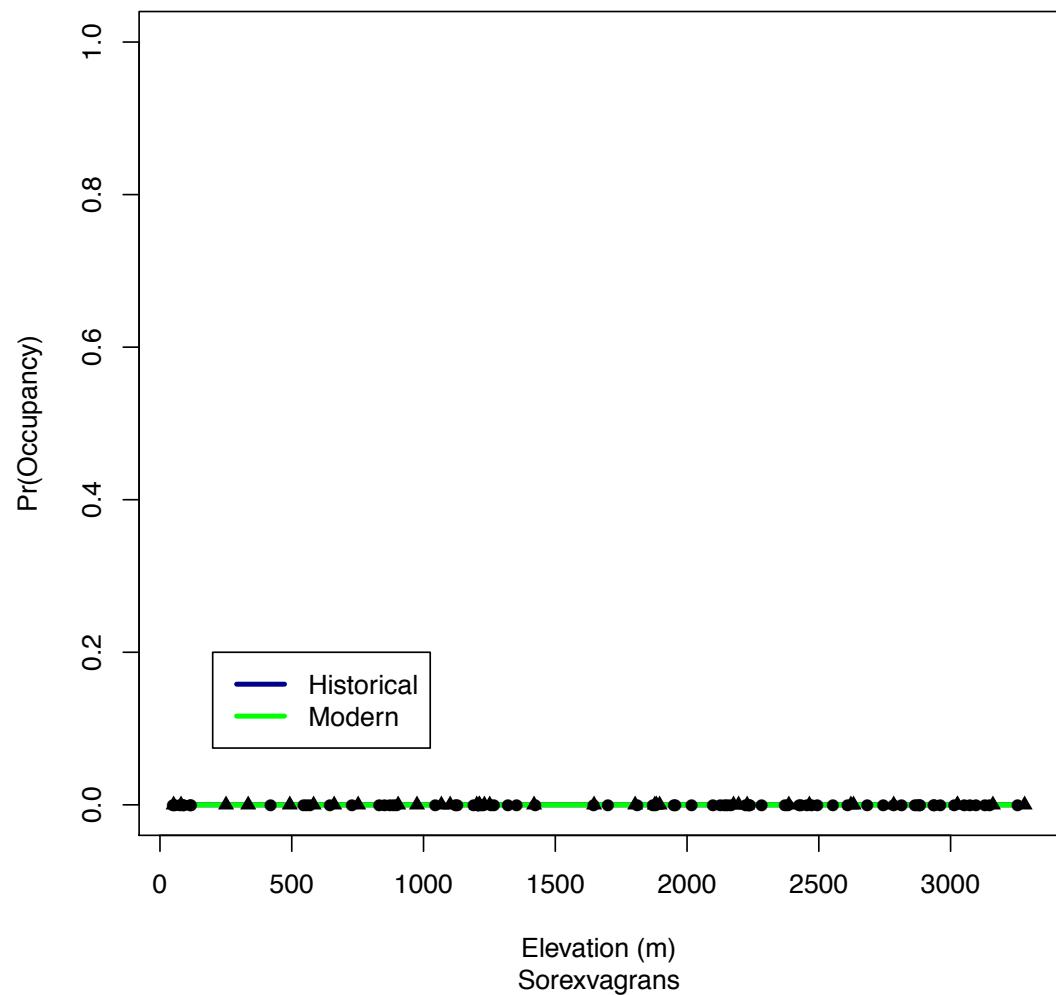
Southern

Sequoia



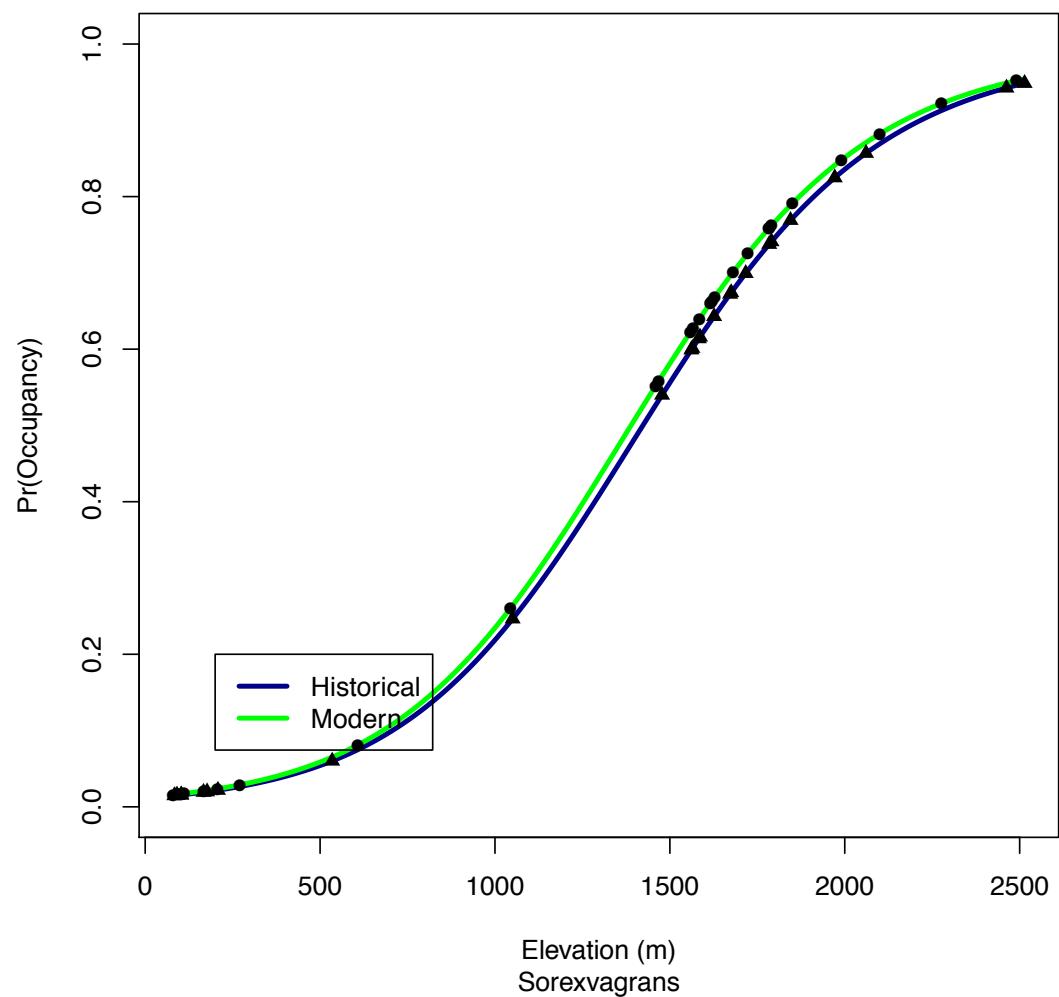
Central

Yosemite



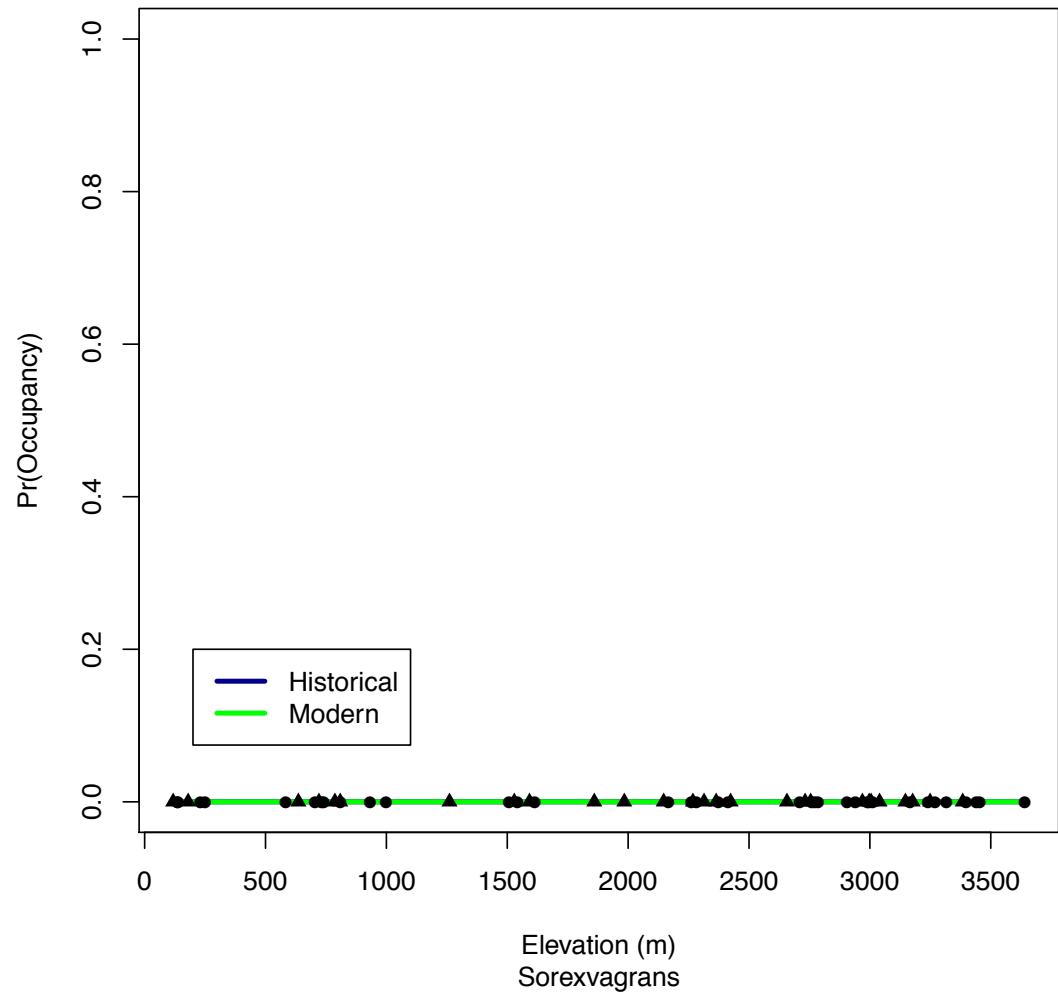
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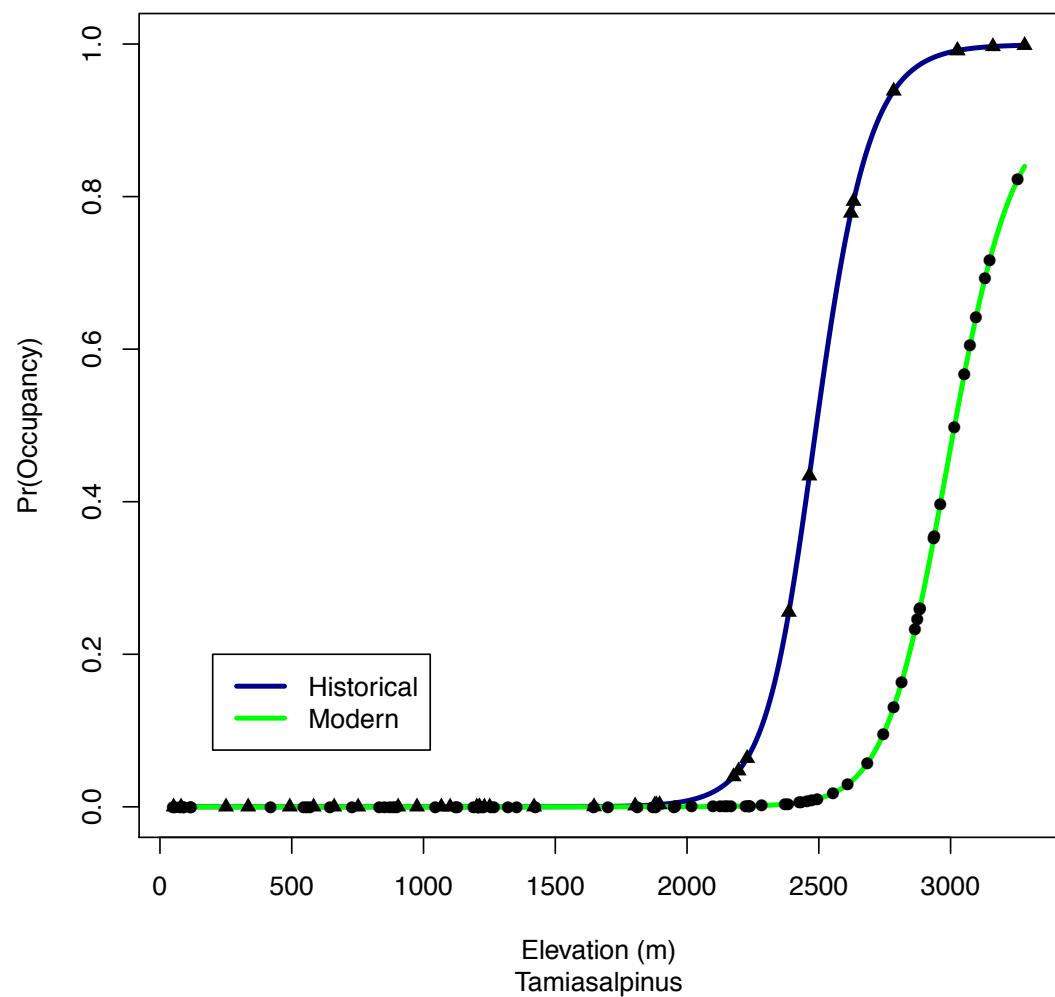
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Sequoia



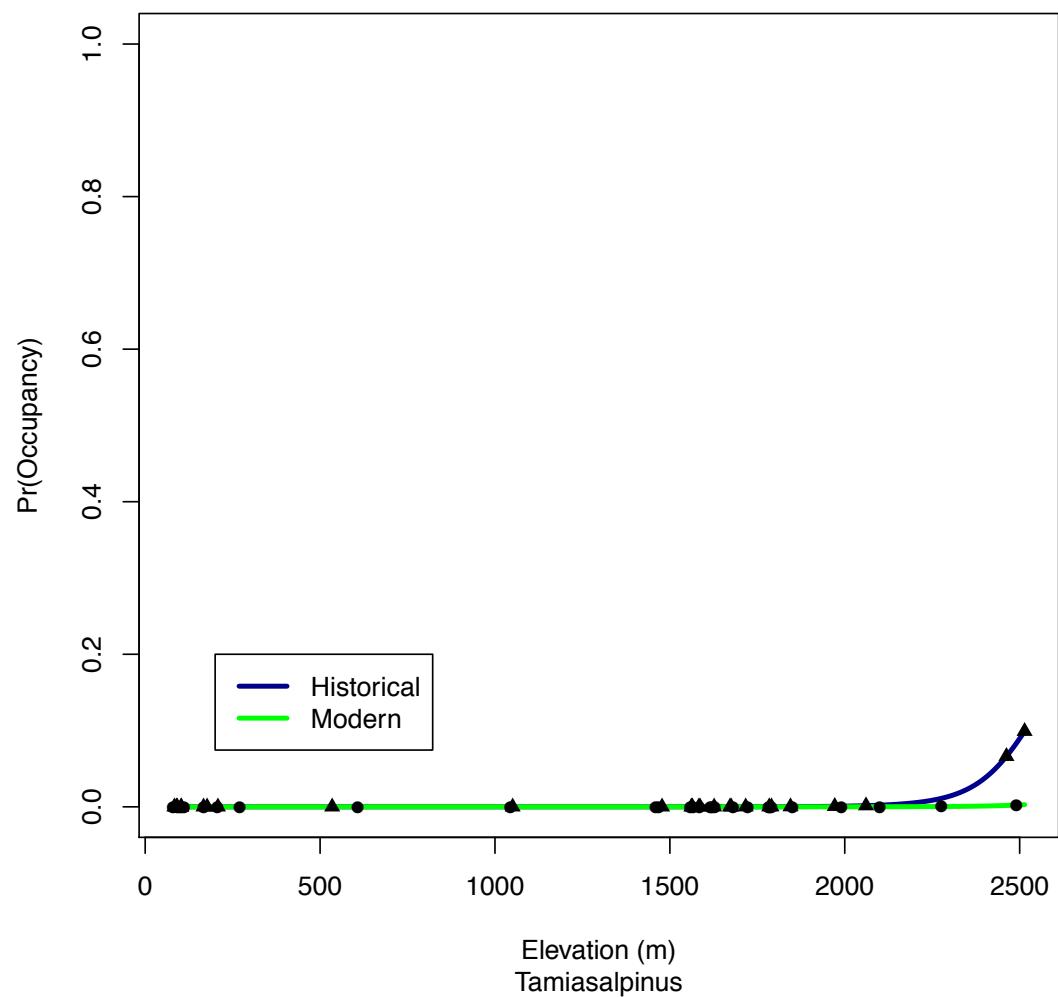
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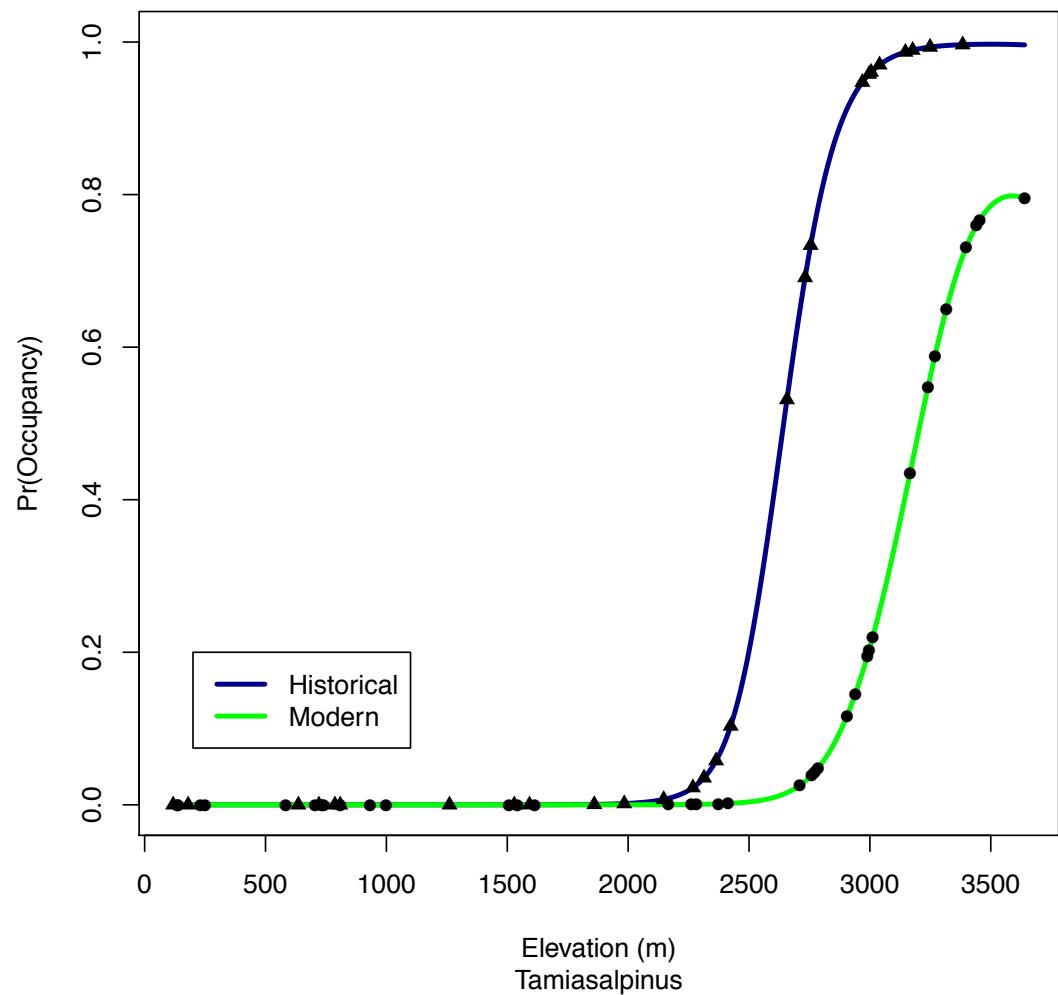
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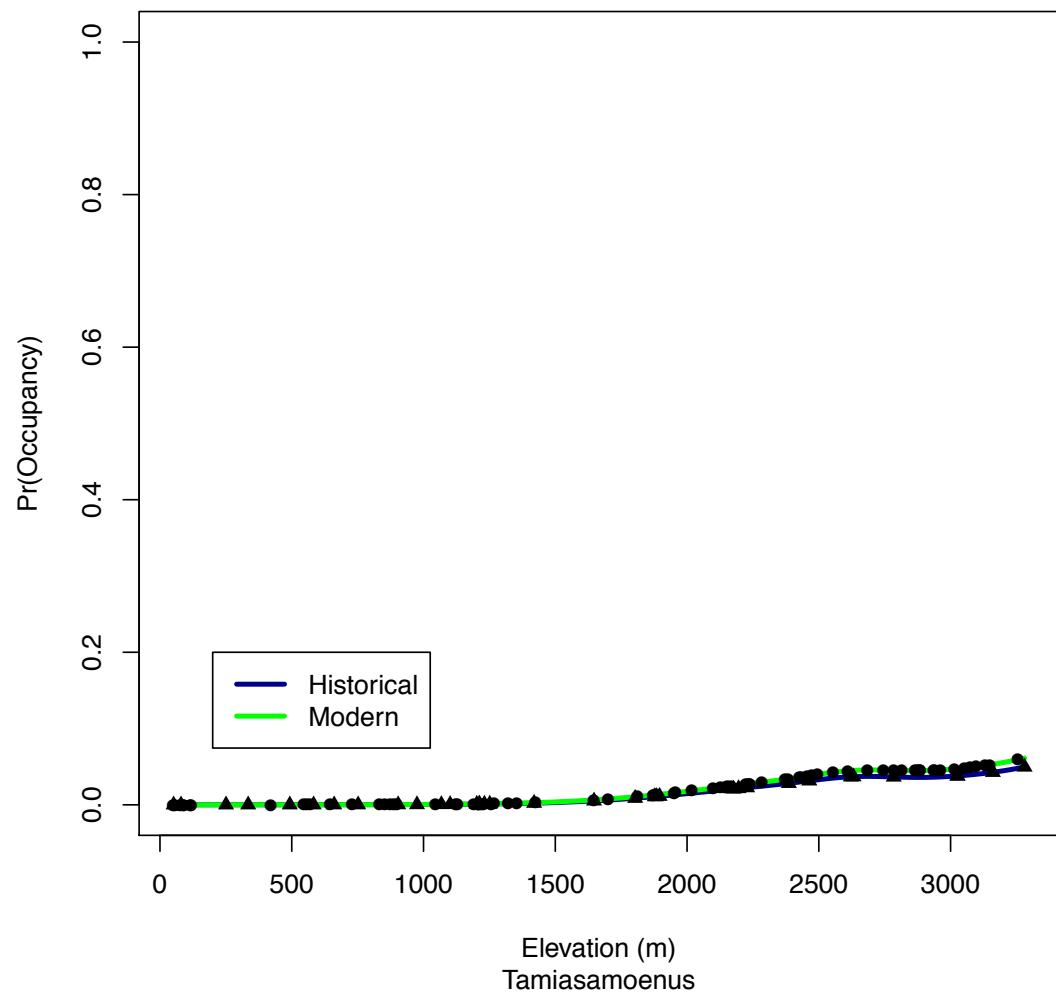
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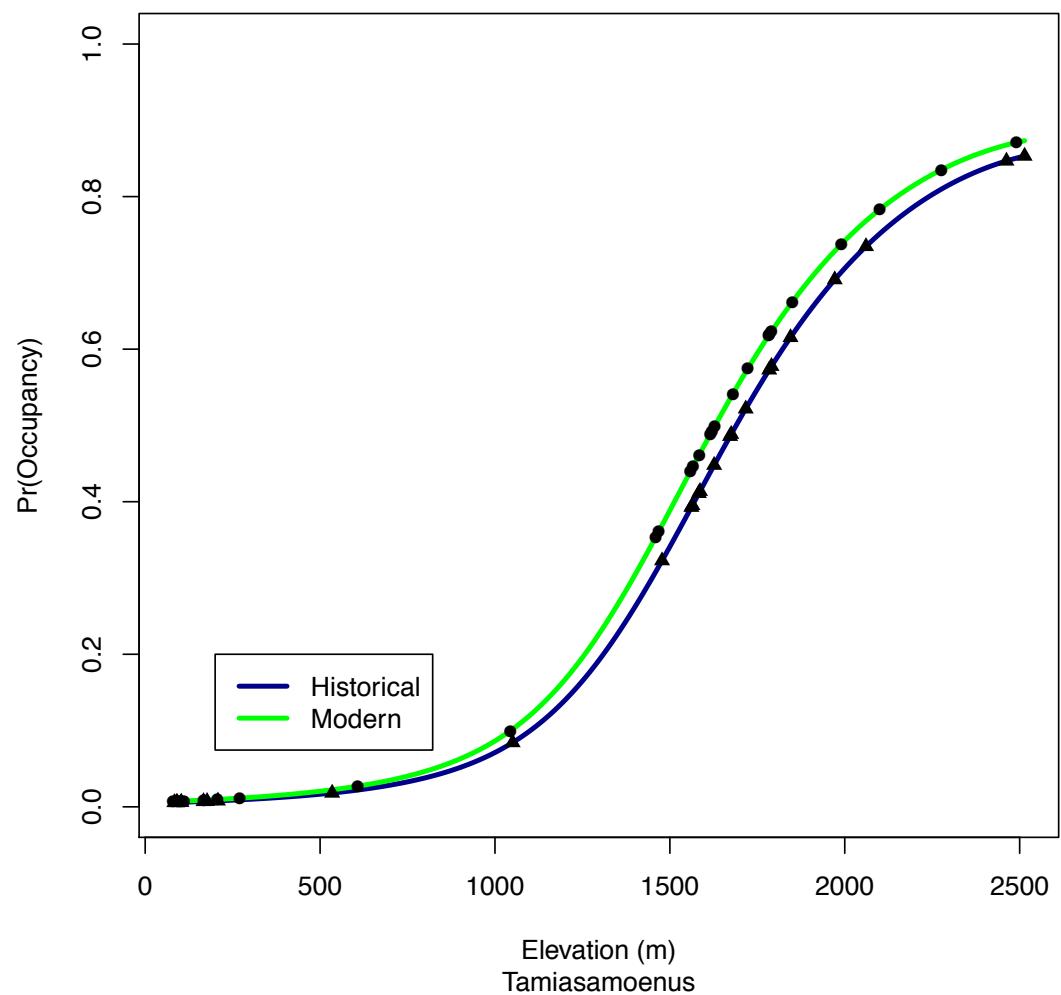
Central

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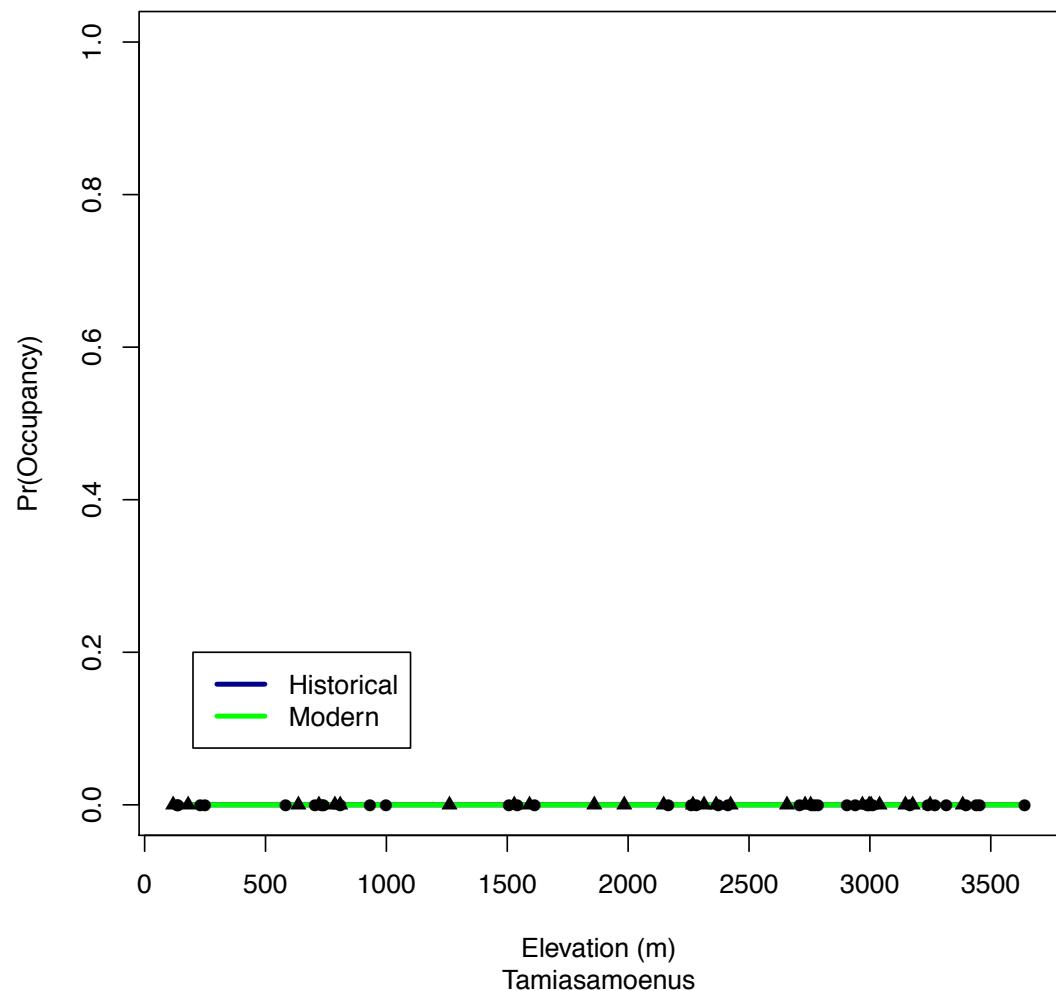
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Lassen



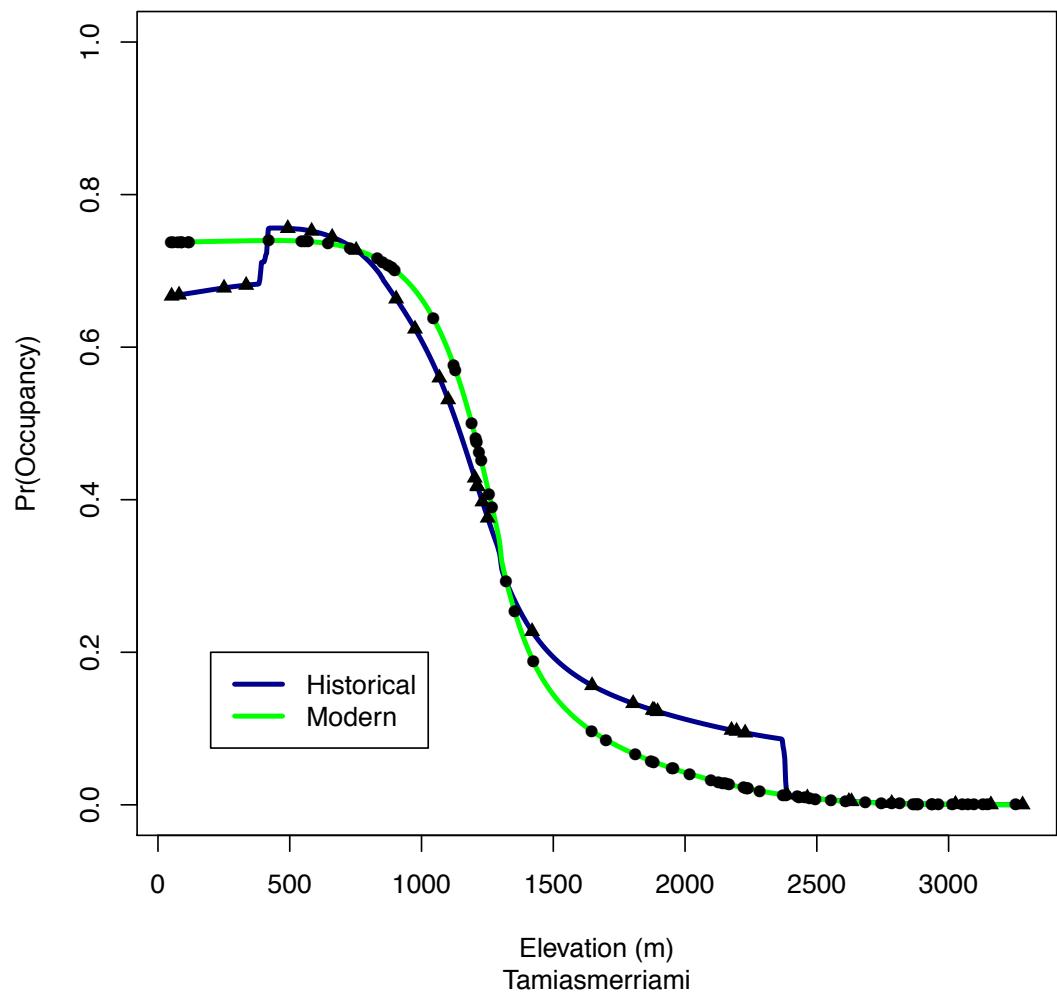
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Sequoia



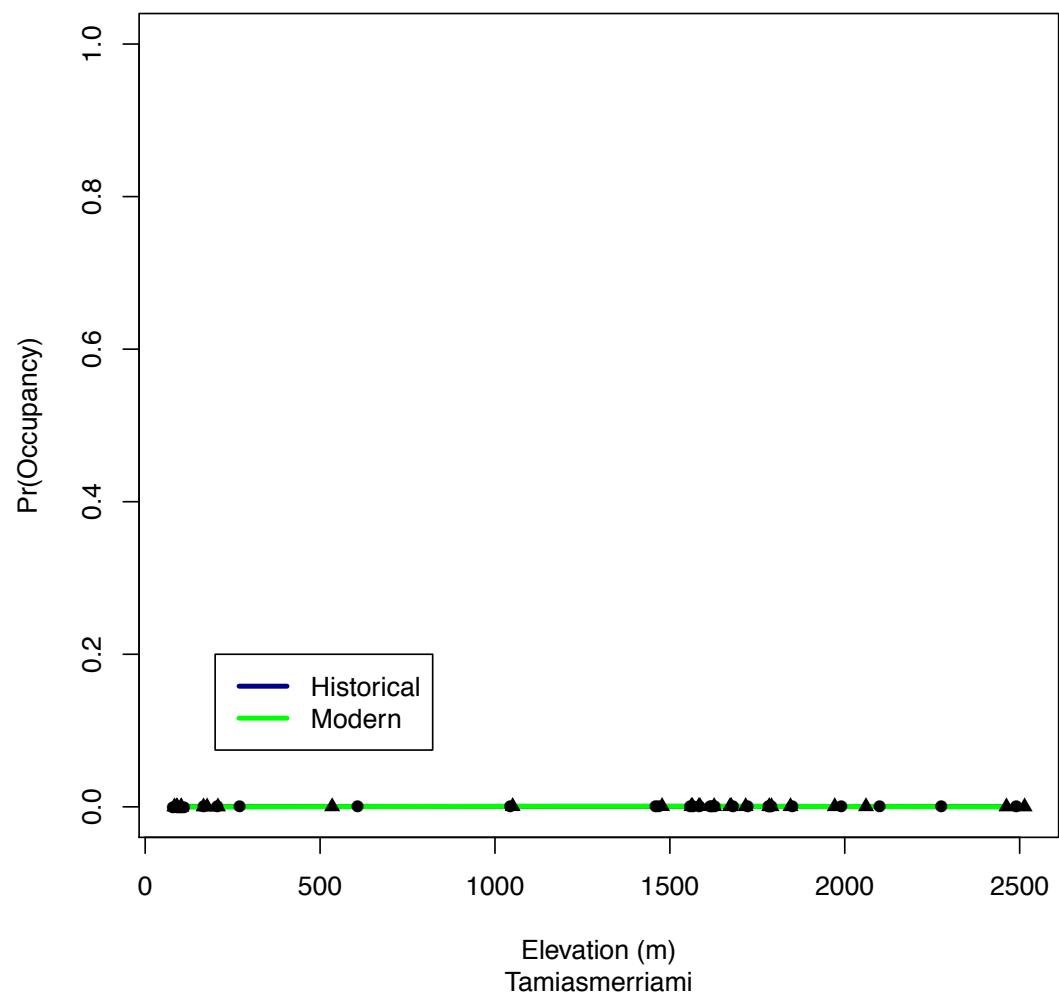
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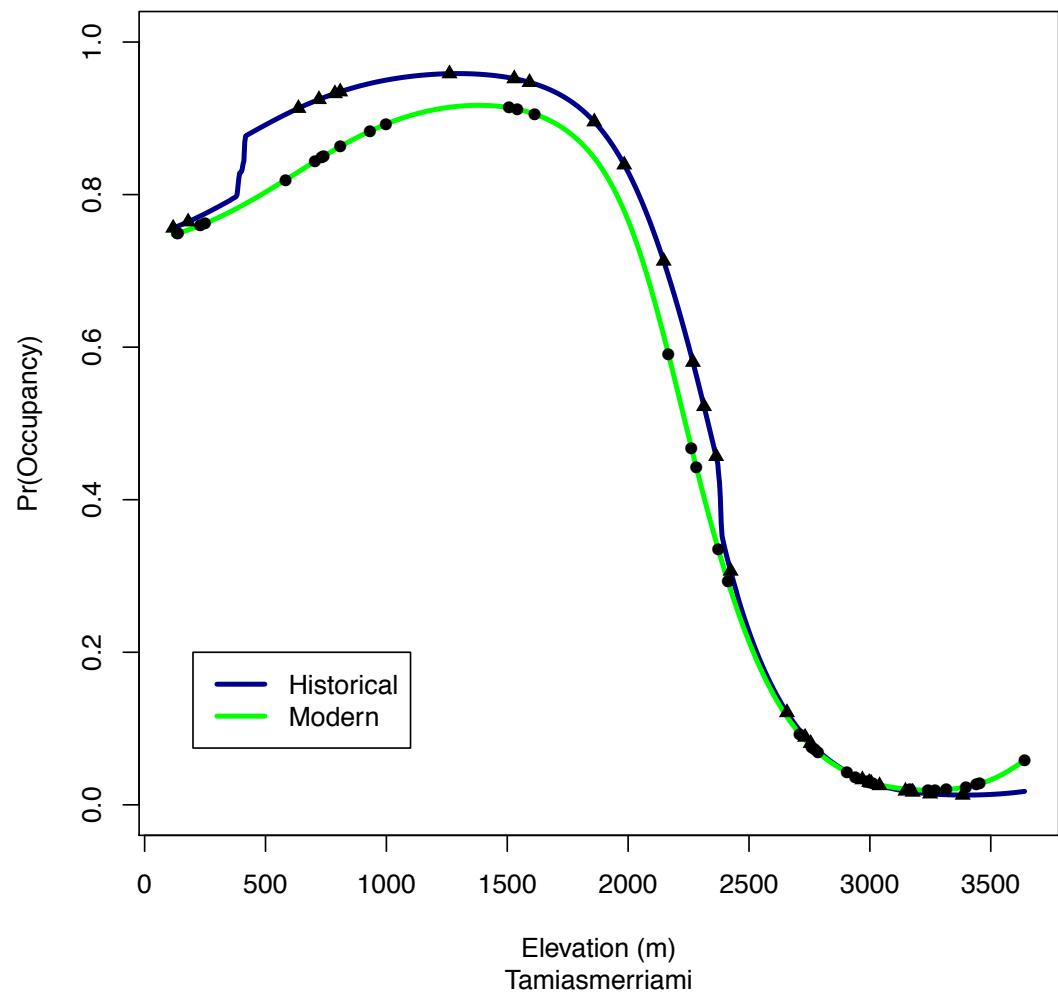
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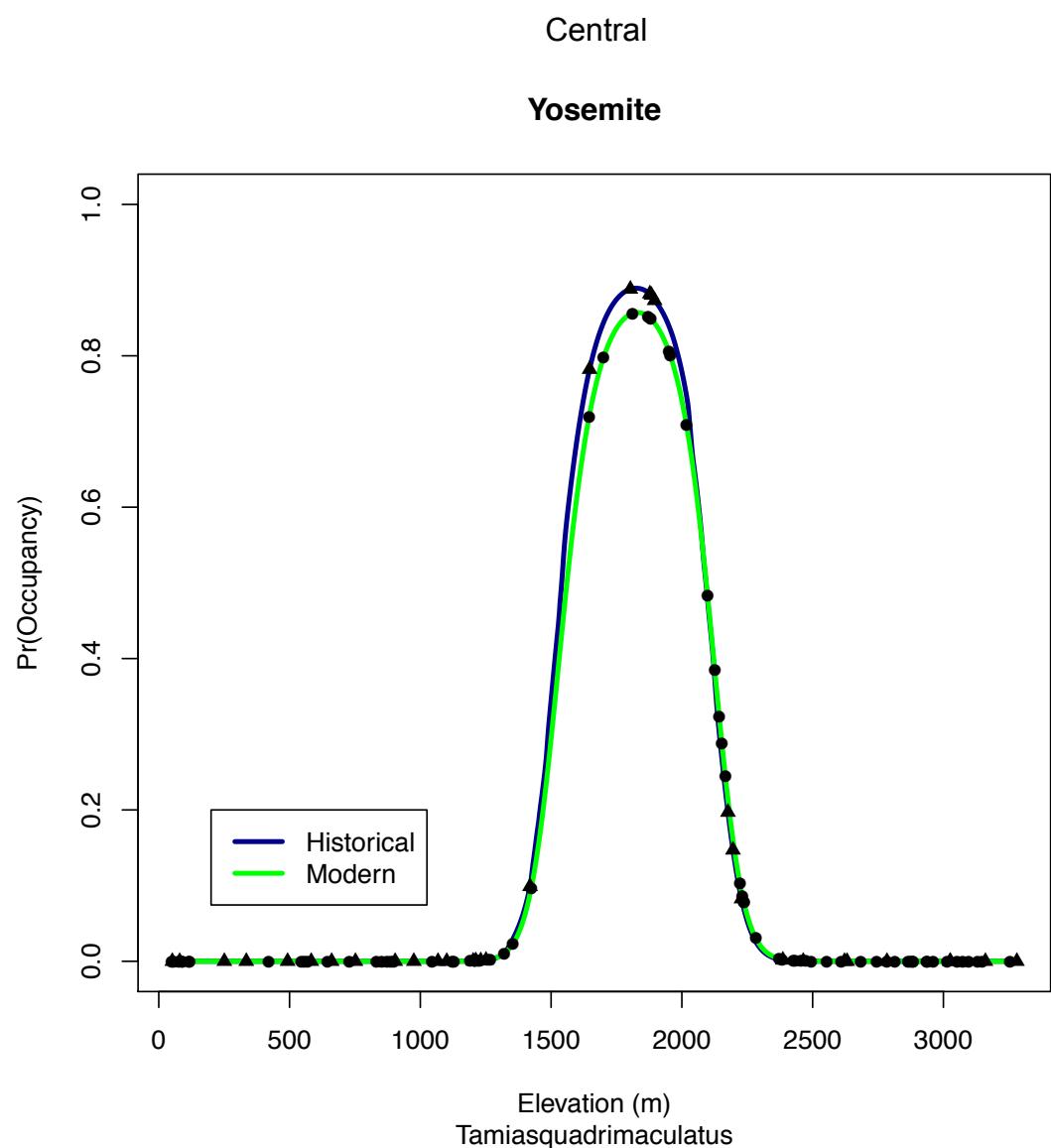
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Southern

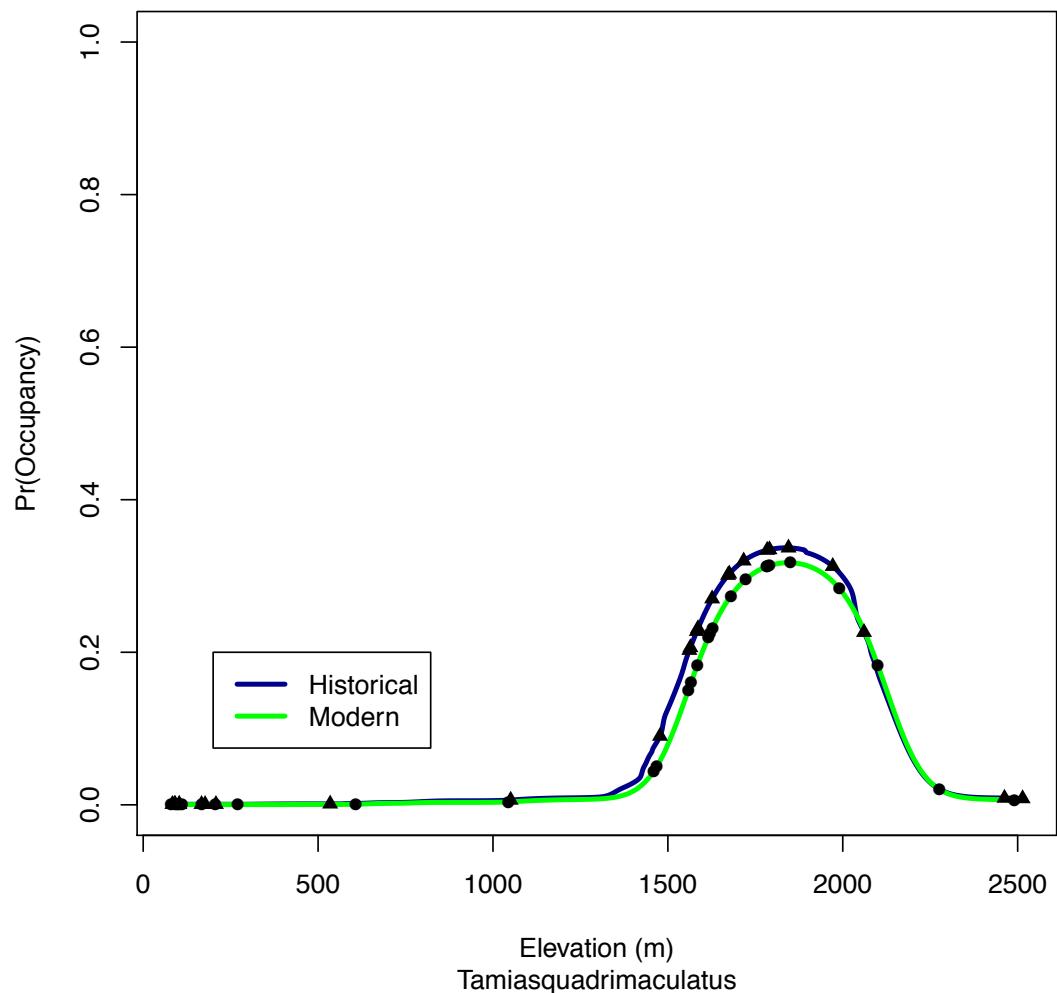
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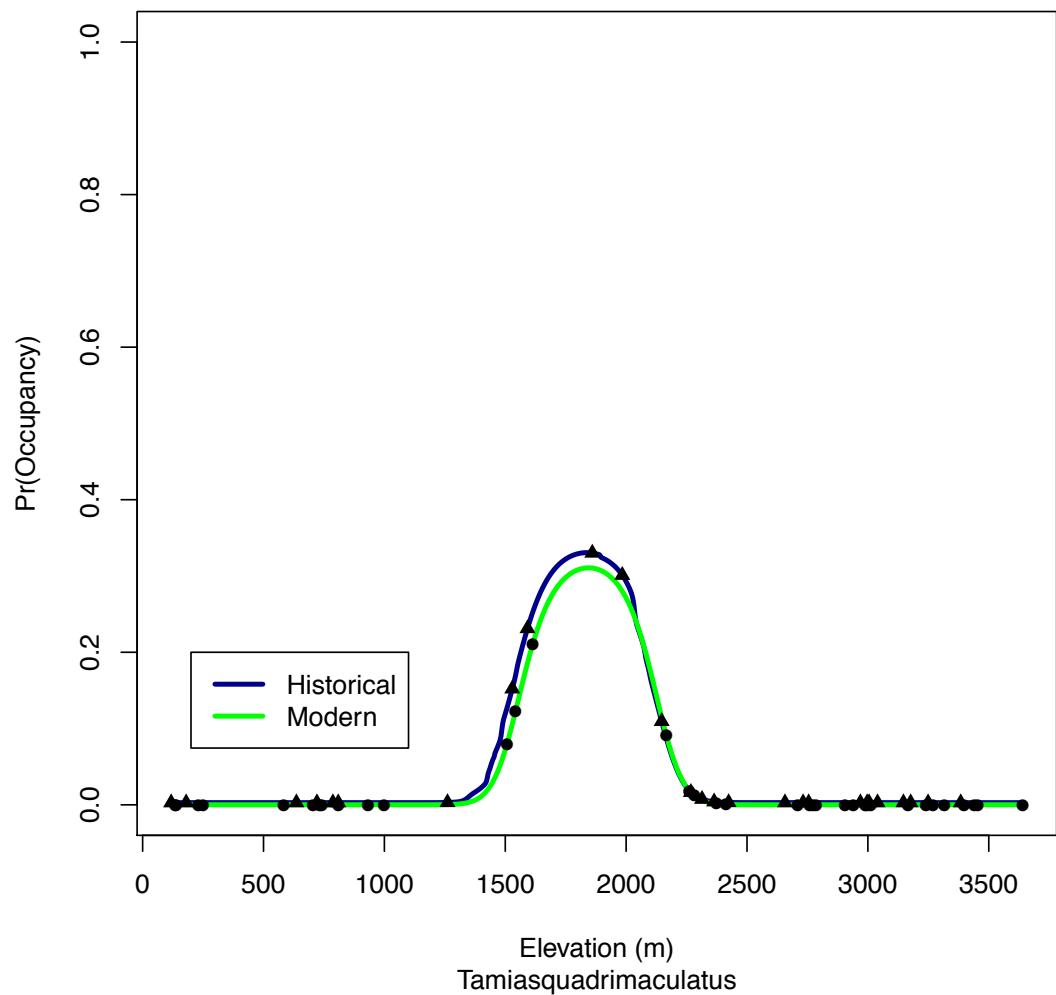
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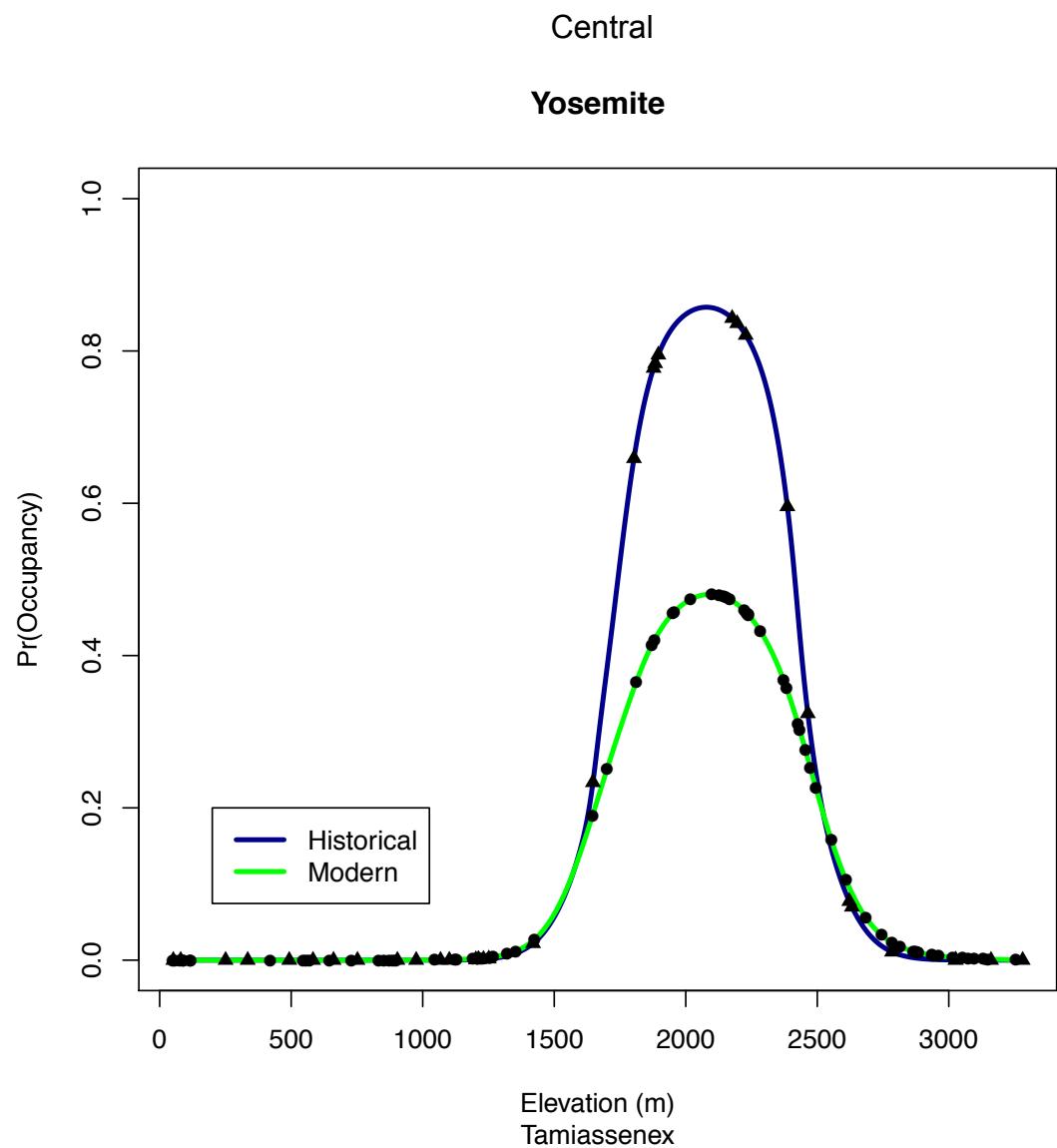
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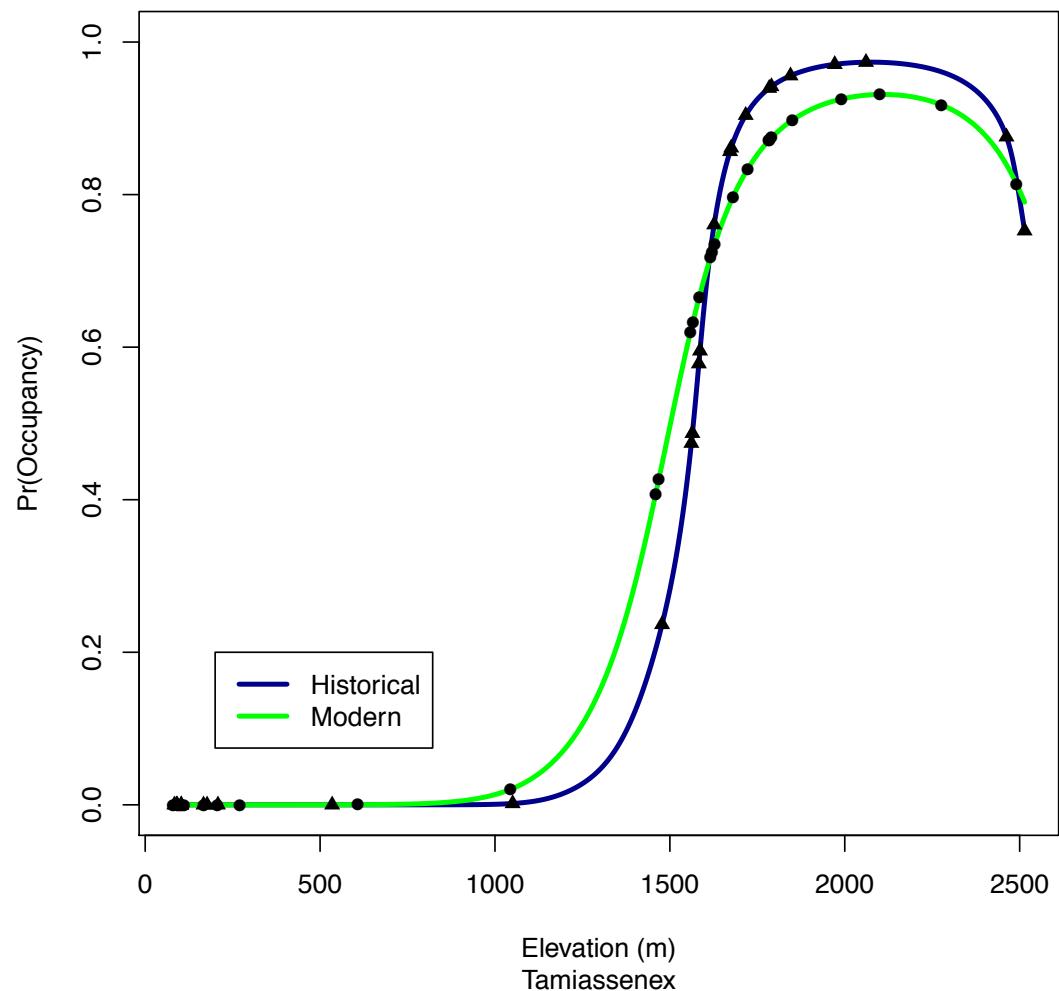
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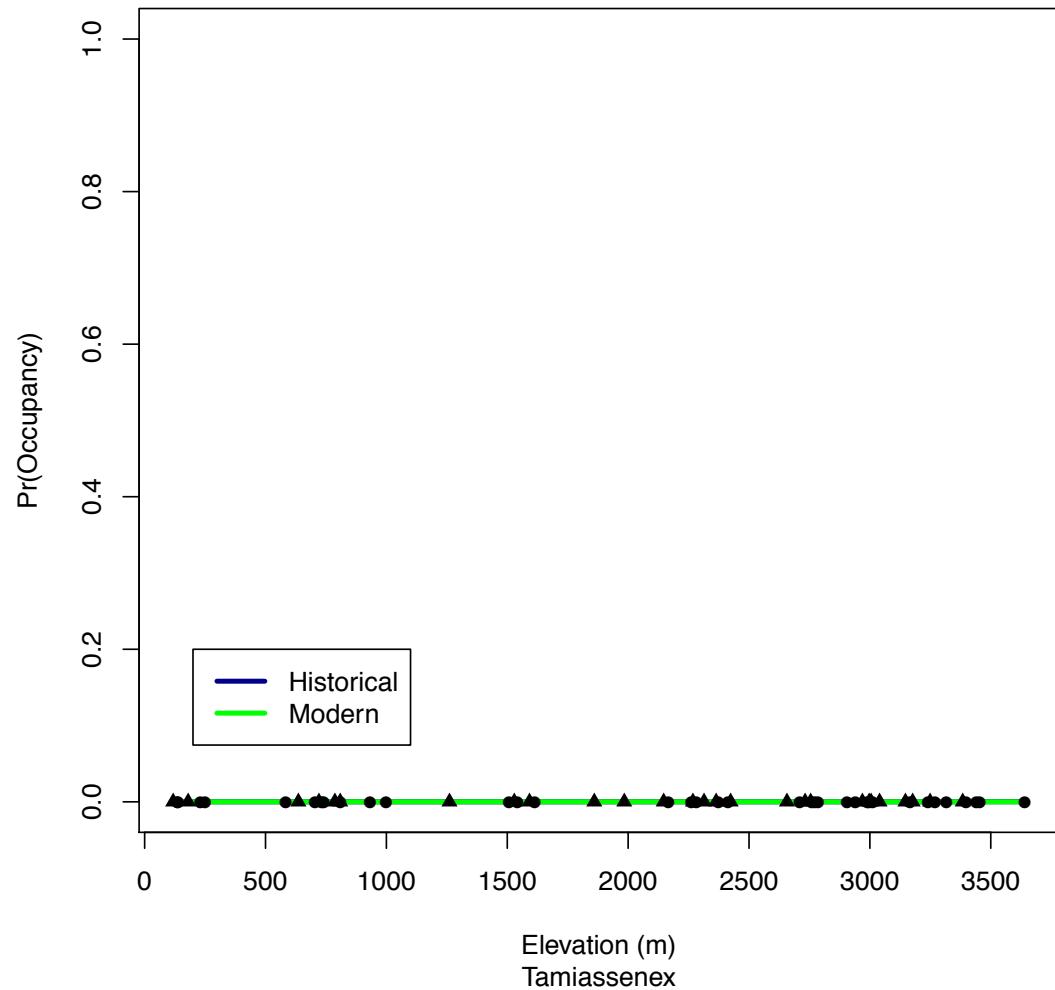
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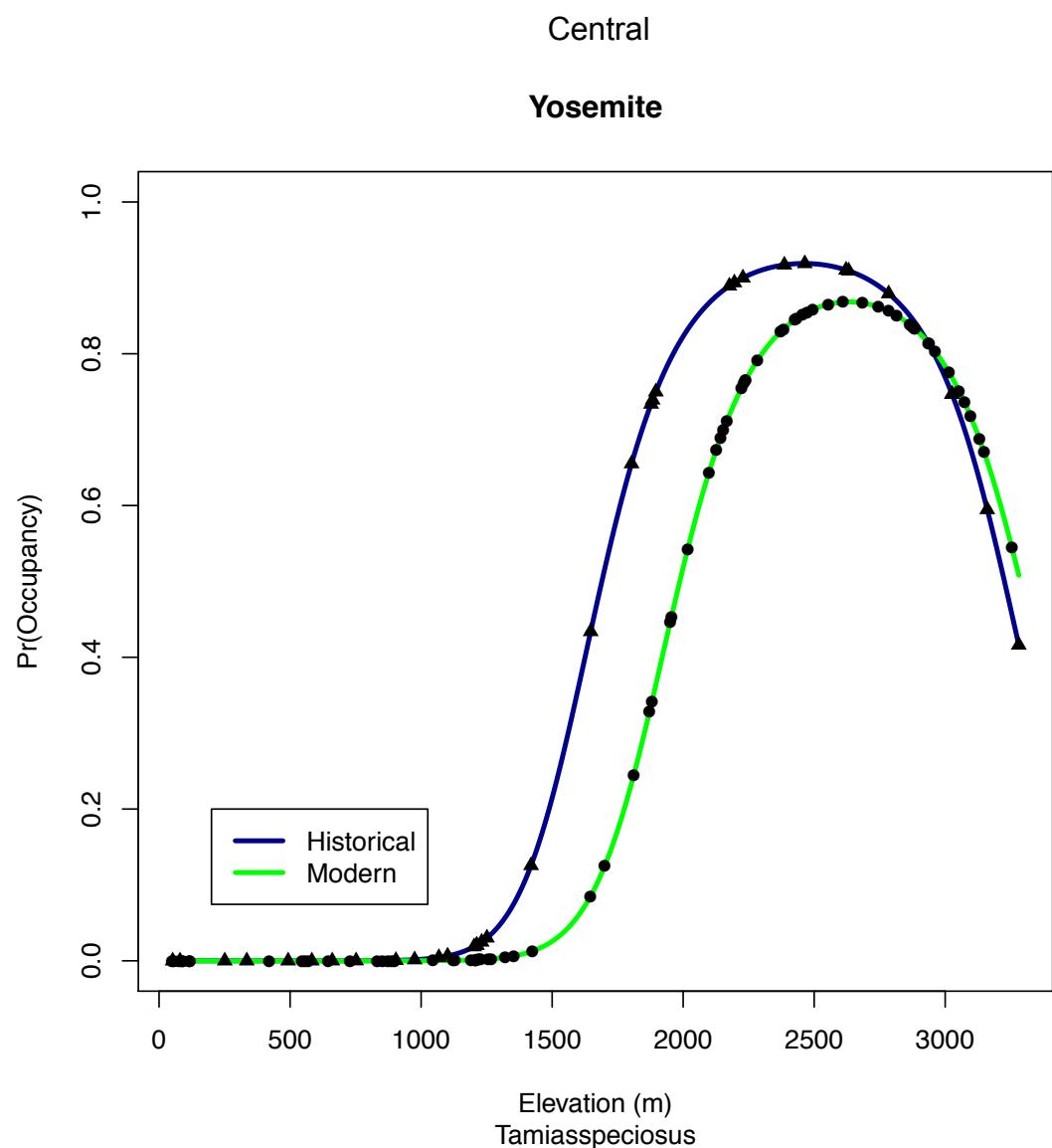
Lassen



Southern

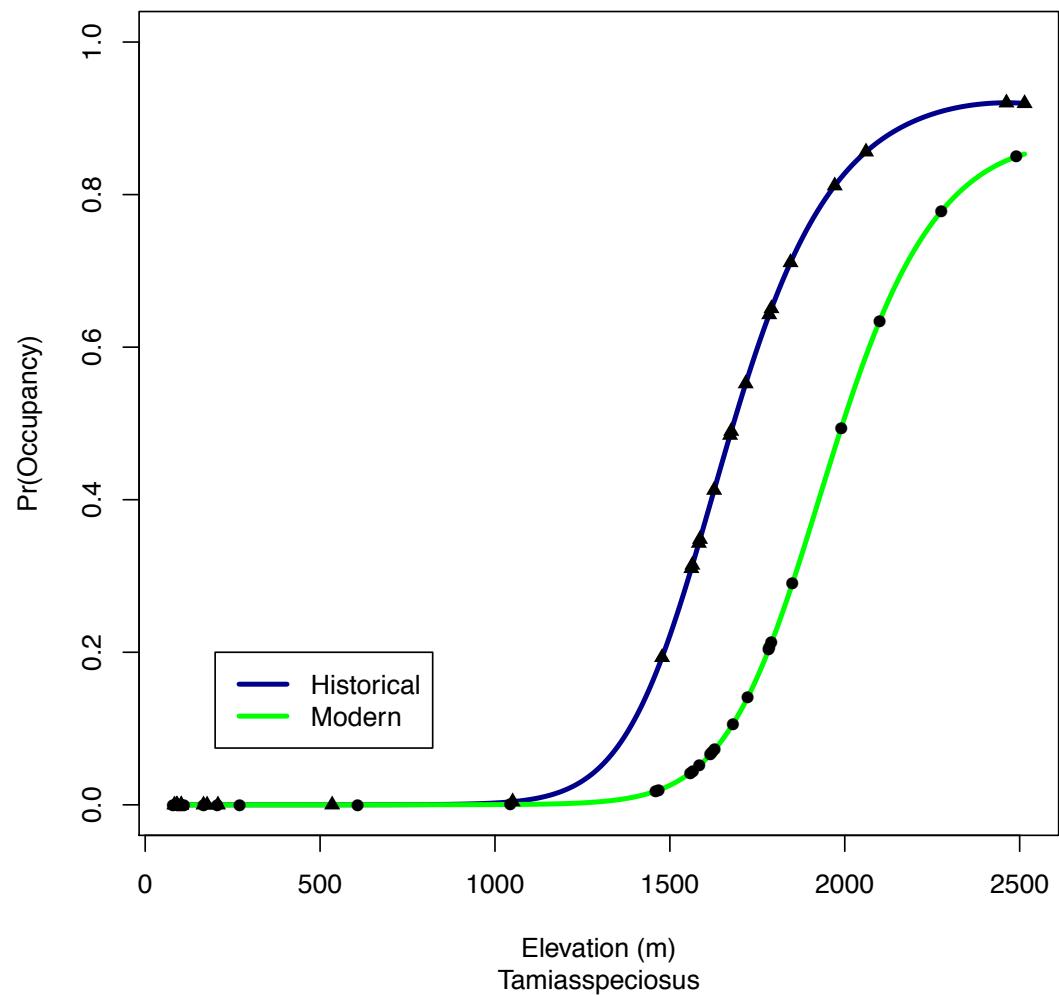
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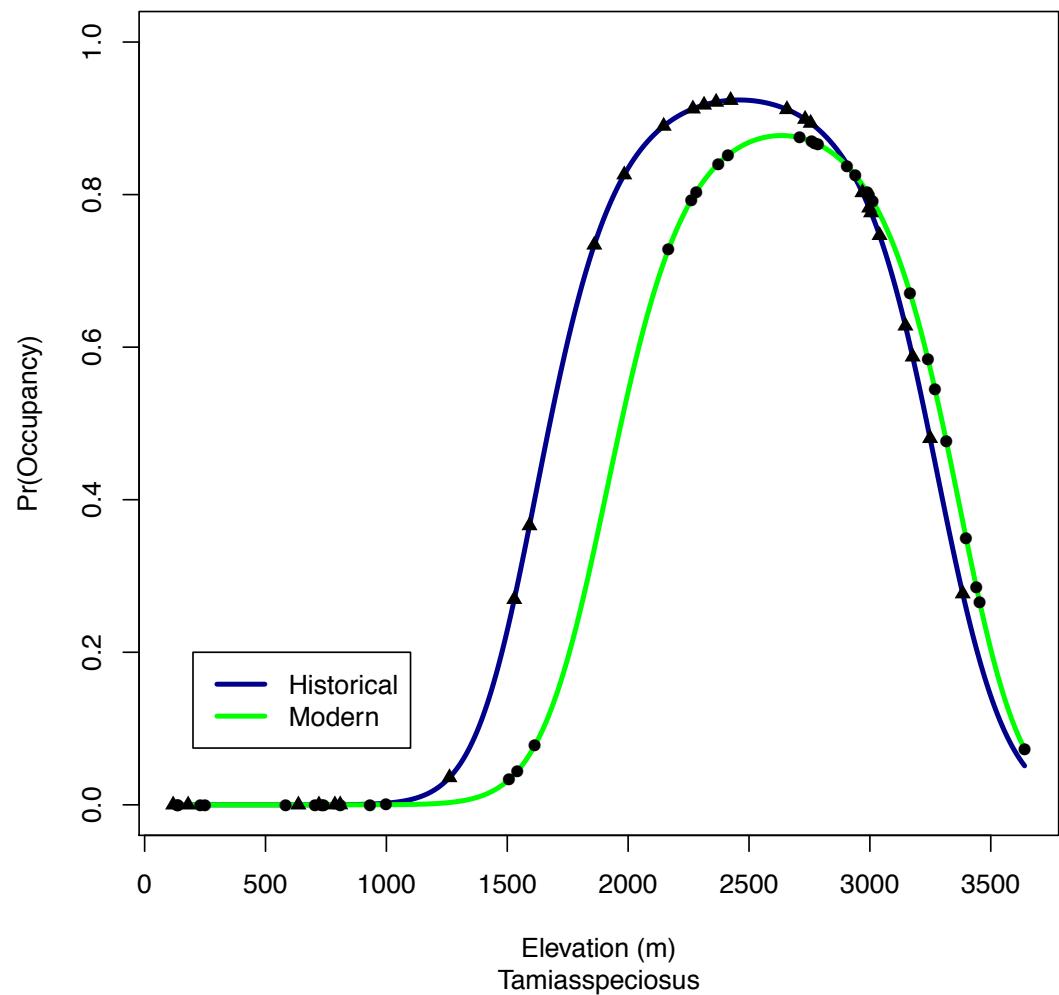
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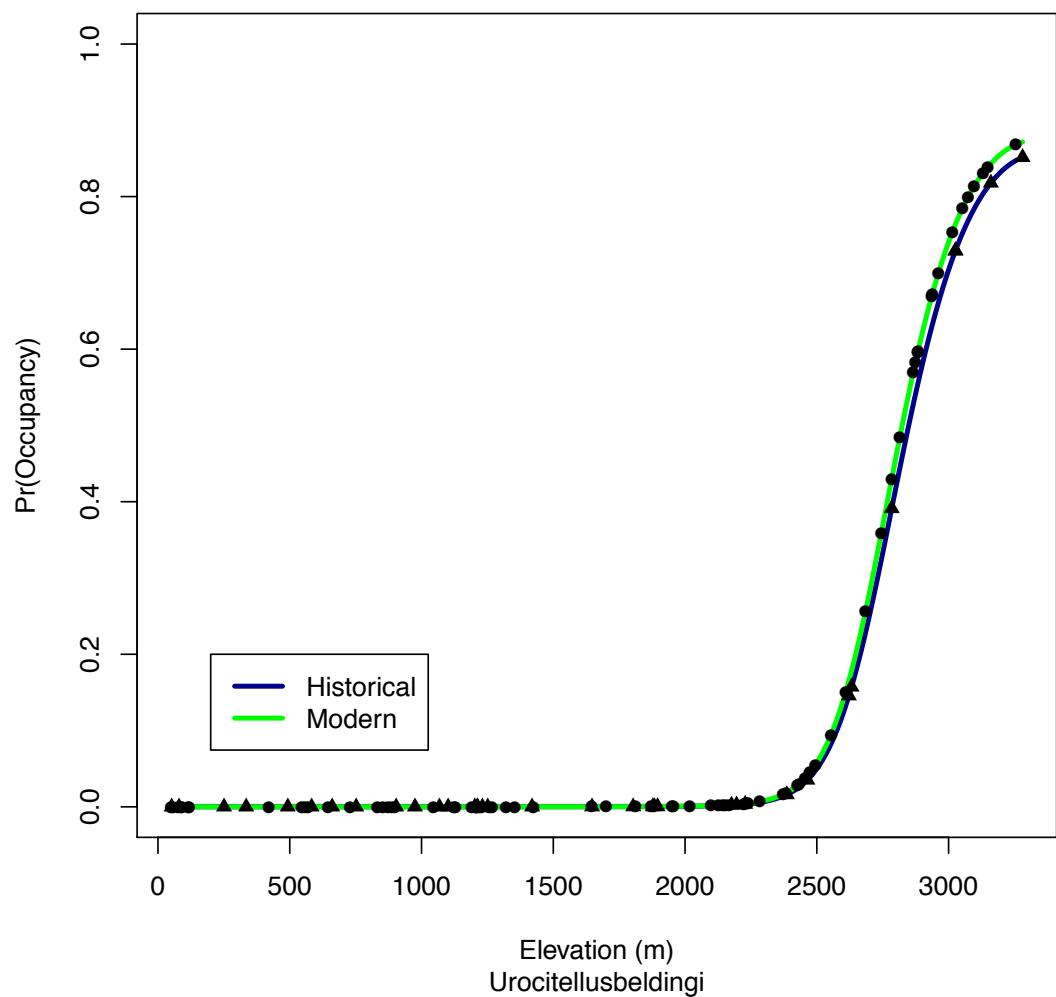
Southern

Sequoia



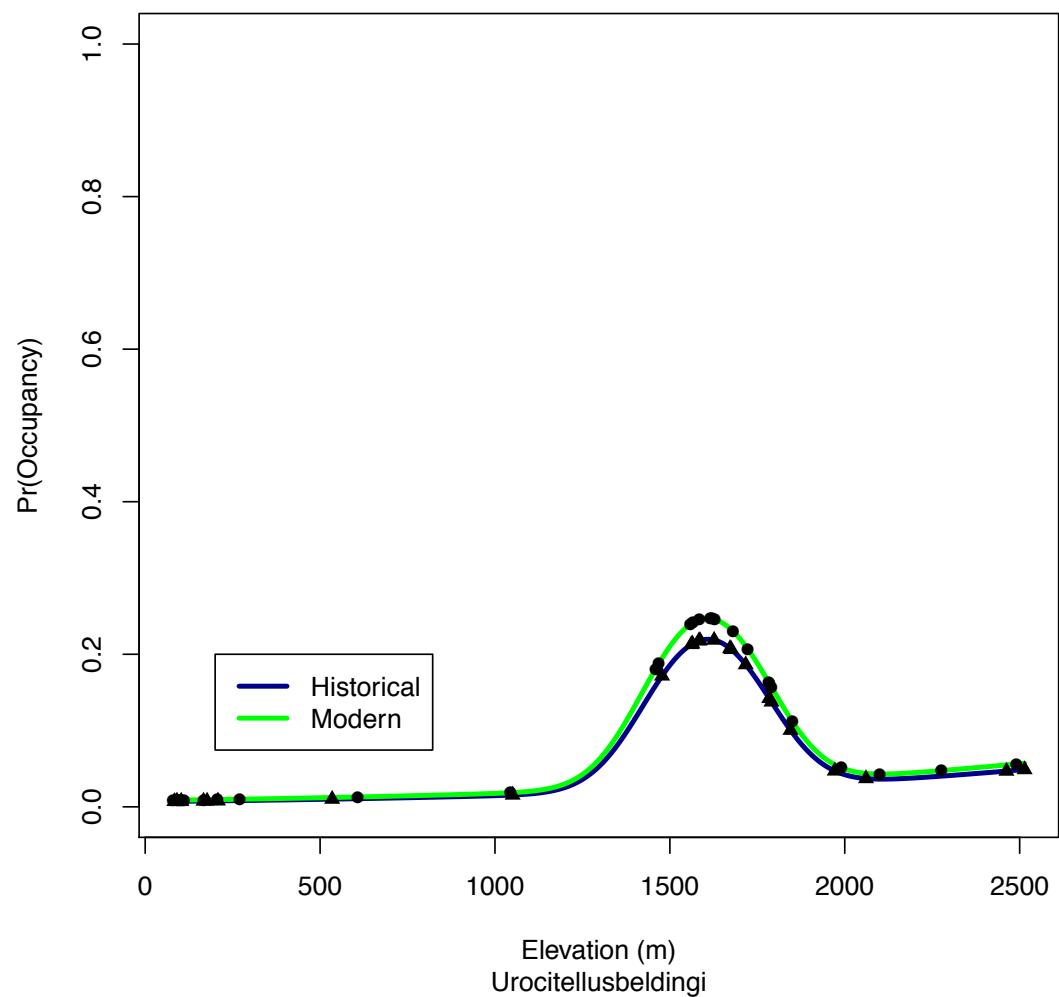
Central

Yosemite



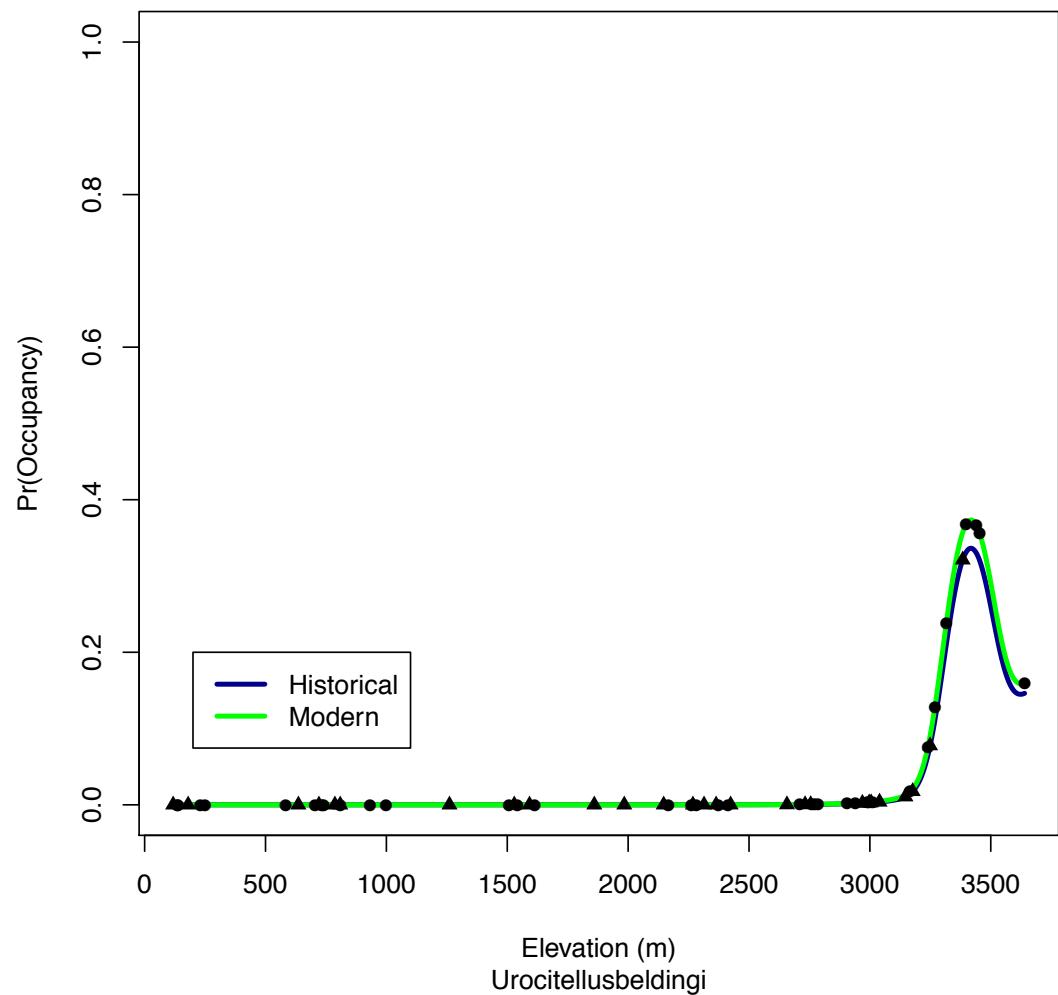
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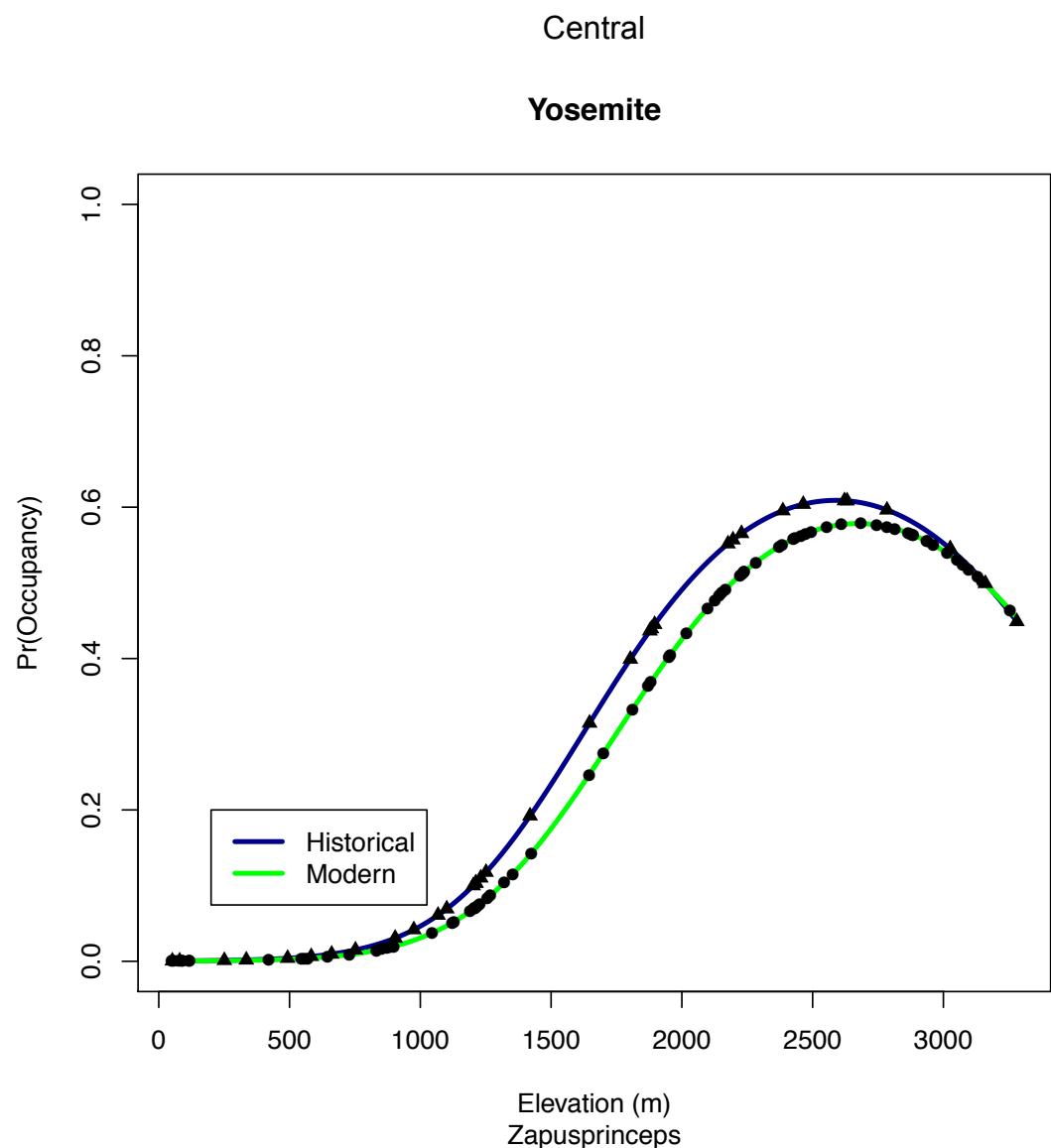
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Southern

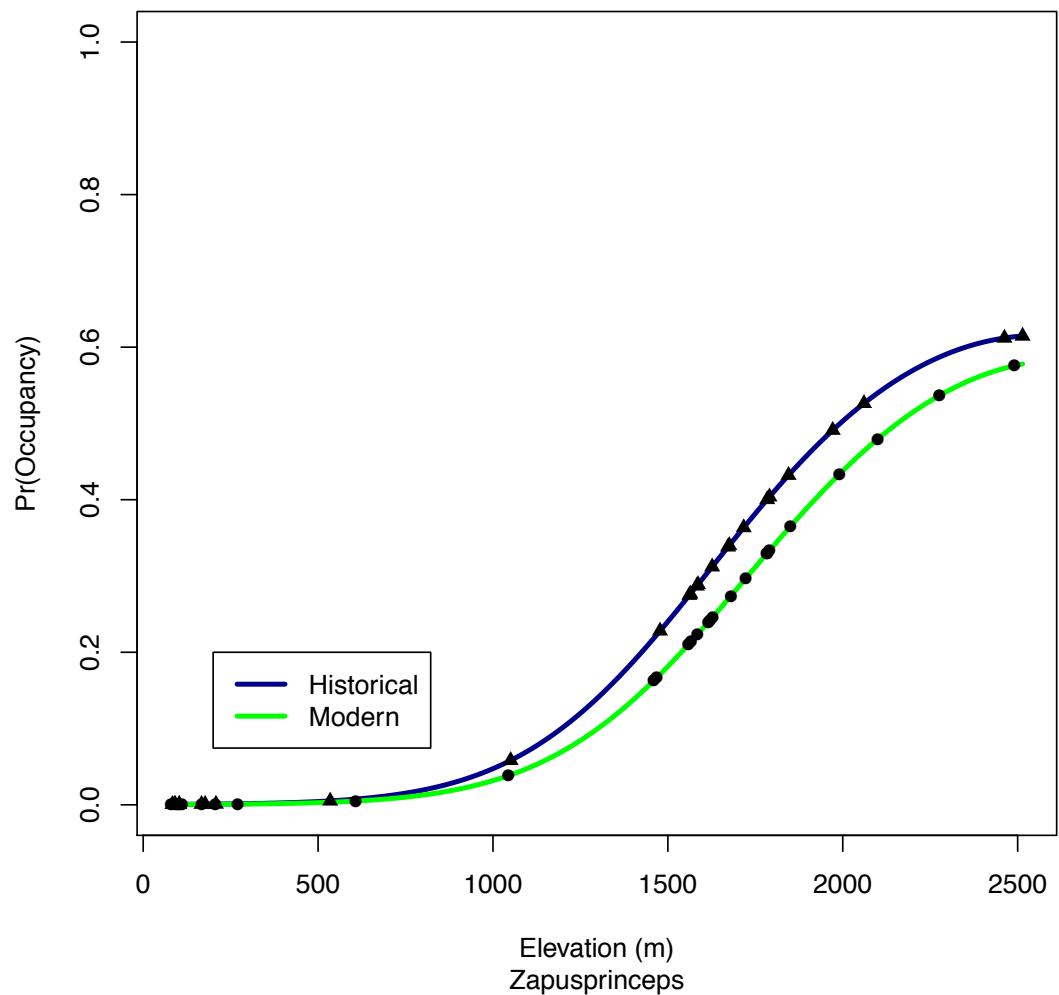
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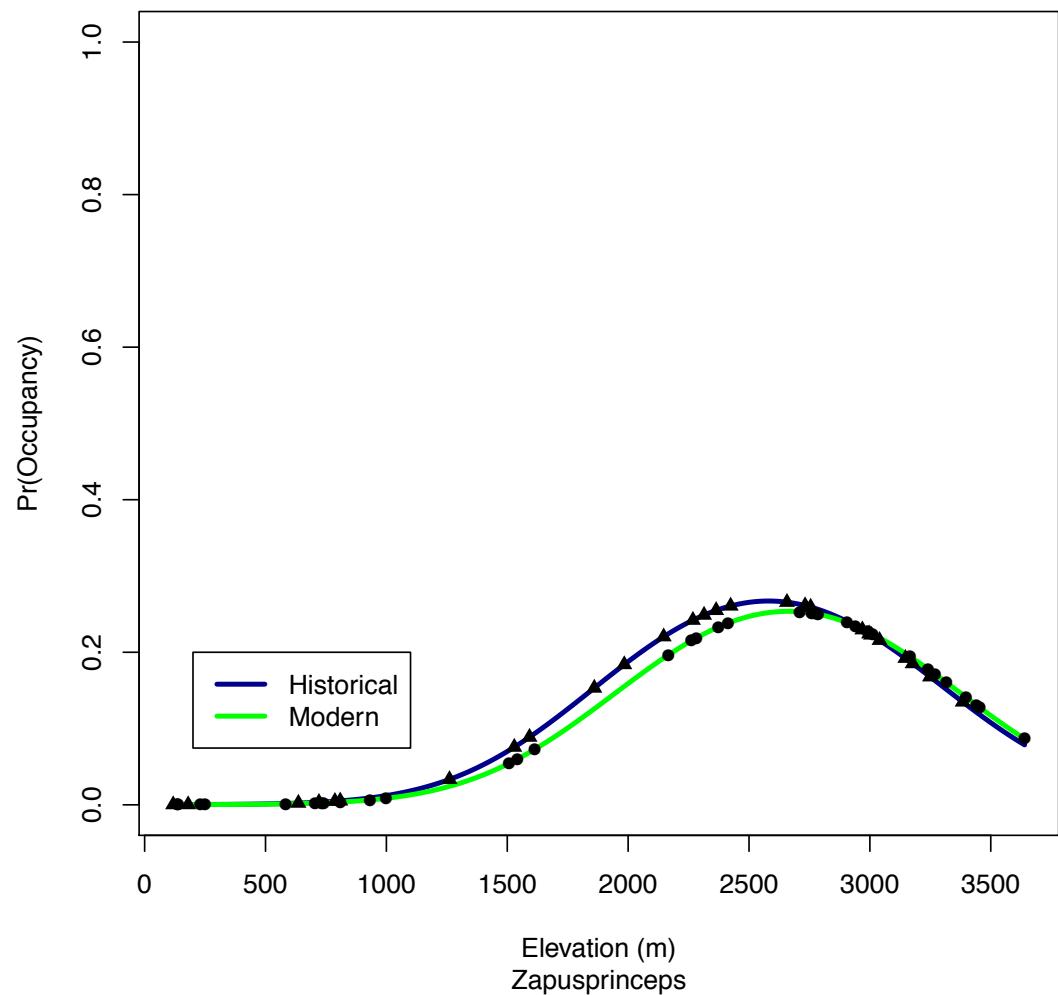
Northern

Lassen



Southern

Sequoia



Elevation (m)
Zapusprinceps