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# North-South differences in GMS Abundances

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Steve Roberts, Centre for Biostatistics, University of Manchester

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### ! Note

Comments and feedback welcome to [steve.roberts@manchester.ac.uk](mailto:steve.roberts@manchester.ac.uk) or [SteveRoberts@live.co.uk](mailto:SteveRoberts@live.co.uk)

## 2 Background

The 2021 State of Britain's Larger Moths report suggested there were differences in trends between Northern and Southern Britain for a number of species, therefore we conducted a secondary analysis estimating trends in the two halves of the country separately.

## 3 Methods

We used the same two-stage methodology as the primary analyse. The annual abundances were estimated allowing different flight periods in the North and South and the trends then estimated in the two halves of the country with bootstrapping used to estimate the confidence intervals and the statistical significance of the difference in trends. We focus on those species with a demonstrably different trend between the North and South - as defined by the bootstrapped P-value<0.05 (i.e. classical statistical significance)

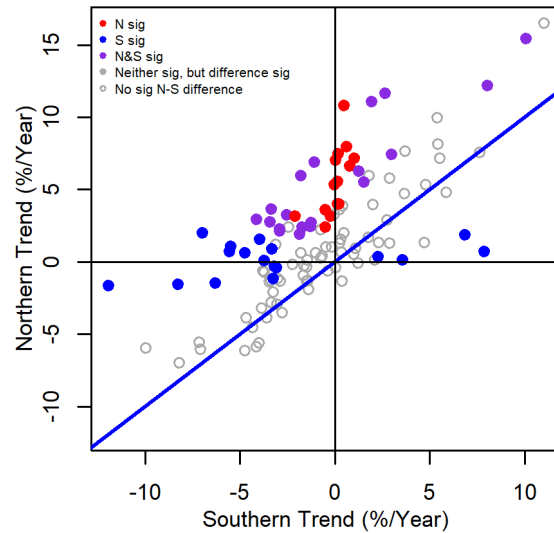
## 4 Species Assessed

127 main season species have potentially sufficient data for a N-S comparison (arbitrarily set at >1000 moths observed in each of the N and S areas). 119 species remaining after exclude those whose flight period extends beyond the GMS main season (exclusions as in the main trend analysis) and 2 species where there are fitting issues due to a lack of 2008 data. None of the winter species have sufficient data to allow us to test for North/South differences.

## 5 Comparing trends between North and South

*Figure 1* below shows the trend estimates in the North compared to the South, with those reaching statistical significance shown with filled symbols:

**Figure 1: Compare North and South trends**



50 / 119 (42%) species show significant N-S trend differences. Nearly all these are showing more positive trends in the North compared to the South.

- 46 species are doing better in the North than the South:
  - 7 species are significantly increasing in both the North and the South but showing much stronger increases in the North (Right hand purple group in the plot above, listed in [Table 1](#))
  - 14 species are significantly increasing in the North but showing no significant change in the South (red in plot above, listed in [Table 2](#))
  - 12 species are significantly increasing in the North and significantly decreasing in the South (Left-hand purple group in plot above, listed in [Table 3](#))
  - 13 species are decreasing in the South but showing no significant change in the North (Left-hand blue group in plot above, listed in [Table 4](#))
- 4 Species are doing better in the North than the South:
  - All these 4 species are increasing in the South but showing no significant change in the North (Right-hand blue group in plot above, listed in [Table 5](#))

**Table 1: Species increasing nationally but more rapidly in the North**

Code	Scientific Name	Common Name	North trend (%/Y)	South trend (%/Y)	NvS P value
63.093	Agriphila straminella	Straw Grass-moth	11.07 (7.71:14.53)	1.94 (0.33:3.58)	<0.001
49.039	Epiphyas postvittana	Light Brown Apple Moth	11.66 (9.65:13.71)	2.66 (1.83:3.49)	<0.001
73.193	Anchoscelis lunosa	Lunar Underwing	15.43 (12.28:18.68)	10.08 (9.04:11.12)	0.038
72.045	Eilema lurideola	Common Footman	6.24 (4.34:8.17)	1.26 (0.49:2.03)	0.002
73.357	Xestia xanthographa	Square-spot Rustic	7.42 (5.67:9.20)	2.98 (2.20:3.76)	0.004
69.016	Deilephila elpenor	Elephant Hawk-moth	12.18 (9.80:14.62)	8.04 (7.08:9.02)	0.048
63.025	Anania hortulata	Small Magpie	5.49 (3.26:7.78)	1.54 (0.67:2.41)	0.014

**Table 2: Species increasing in the North but no significant change in the South**

Code	Scientific Name	Common Name	North trend (%/Y)	South trend (%/Y)	NvS P value
73.359	Xestia c-nigrum	Setaceous Hebrew Character	10.78 (8.46:13.15)	0.48 (-0.38:1.34)	<0.001
73.325	Agrotis puta	Shuttle-shaped Dart	7.95 (5.38:10.57)	0.61 (-0.26:1.49)	<0.001
73.187	Anchoscelis litura	Brown-spot Pinion	7.48 (3.70:11.41)	0.18 (-1.89:2.28)	0.010
70.061	Epirrhoe alternata	Common Carpet	7.01 (5.26:8.79)	0.03 (-0.86:0.93)	<0.001
70.277	Cabera pusaria	Common White Wave	7.15 (4.48:9.89)	1.04 (-0.23:2.32)	0.004
63.038	Patania ruralis	Mother of Pearl	6.63 (4.53:8.77)	0.80 (-0.10:1.71)	<0.001
73.267	Lacanobia oleracea	Bright-line Brown-eye	5.57 (3.78:7.39)	0.15 (-0.64:0.95)	<0.001
73.338	Lycophotia porphyrea	True Lover's Knot	5.34 (2.40:8.37)	-0.04 (-2.23:2.19)	0.018
73.264	Lacanobia thalassina	Pale-shouldered Brocade	3.16 (0.63:5.76)	-2.10 (-4.41:0.26)	0.036
73.317	Agrotis exclamationis	Heart and Dart	3.61 (2.08:5.15)	-0.51 (-1.20:0.19)	<0.001
73.298	Mythimna ferrago	Clay	3.98 (1.48:6.53)	0.14 (-0.88:1.18)	0.018
70.016	Idaea aversata	Riband Wave	3.98 (2.75:5.21)	0.21 (-0.34:0.77)	<0.001
69.003	Laotohe populi	Poplar Hawk-moth	3.14 (1.82:4.48)	-0.24 (-0.93:0.45)	0.002
70.243	Ourapteryx sambucaria	Swallow-tailed Moth	2.39 (0.34:4.48)	-0.49 (-1.44:0.46)	0.022

**Table 3: Species increasing significantly in the North while decreasing significantly in the South**

Code	Scientific Name	Common Name	North trend (%/Y)	South trend (%/Y)	NvS P value
73.069	Xylocampa areola	Early Grey	6.89 (5.12:8.68)	-1.09 (-1.83:-0.35)	<0.001
73.064	Amphipyra tragopoginis	Mouse Moth	5.94 (3.40:8.54)	-1.80 (-3.47:-0.09)	<0.001
73.328	Axylia putris	Flame	2.94 (0.94:4.99)	-4.13 (-4.95:-3.30)	<0.001
73.216	Cosmia trapezina	Dun-bar	3.62 (1.33:5.95)	-3.36 (-4.32:-2.38)	<0.001
72.053	Herminia tarsipennalis	Fan-foot	2.74 (0.56:4.96)	-3.40 (-4.46:-2.32)	<0.001
70.094	Ecliptopera silaceata	Small Phoenix	3.22 (1.11:5.37)	-2.55 (-3.65:-1.44)	0.002
73.123	Hydraecia micacea	Rosy Rustic	2.27 (0.63:3.95)	-2.89 (-3.93:-1.84)	<0.001
72.019	Spilosoma lutea	Buff Ermine	2.14 (0.41:3.90)	-2.92 (-3.67:-2.17)	<0.001
72.002	Rivula sericealis	Straw Dot	2.39 (0.32:4.50)	-1.71 (-2.70:-0.71)	<0.001
71.013	Notodonta ziczac	Pebble Prominent	2.72 (0.20:5.30)	-1.24 (-2.44:-0.01)	0.018
73.342	Noctua pronuba	Large Yellow Underwing	1.88 (0.73:3.05)	-1.85 (-2.40:-1.30)	<0.001
70.053	Xanthorhoe designata	Flame Carpet	2.44 (0.77:4.13)	-1.27 (-2.31:-0.23)	0.020

**Table 4: Species decreasing in the South but no significant change in the North**

Code	Scientific Name	Common Name	North trend (%/Y)	South trend (%/Y)	NvS P value
73.206	Lithophane leautieri	Blair's Shoulder-knot	-1.65 (-4.19:0.95)	-11.93 (-13.07:-10.77)	<0.001
73.250	Anorthoa munda	Twin-spotted Quaker	1.99 (-1.62:5.74)	-6.97 (-8.46:-5.45)	<0.001
73.353	Xestia baja	Dotted Clay	-1.57 (-3.44:0.35)	-8.26 (-10.29:-6.18)	0.002
73.361	Xestia triangulum	Double Square-spot	1.06 (-0.92:3.07)	-5.47 (-6.50:-4.44)	<0.001
65.009	Habrosyne pyritoides	Buff Arches	0.70 (-2.07:3.54)	-5.54 (-6.74:-4.32)	<0.001
73.182	Cirrhia icteritia	Sallow	1.55 (-1.53:4.73)	-3.96 (-5.55:-2.34)	0.002
70.241	Crocallis elinguarua	Scalloped Oak	0.63 (-0.89:2.17)	-4.74 (-5.47:-4.00)	<0.001
73.084	Bryophila domestica	Marbled Beauty	-1.47 (-3.45:0.56)	-6.29 (-7.27:-5.30)	<0.001
72.020	Spilosoma lubricipeda	White Ermine	0.89 (-0.86:2.67)	-3.32 (-4.21:-2.42)	0.008
70.237	Selenia dentaria	Early Thorn	0.06 (-1.61:1.76)	-3.72 (-4.52:-2.91)	<0.001
73.329	Ochropleura plecta	Flame Shoulder	-0.33 (-1.83:1.20)	-3.17 (-3.84:-2.48)	0.002
73.249	Orthosia gothica	Hebrew Character	-0.43 (-1.64:0.80)	-3.09 (-3.71:-2.46)	0.002
70.097	Dysstroma truncata	Common Marbled Carpet	-1.17 (-2.54:0.21)	-3.23 (-3.93:-2.52)	0.024

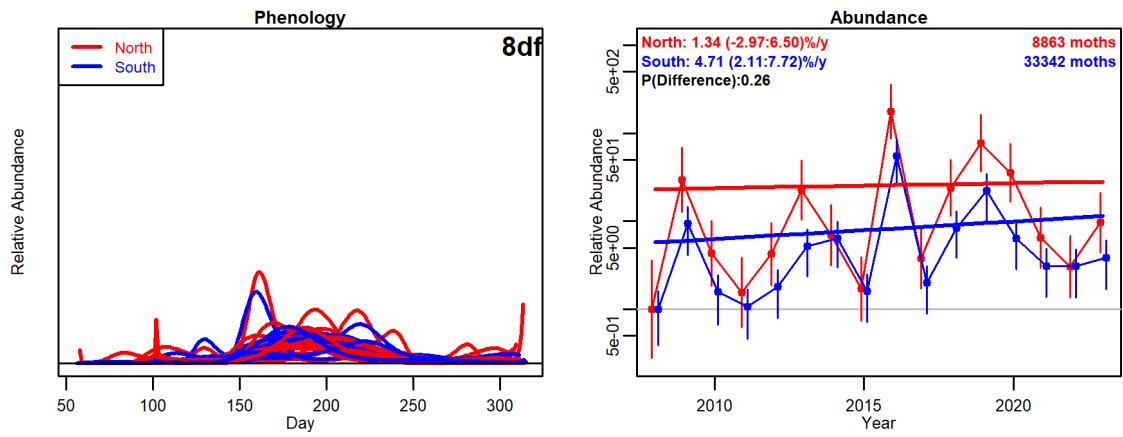
**Table 5: Species doing better in the South: increasing in the South but no significant change in the North**

Code	Scientific Name	Common Name	North trend (%/Y)	South trend (%/Y)	NvS P value
70.226	Opisthograptis luteolata	Brimstone Moth	0.36 (-0.84:1.57)	2.27 (1.72:2.83)	0.038
70.283	Campaea margaritaria	Light Emerald	0.14 (-1.65:1.97)	3.56 (2.68:4.45)	0.004
73.219	Atethmia centrugo	Centre-barred Sallow	1.86 (-1.00:4.81)	6.86 (5.36:8.38)	0.026
73.291	Mythimna pallens	Common Wainscot	0.72 (-1.97:3.49)	7.86 (6.66:9.08)	<0.001

## 6 Individual species plots

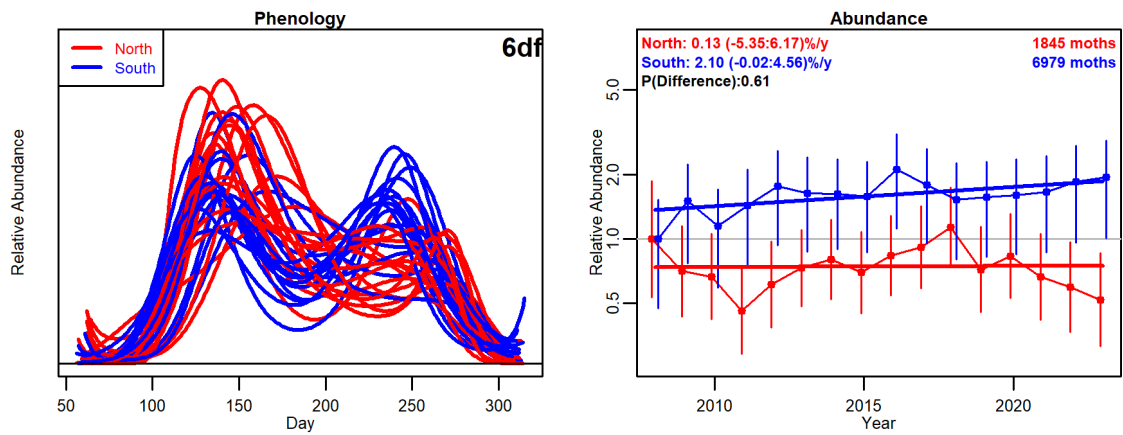
The plots below show the phenology (for each year) and trends for the North and South. Note there are some artefacts in the phenology plots which do not materially affect the trend estimates but reflect a bit of over-fitting to a few outlying observations.

Figure 2



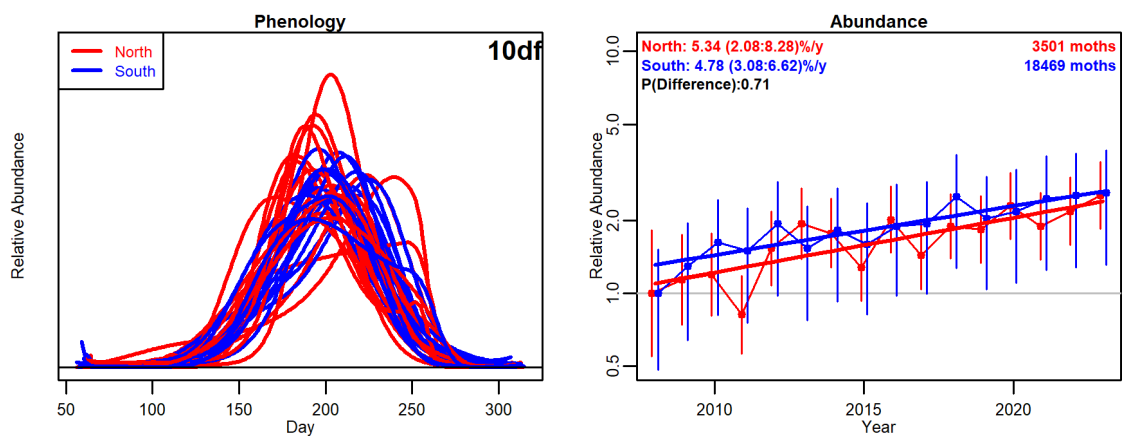
18.001: Diamond-back Moth (*Plutella xylostella*)

Figure 3



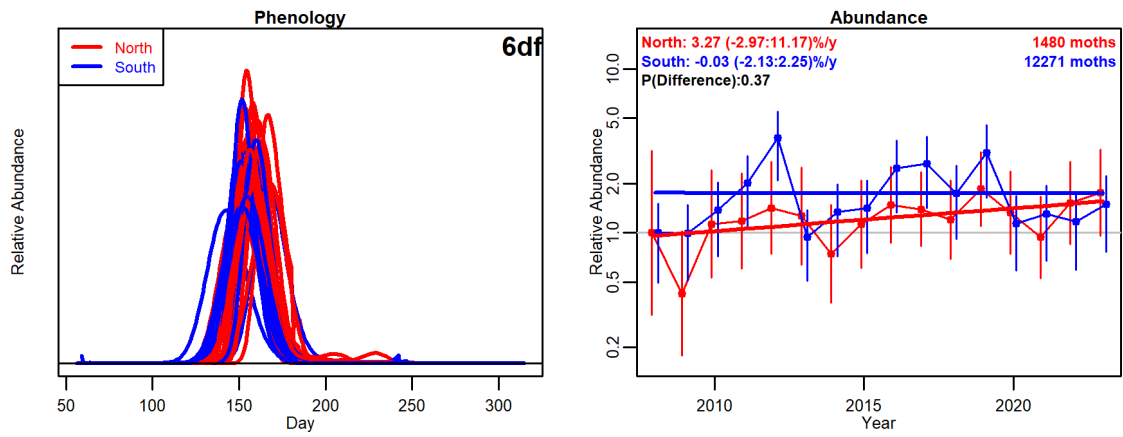
28.009: White-shouldered House-moth (*Endrosis sarcitrella*)

Figure 4



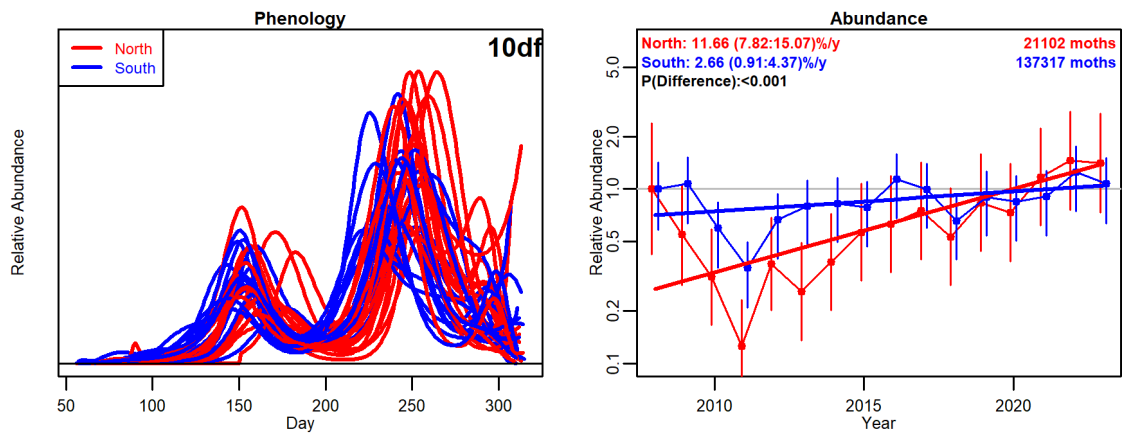
28.010: Brown House-moth (*Hofmannophila pseudospretella*)

Figure 5



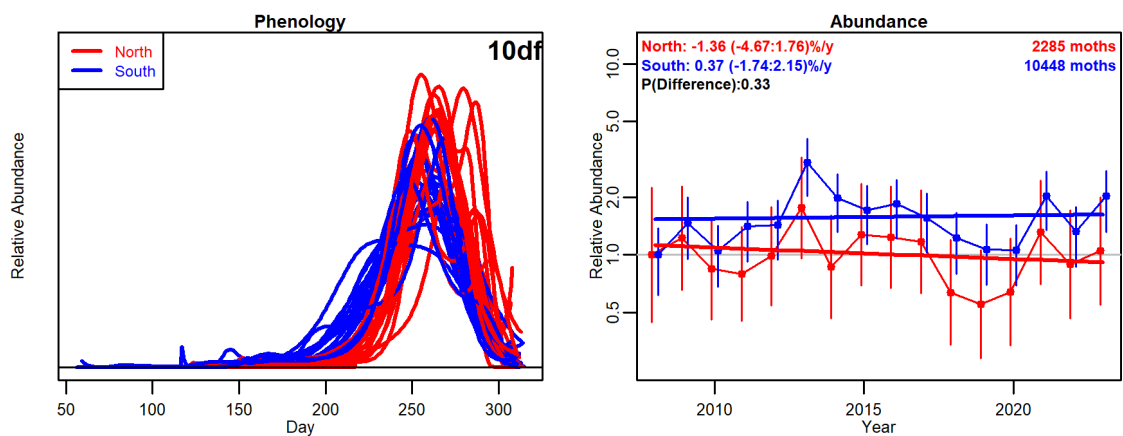
3.002: Common Swift (*Korscheltellus lupulina*)

Figure 6



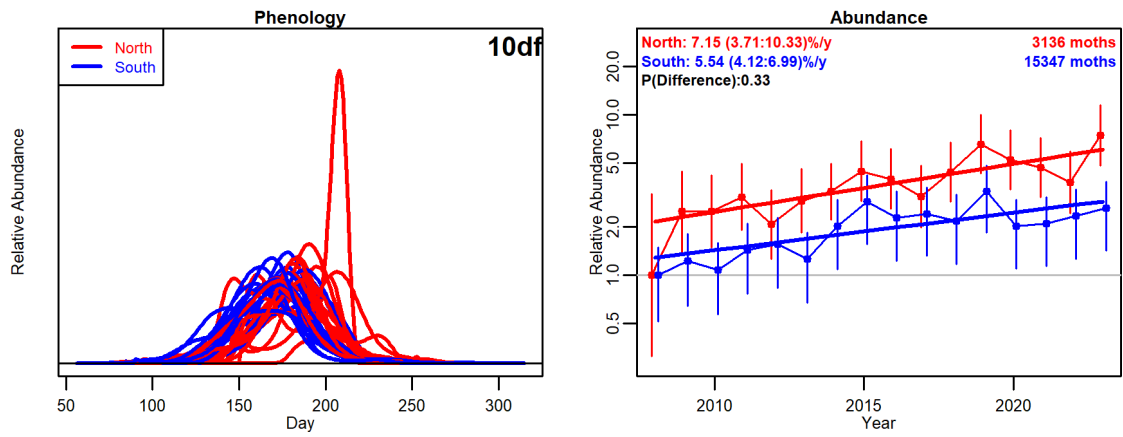
49.039: Light Brown Apple Moth (*Epiphyas postvittana*)

Figure 7



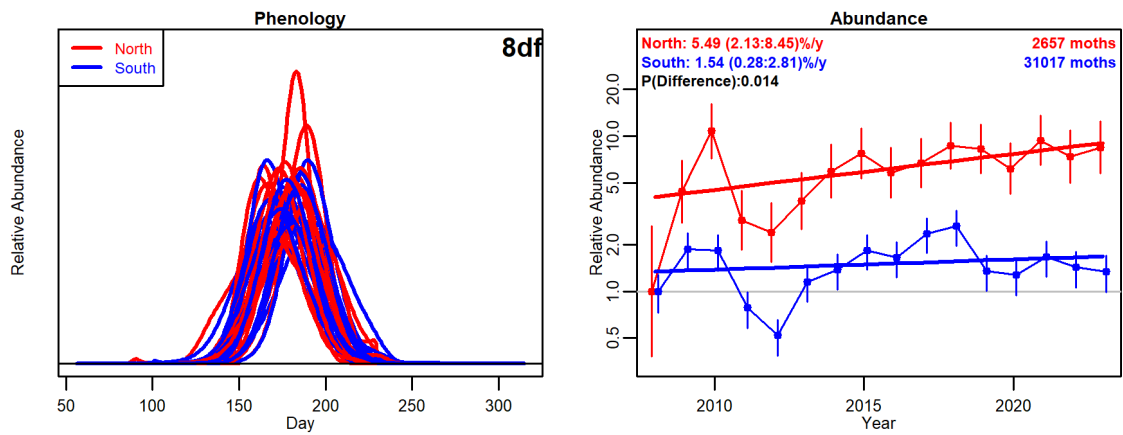
49.077: Garden Rose Tortrix (*Acleris variegana*)

Figure 8



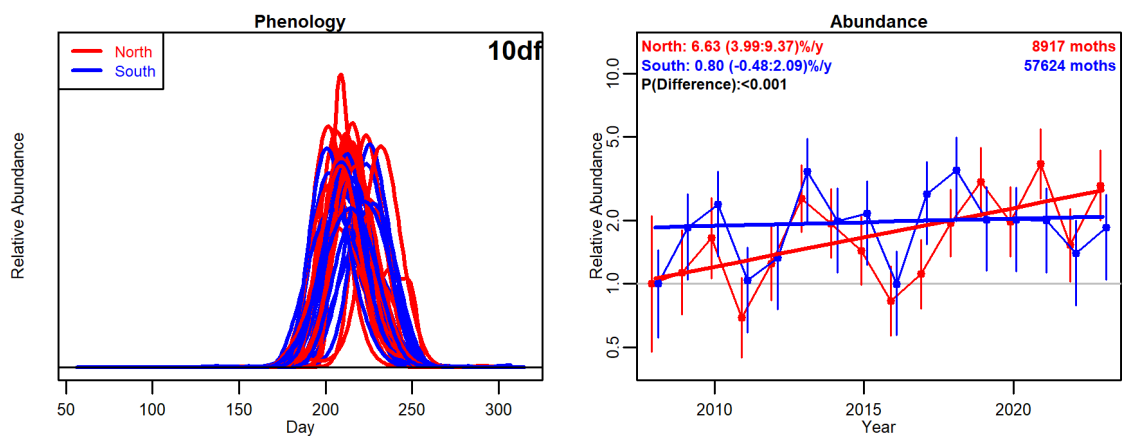
62.001: Bee Moth (*Aphomia sociella*)

Figure 9



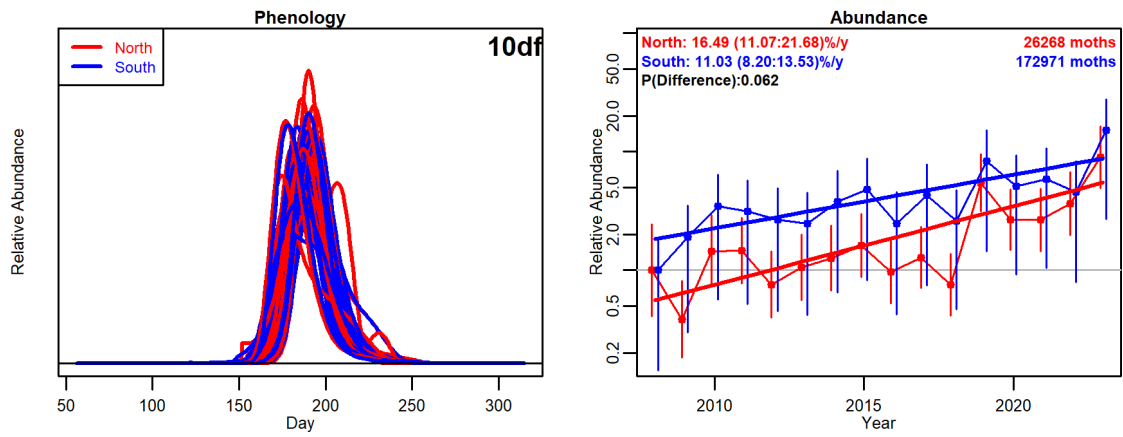
63.025: Small Magpie (*Anania hortulata*)

Figure 10



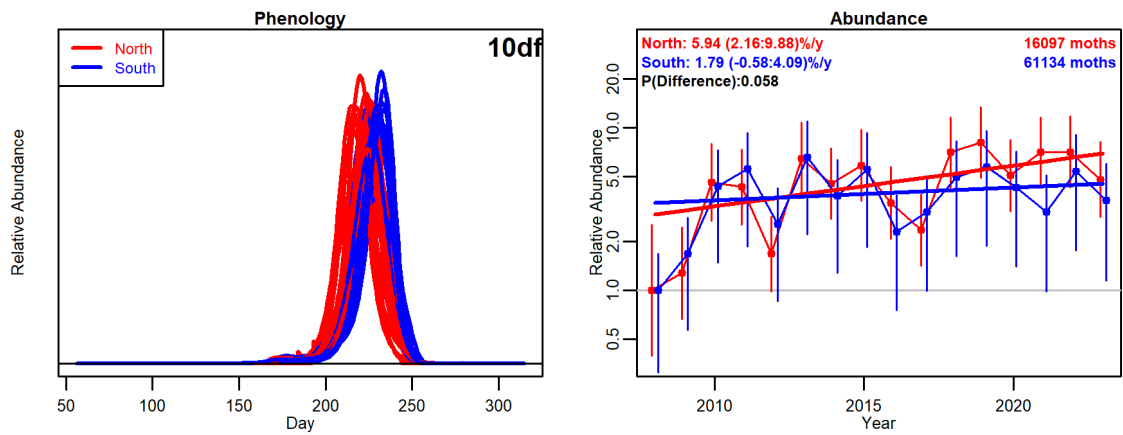
63.038: Mother of Pearl (*Patania ruralis*)

Figure 11



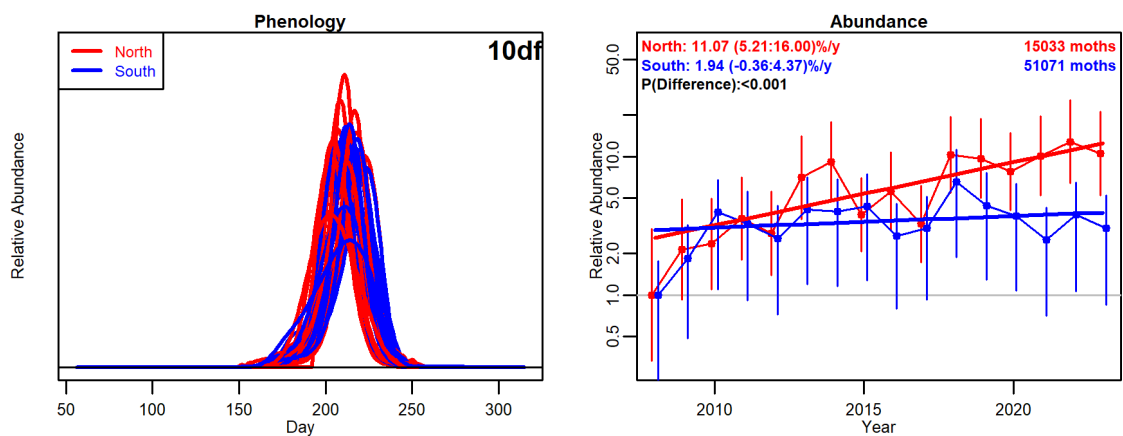
63.080: Garden Grass-veener (*Chrysoteuchia culmella*)

Figure 12



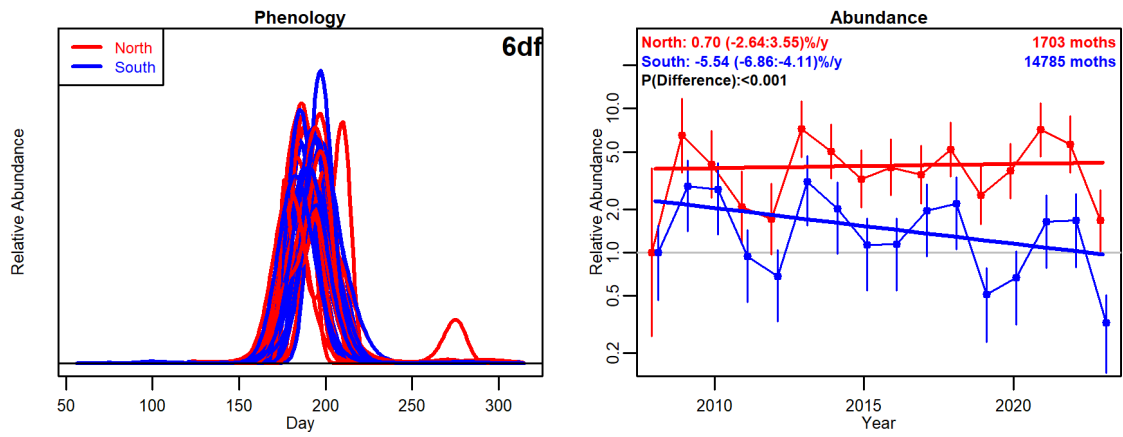
63.089: Common Grass-moth (*Agriphila tristella*)

Figure 13



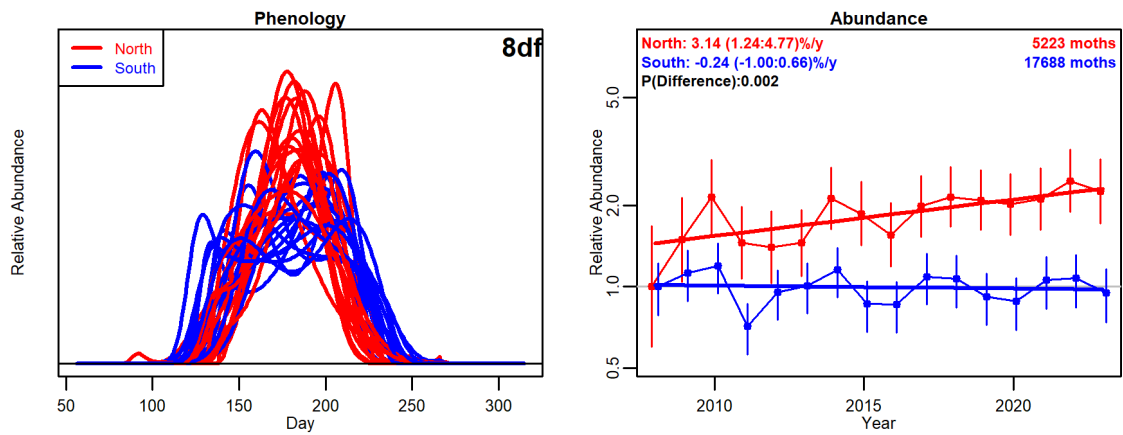
63.093: Straw Grass-moth (*Agriphila straminella*)

Figure 14



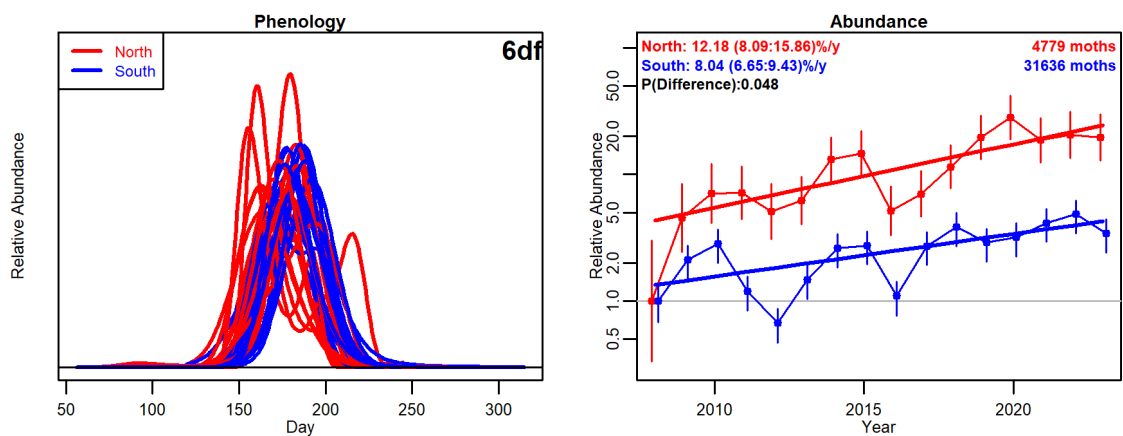
65.009: Buff Arches (*Habrosyne pyritoides*)

Figure 15



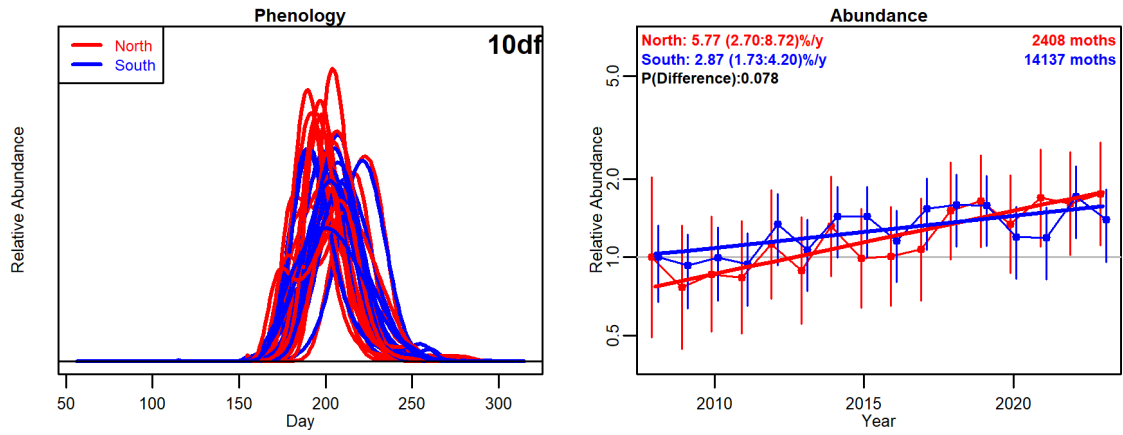
69.003: Poplar Hawk-moth (*Laothoe populi*)

Figure 16



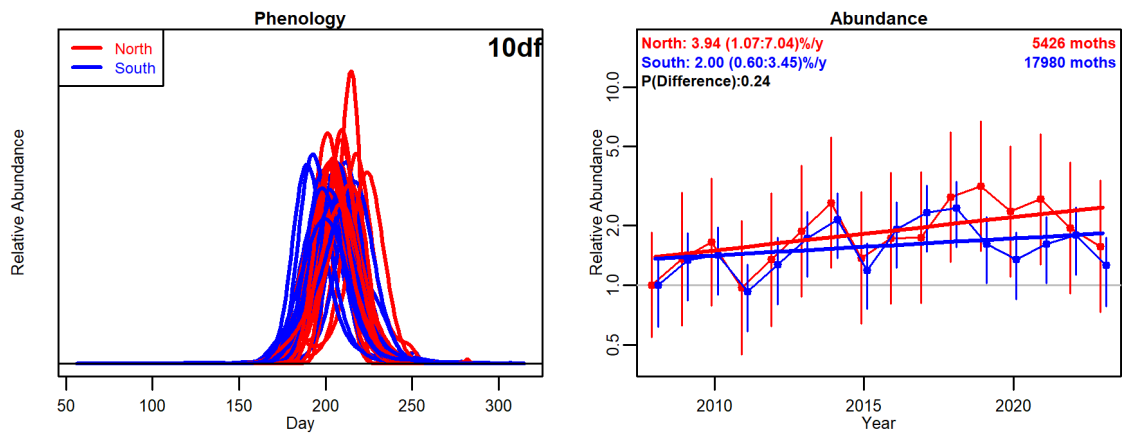
69.016: Elephant Hawk-moth (*Deilephila elpenor*)

Figure 17



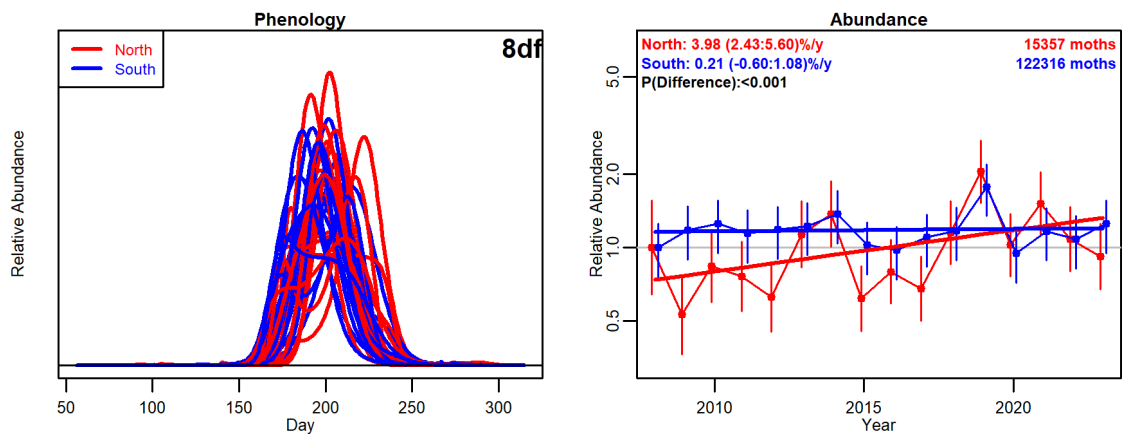
70.011: Single-dotted Wave (*Idaea dimidiata*)

Figure 18



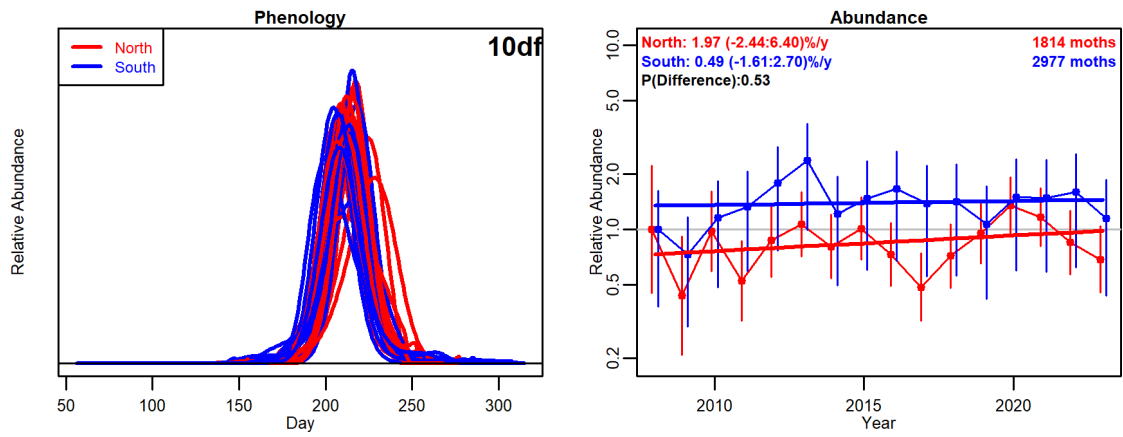
70.013: Small Fan-footed Wave (*Idaea biselata*)

Figure 19



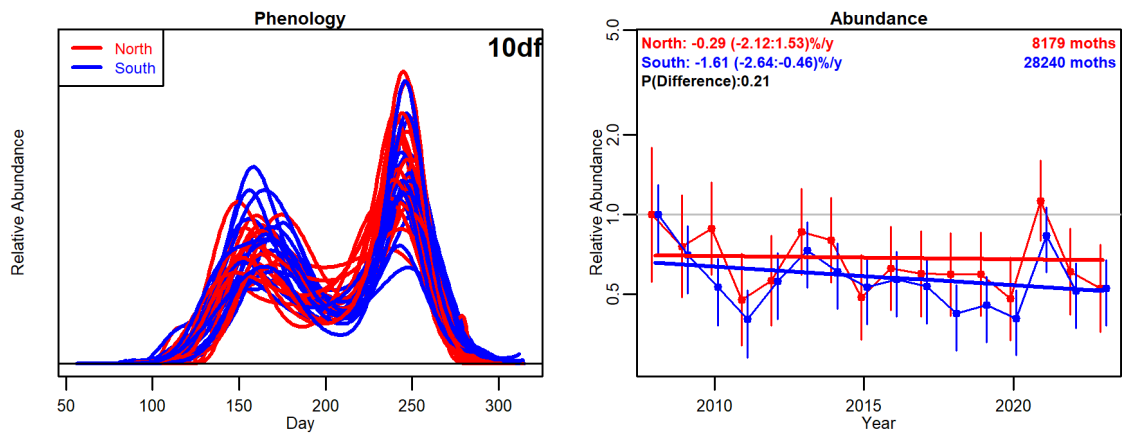
70.016: Riband Wave (*Idaea aversata*)

Figure 20



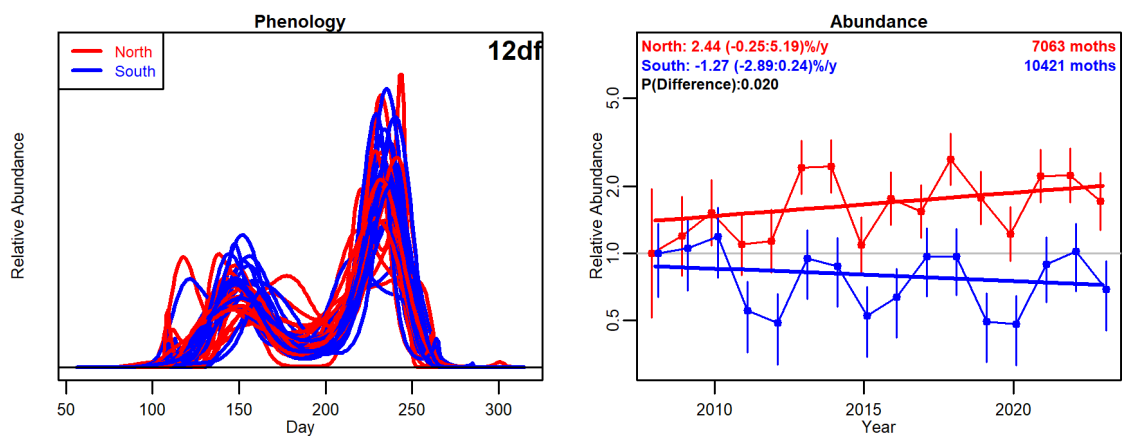
70.045: Shaded Broad-bar (*Scotopteryx chenopodiata*)

Figure 21



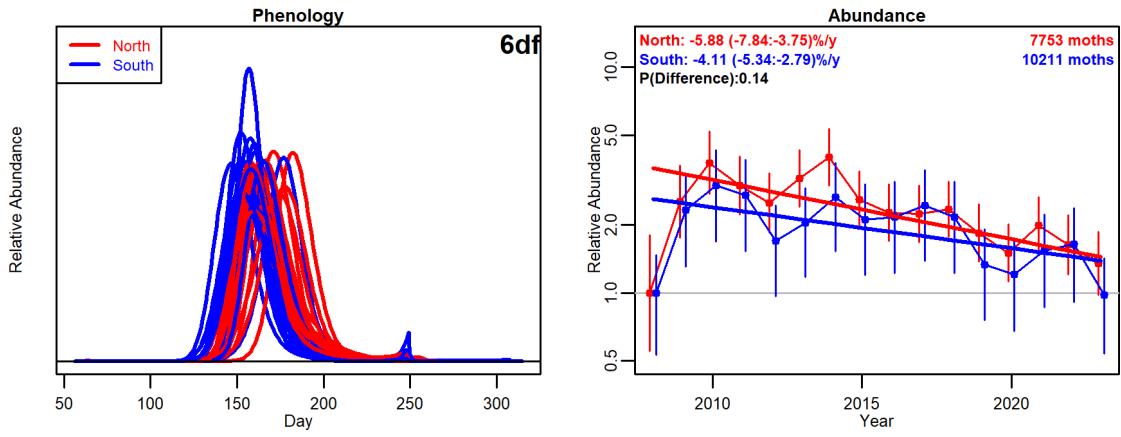
70.049: Garden Carpet (*Xanthorhoe fluctuata*)

Figure 22



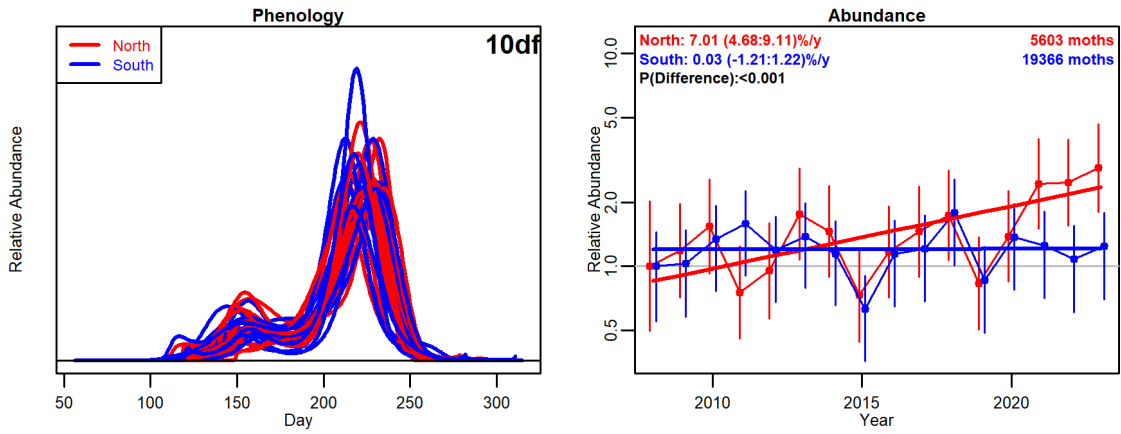
70.053: Flame Carpet (*Xanthorhoe designata*)

Figure 23



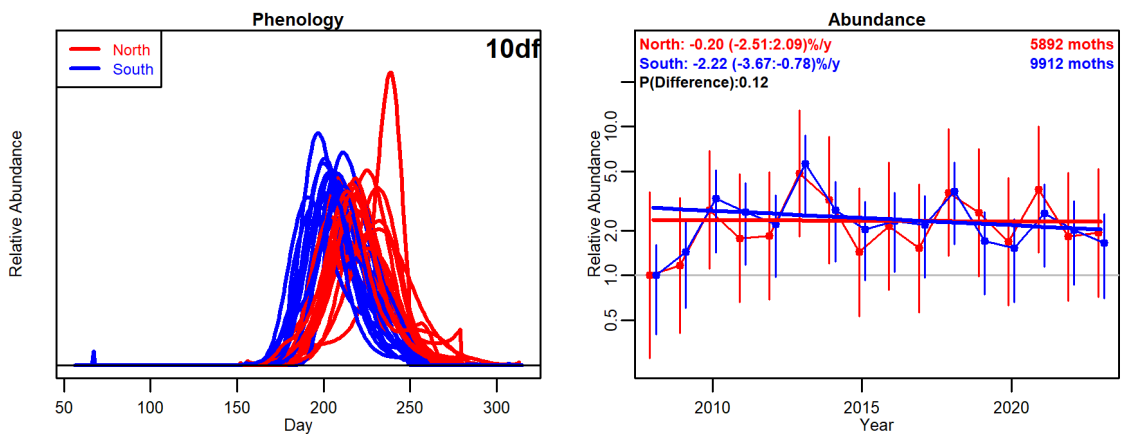
70.054: Silver-ground Carpet (*Xanthorhoe montanata*)

Figure 24



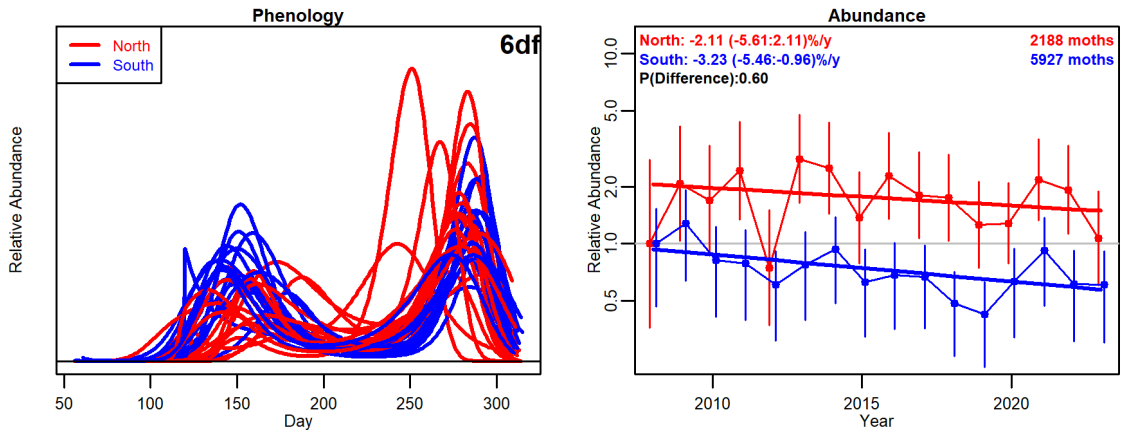
70.061: Common Carpet (*Epirrhoe alternata*)

Figure 25



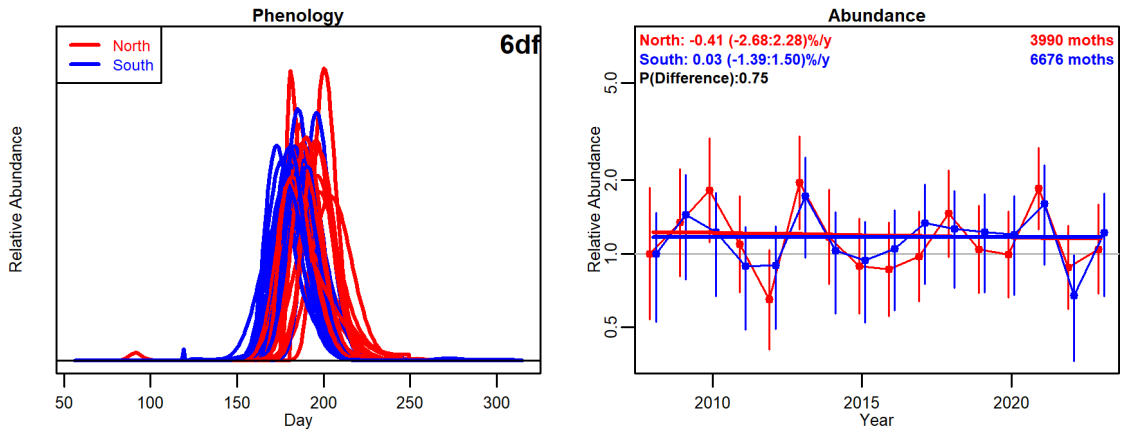
70.074: July Highflyer (*Hydriomena furcata*)

Figure 26



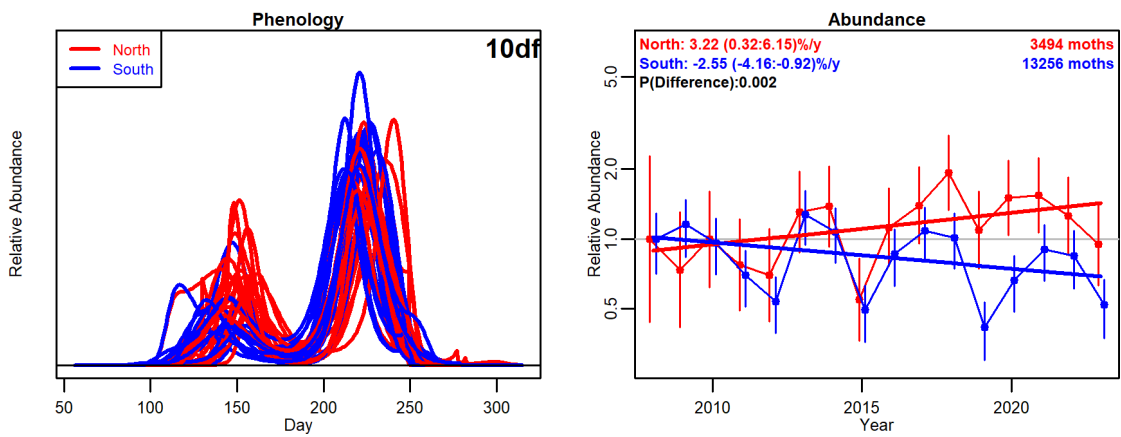
70.081: Grey Pine Carpet (*Thera obeliscata*)

Figure 27



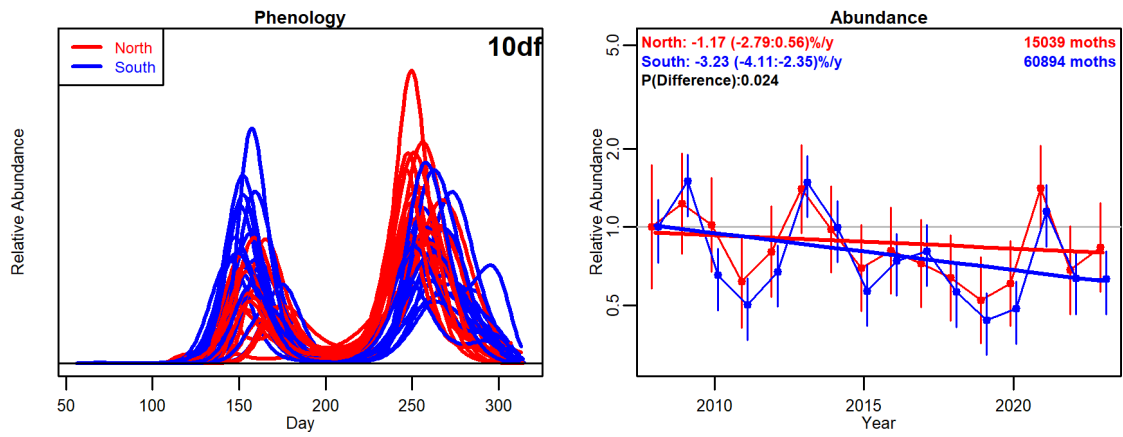
70.093: Barred Straw (*Gandaritis pyraliata*)

Figure 28



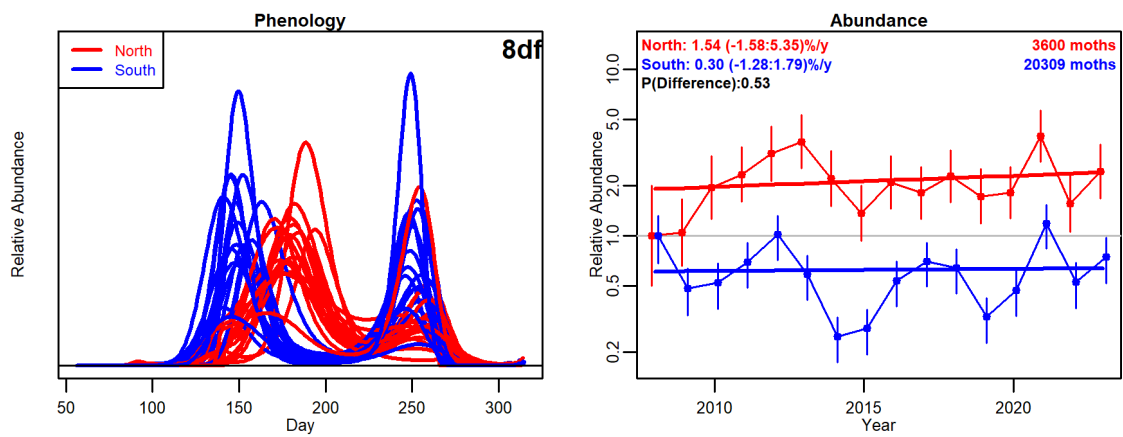
70.094: Small Phoenix (*Ecliptopera silaceata*)

Figure 29



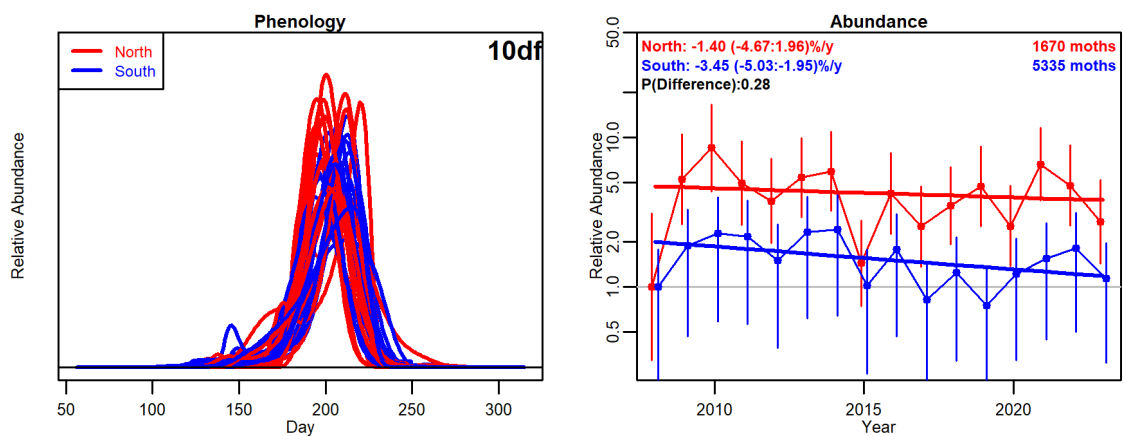
70.097: Common Marbled Carpet (*Dysstroma truncata*)

Figure 30



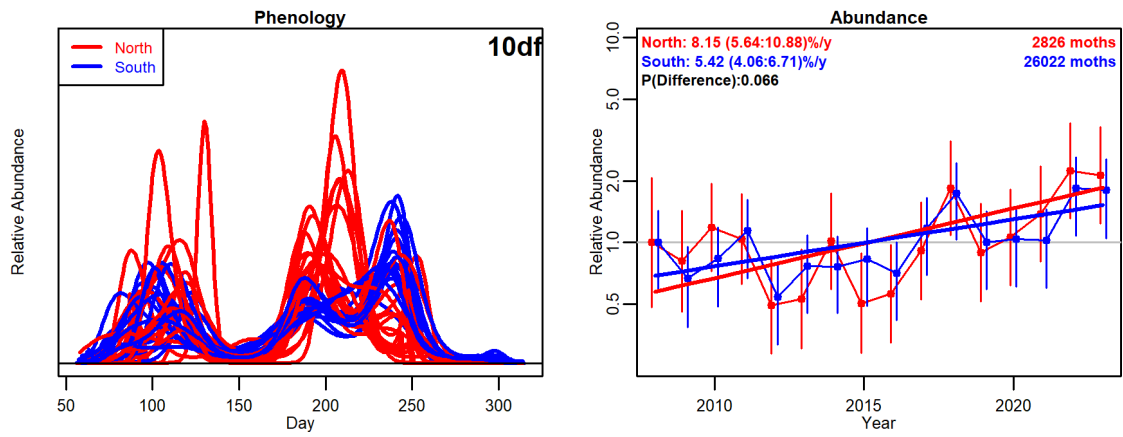
70.100: Green Carpet (*Colostygia pectinataria*)

Figure 31



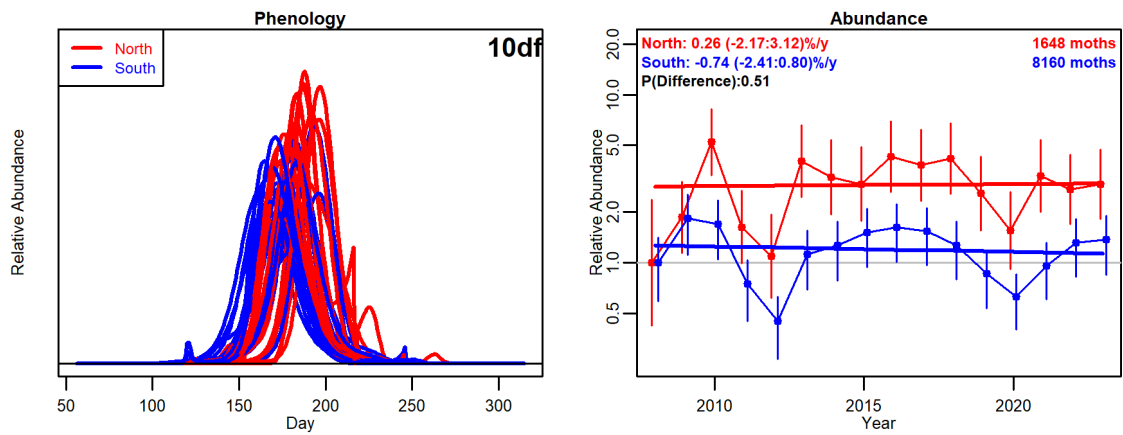
70.133: Small Rivulet (*Perizoma alchemillata*)

Figure 32



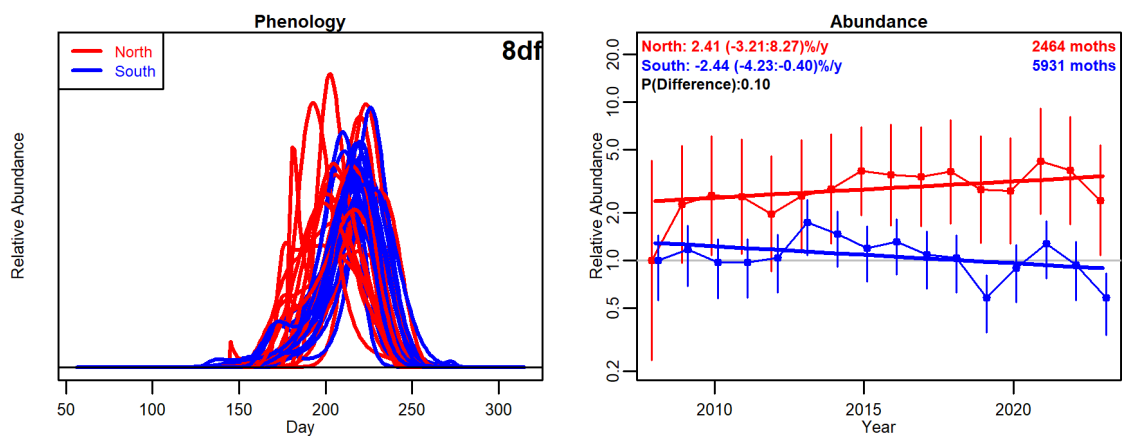
70.141: Double-striped Pug (*Gymnoscelis rufifasciata*)

Figure 33



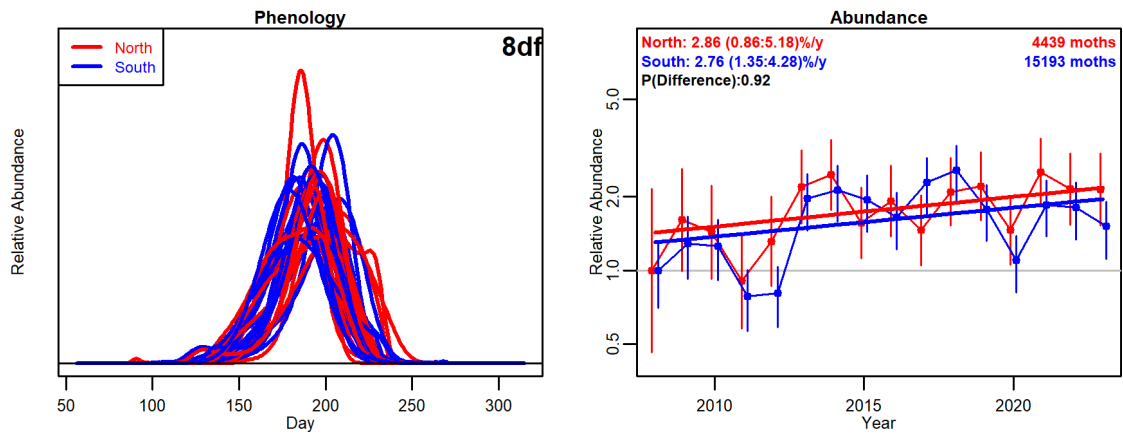
70.144: Green Pug (*Pasiphila rectangularata*)

Figure 34



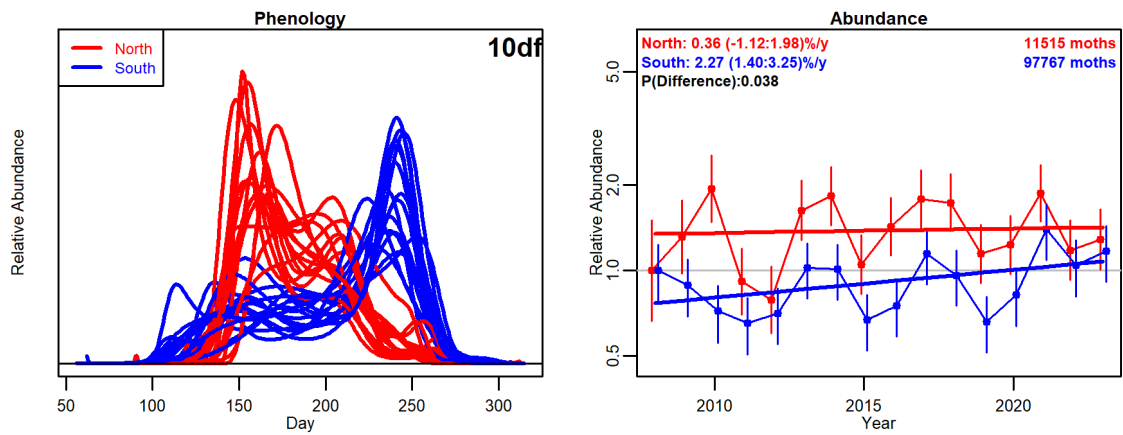
70.205: Magpie Moth (*Abraxas grossulariata*)

Figure 35



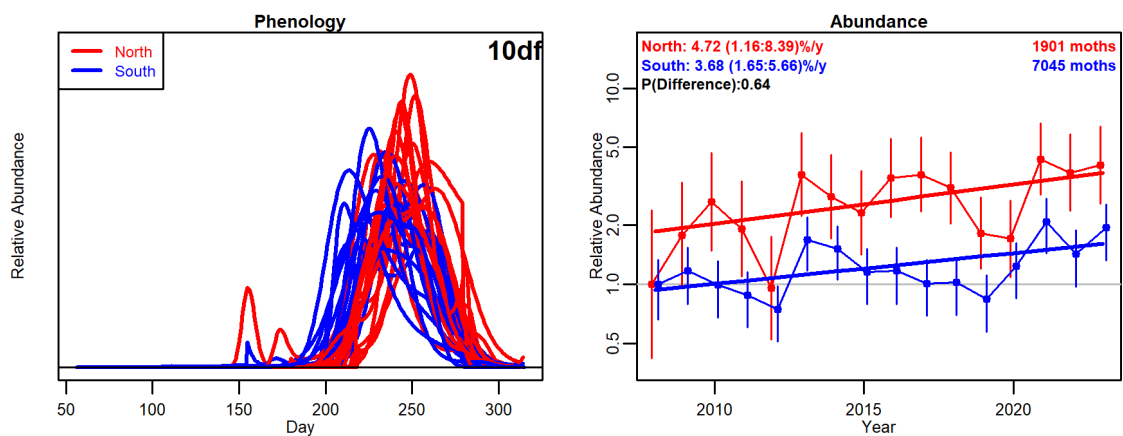
70.207: Clouded Border (*Lomaspilis marginata*)

Figure 36



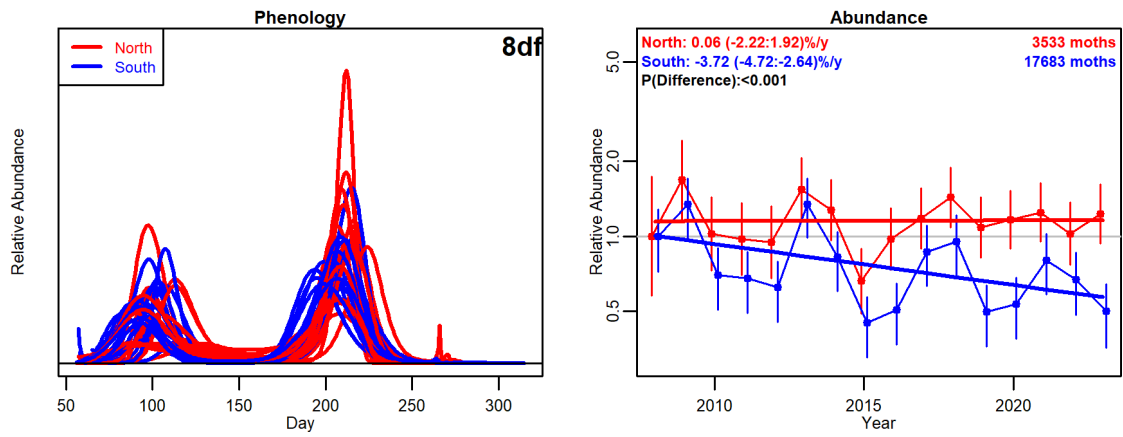
70.226: Brimstone Moth (*Opisthograptis luteolata*)

Figure 37



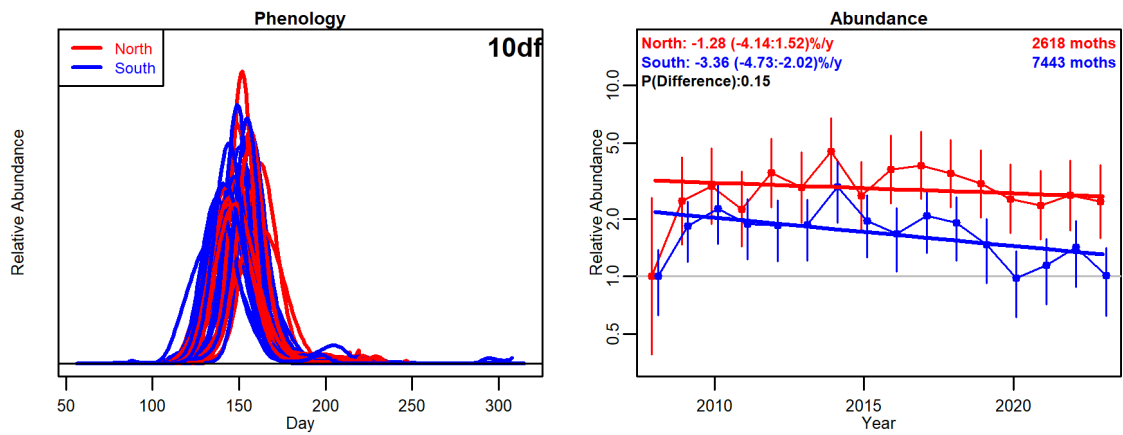
70.234: Canary-shouldered Thorn (*Ennomos alniaria*)

Figure 38



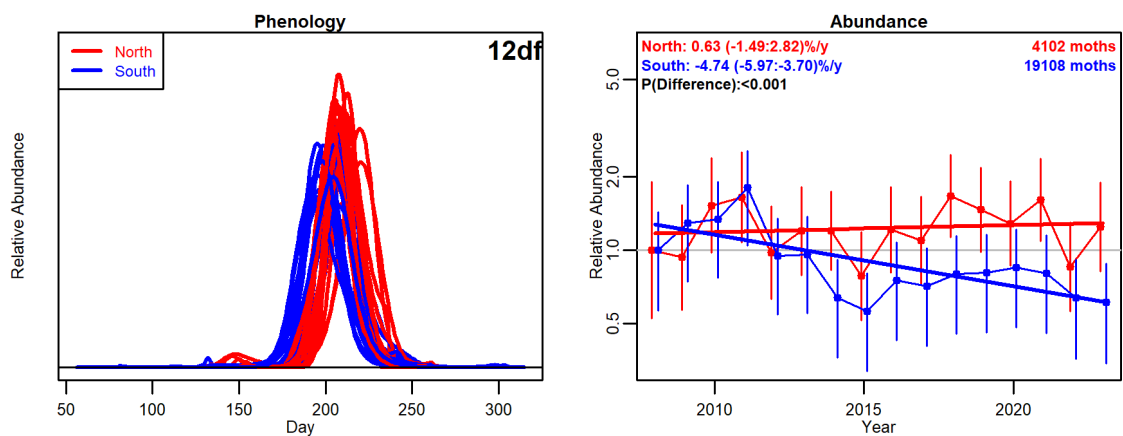
70.237: Early Thorn (*Selenia dentaria*)

Figure 39



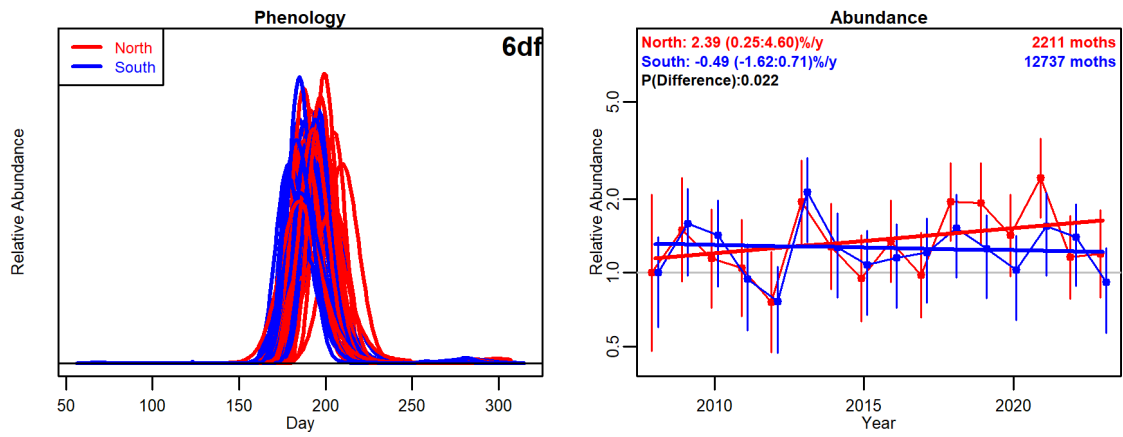
70.240: Scalloped Hazel (*Odontopera bidentata*)

Figure 40



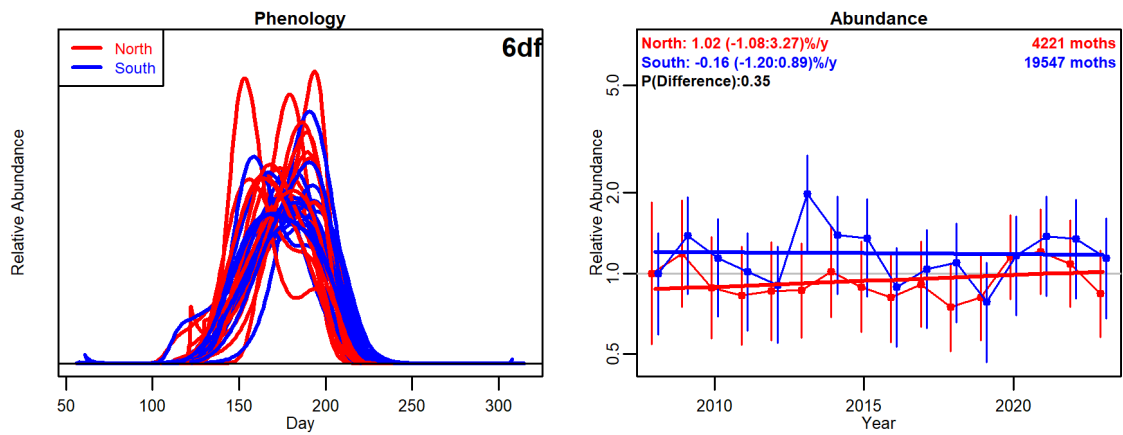
70.241: Scalloped Oak (*Crocallis elinguaris*)

Figure 41



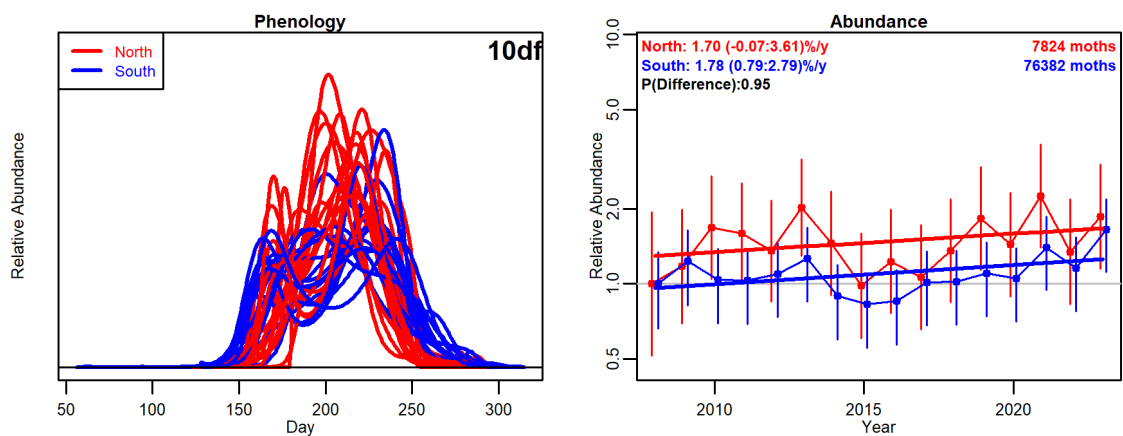
70.243: Swallow-tailed Moth (*Ourapteryx sambucaria*)

Figure 42



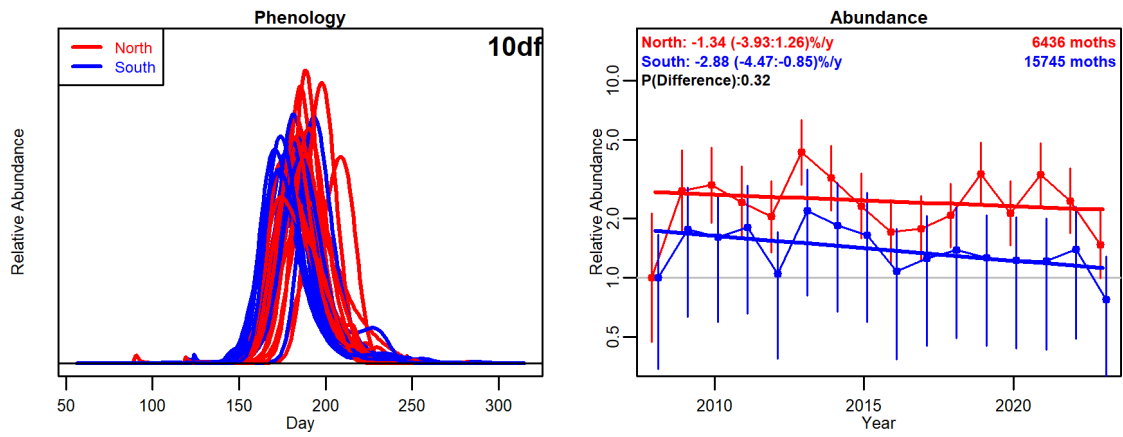
70.252: Peppered Moth (*Biston betularia*)

Figure 43



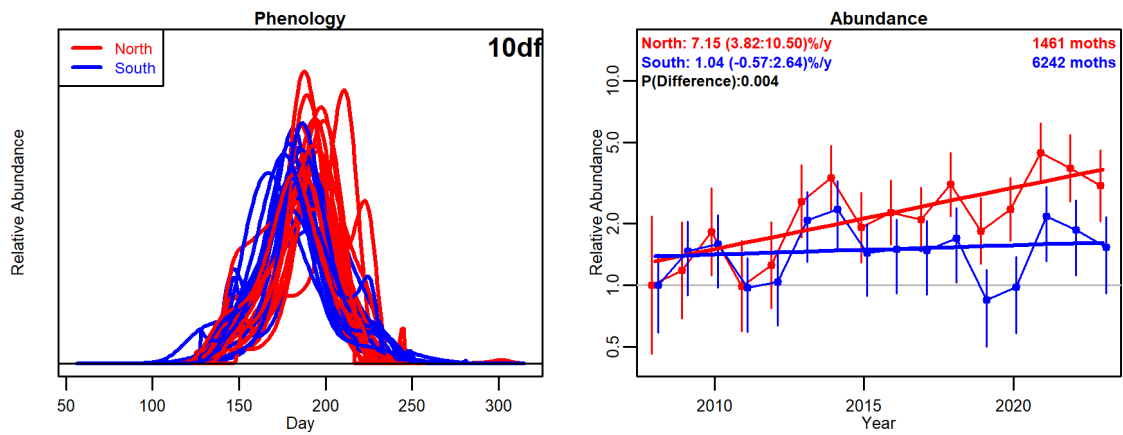
70.258: Willow Beauty (*Peribatodes rhomboidaria*)

Figure 44



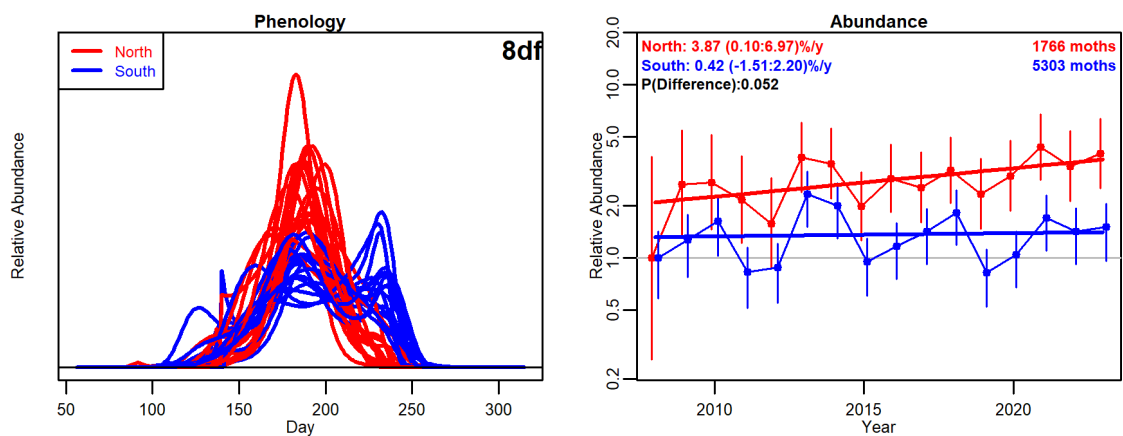
70.265: Mottled Beauty (*Alcis repandata*)

Figure 45



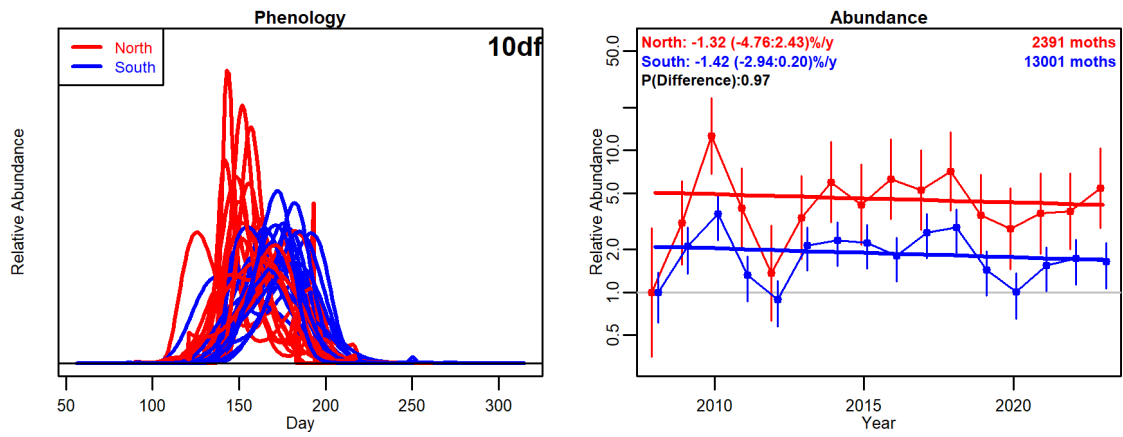
70.277: Common White Wave (*Cabera pusaria*)

Figure 46



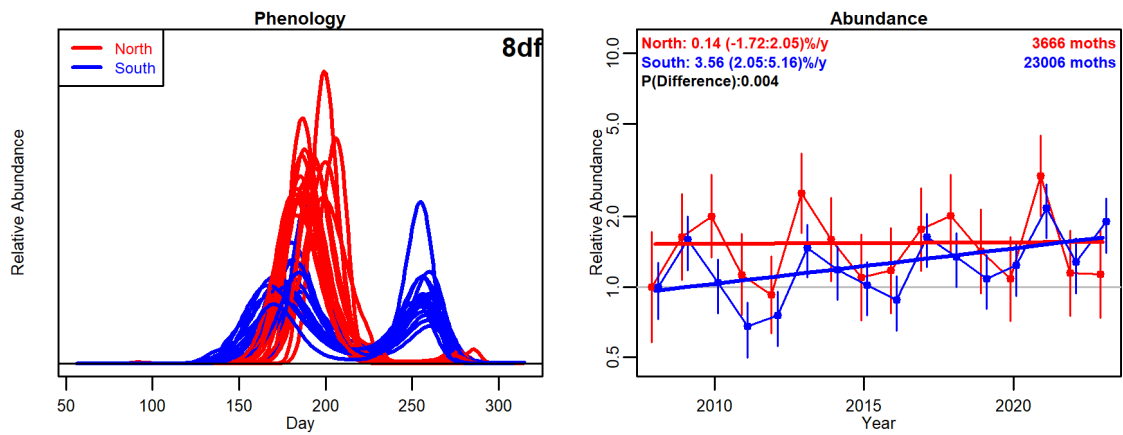
70.278: Common Wave (*Cabera exanthemata*)

Figure 47



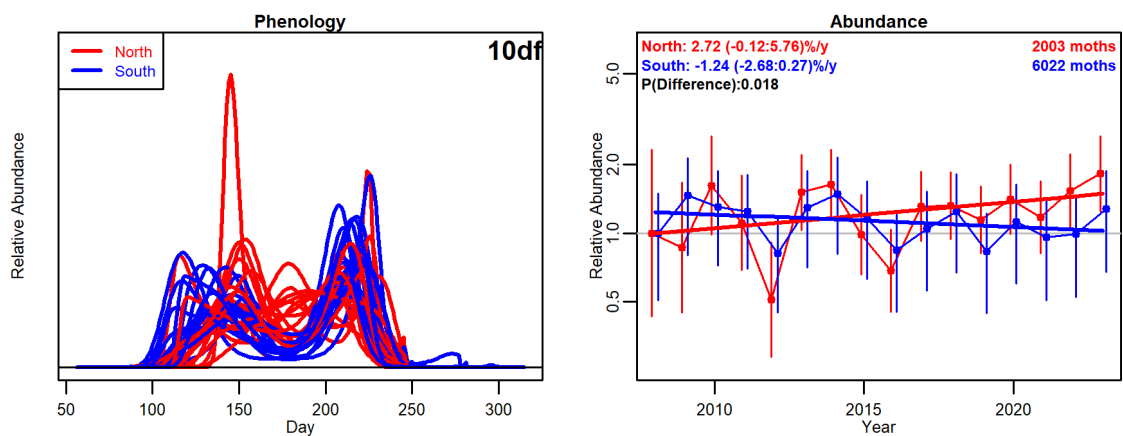
70.280: Clouded Silver (*Lomographa temerata*)

Figure 48



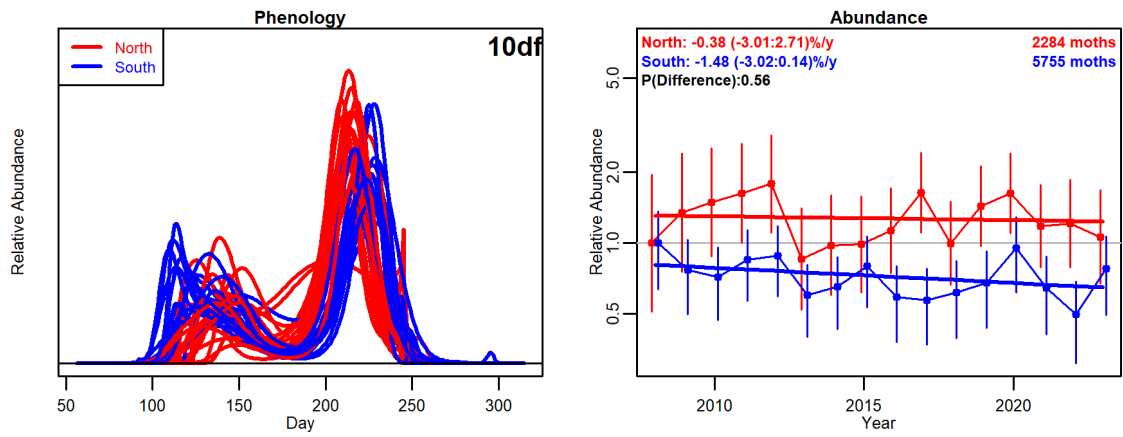
70.283: Light Emerald (*Campaea margaritaria*)

Figure 49



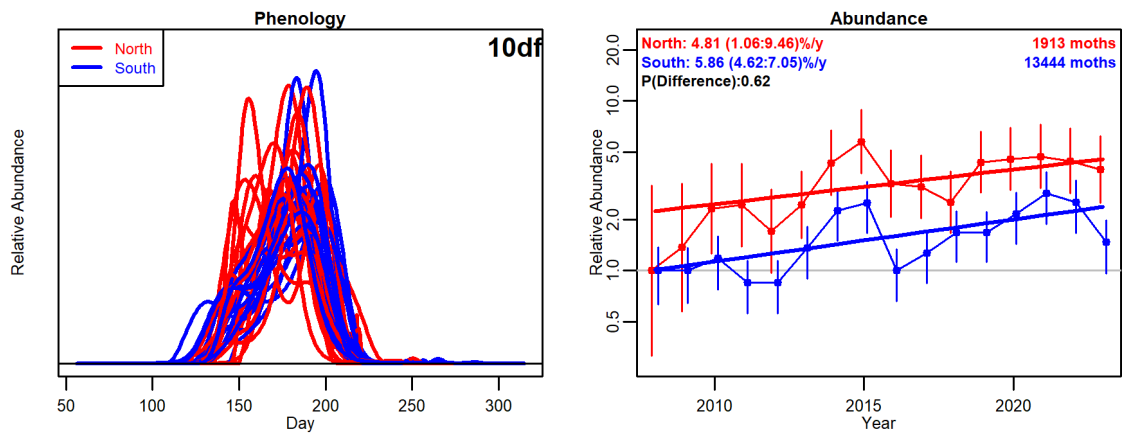
71.013: Pebble Prominent (*Notodonta ziczac*)

Figure 50



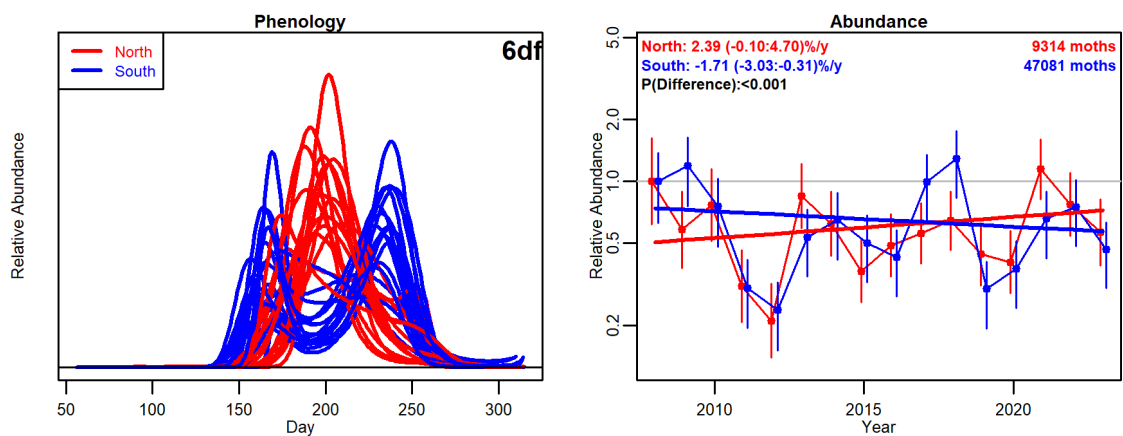
71.018: Lesser Swallow Prominent (*Pheosia gnoma*)

Figure 51



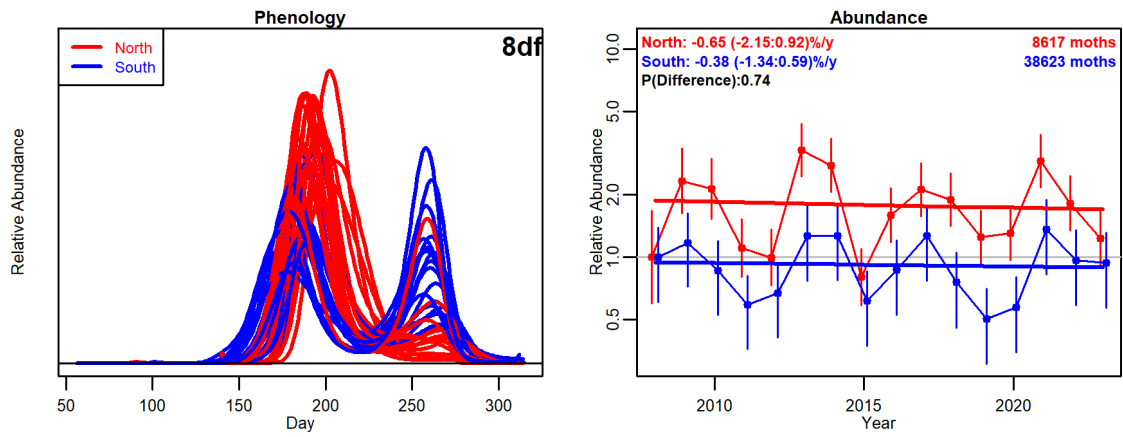
71.025: Buff-tip (*Phalera bucephala*)

Figure 52



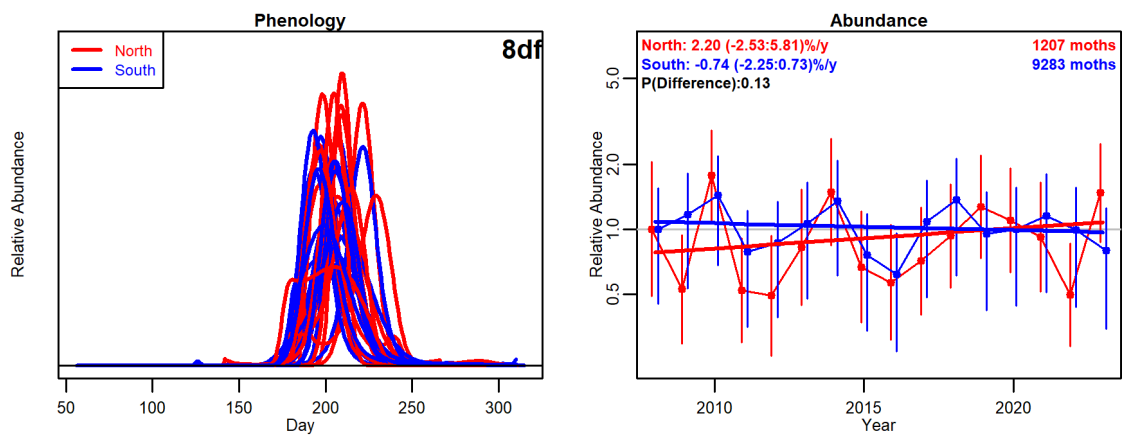
72.002: Straw Dot (*Rivula sericealis*)

Figure 53



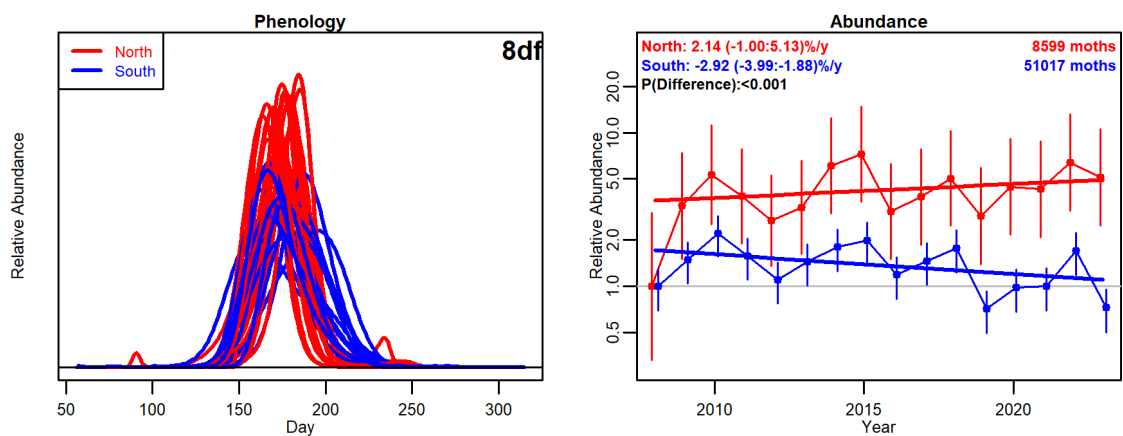
72.003: Snout (*Hypena proboscidalis*)

Figure 54



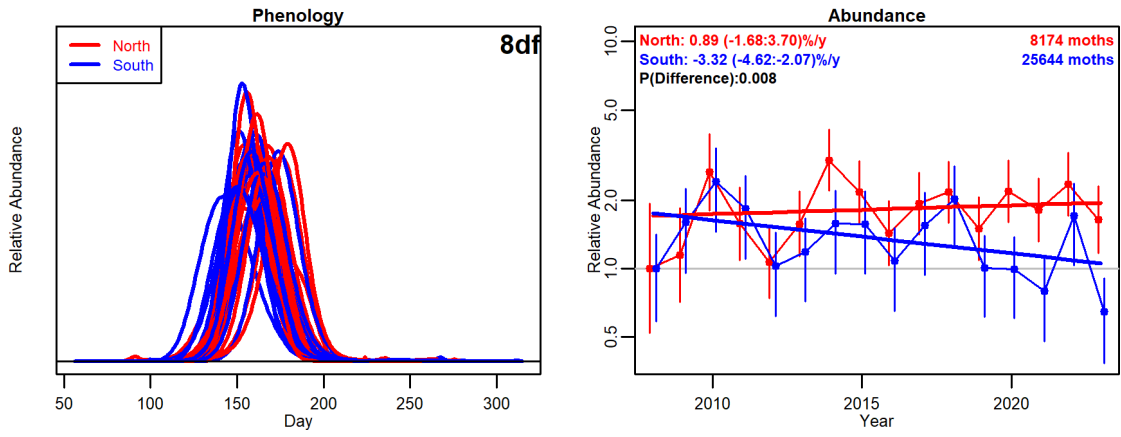
72.013: Yellow-tail (*Euproctis similis*)

Figure 55



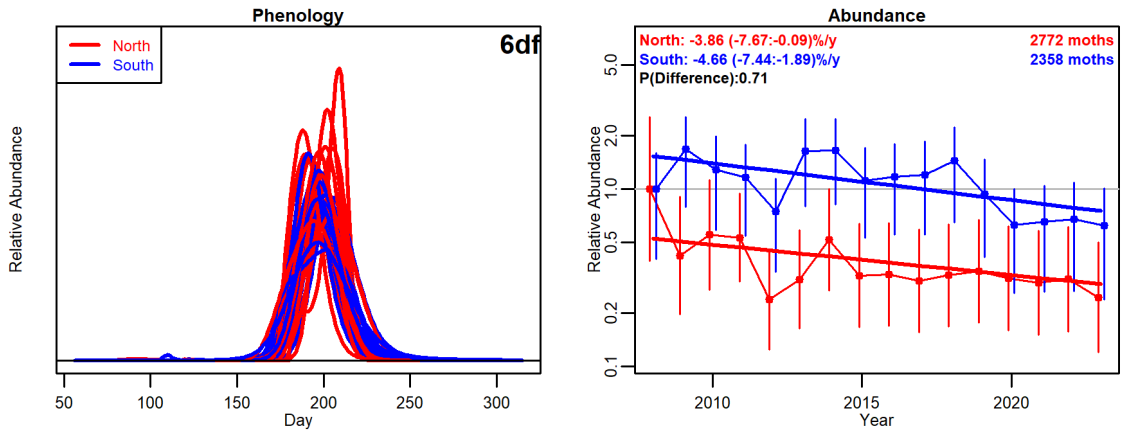
72.019: Buff Ermine (*Spilosoma lutea*)

Figure 56



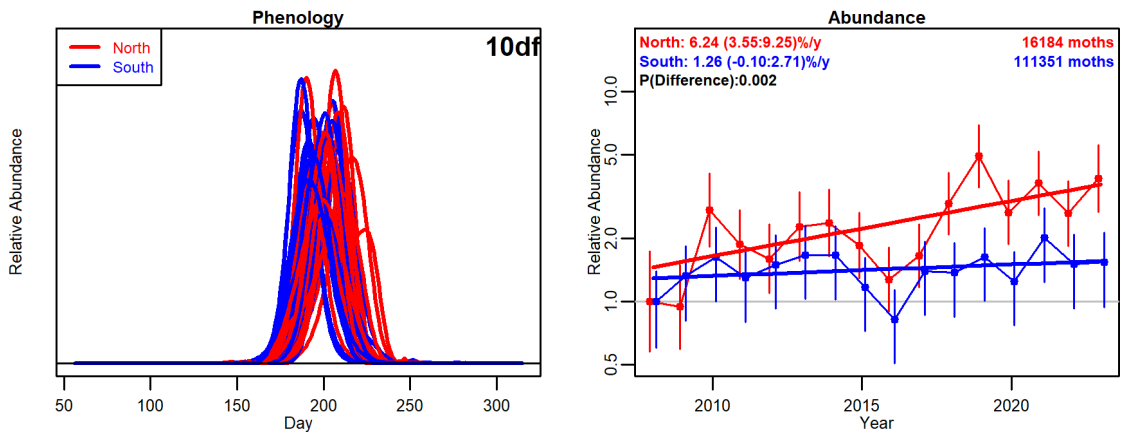
72.020: White Ermine (*Spilosoma lubricipeda*)

Figure 57



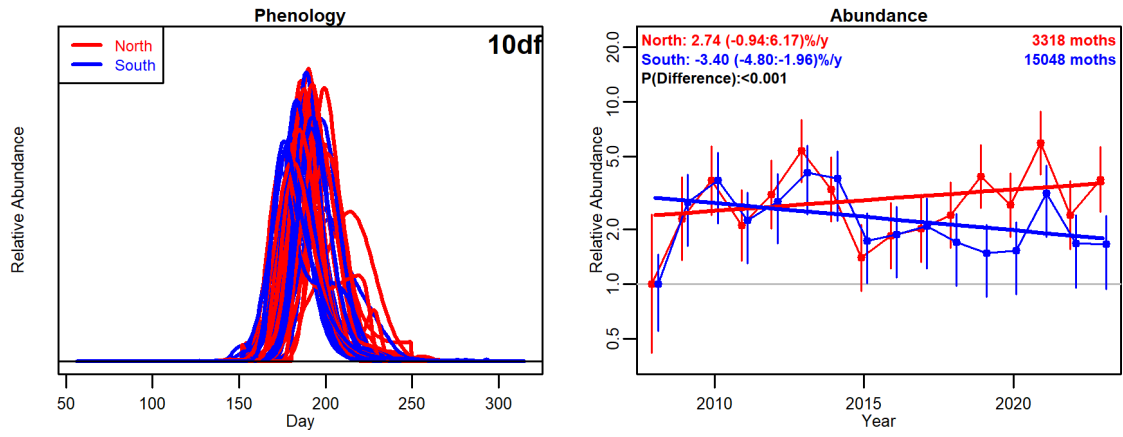
72.026: Garden Tiger (*Arctia caja*)

Figure 58



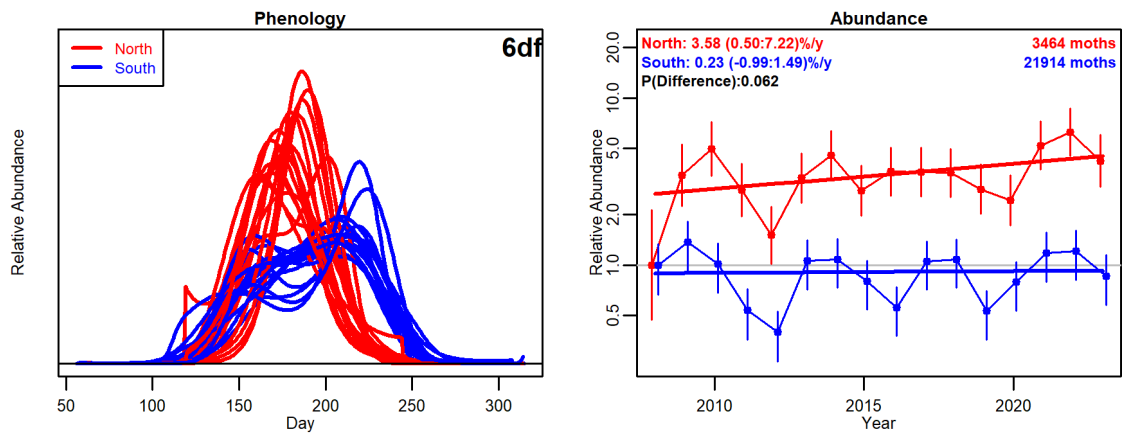
72.045: Common Footman (*Eilema lurideola*)

Figure 59



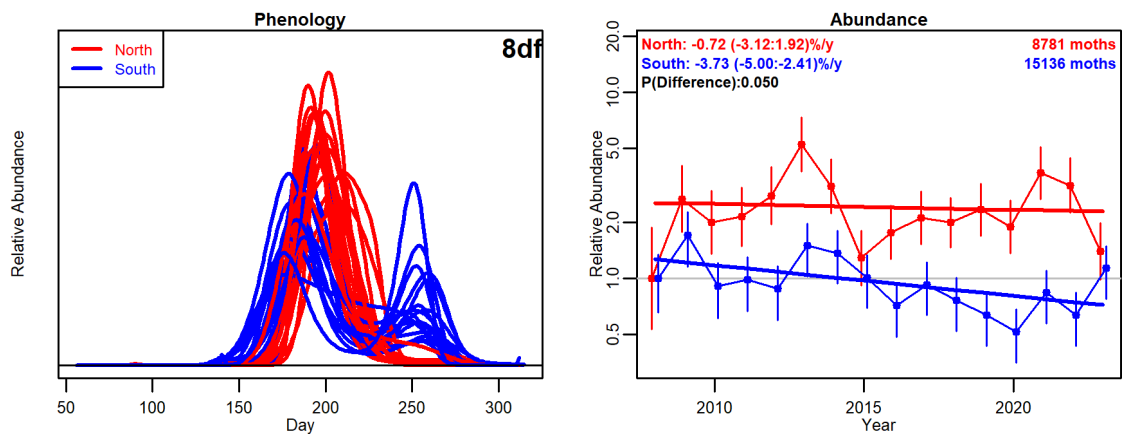
72.053: Fan-foot (*Herminia tarsipennalis*)

Figure 60



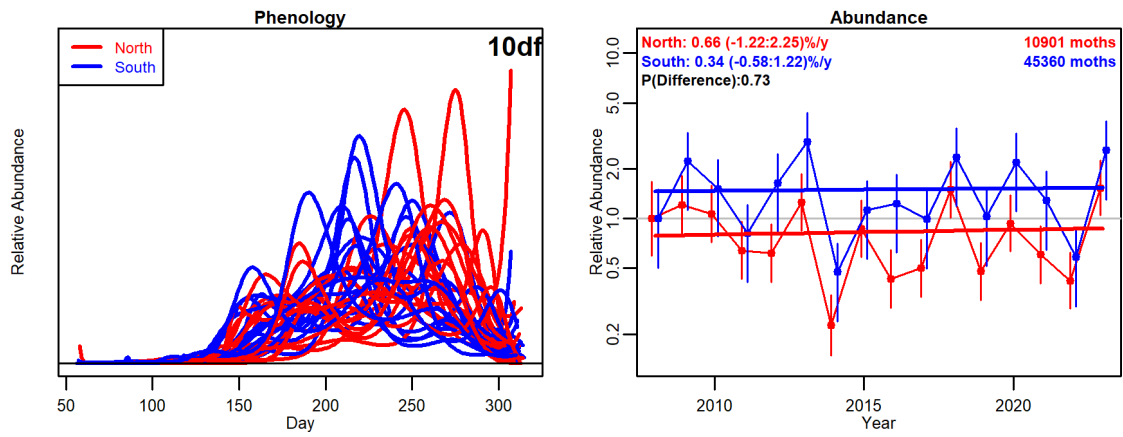
73.001: Spectacle (*Abrostola tripartita*)

Figure 61



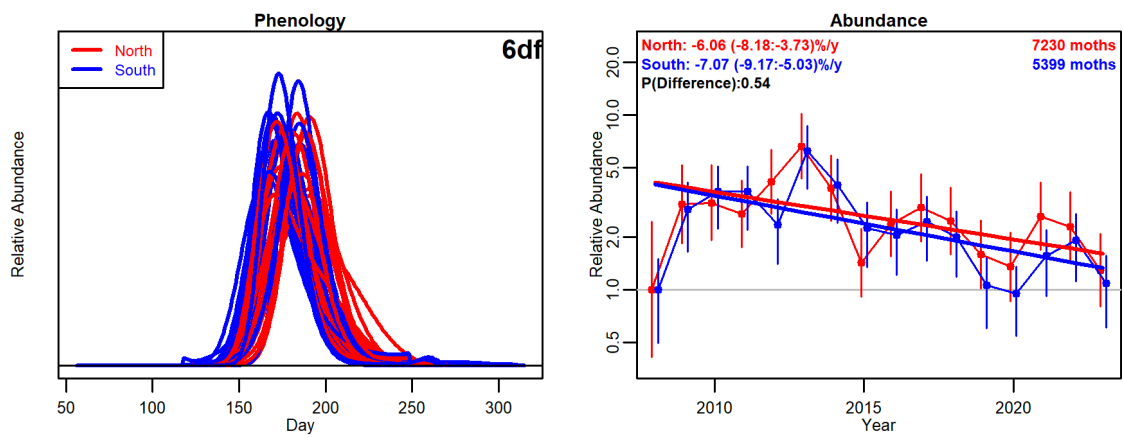
73.012: Burnished Brass (*Diachrysia chrysitis*)

Figure 62



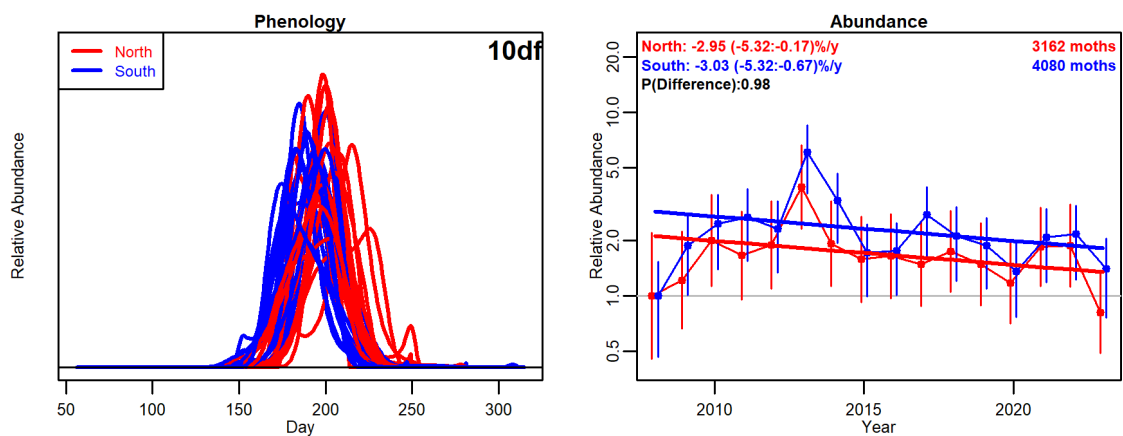
73.015: Silver Y (*Autographa gamma*)

Figure 63



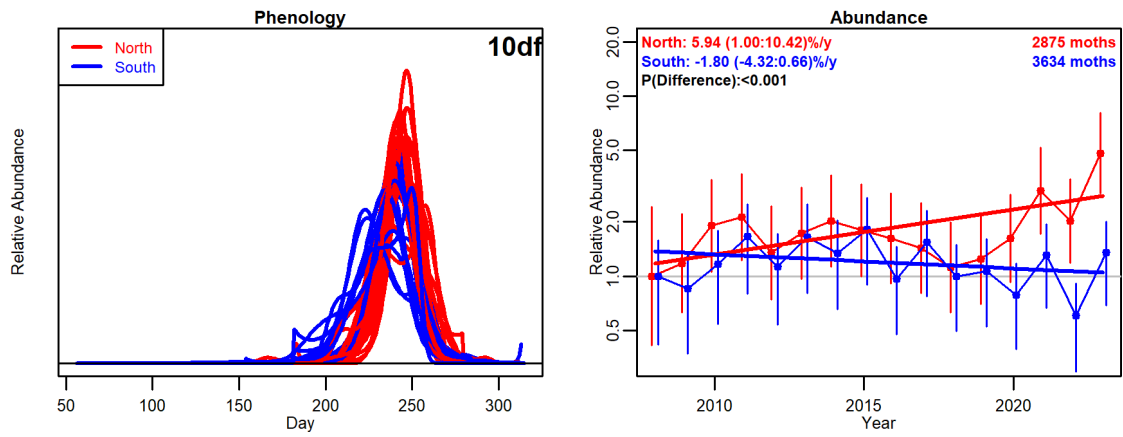
73.016: Beautiful Golden Y (*Autographa pulchrina*)

Figure 64



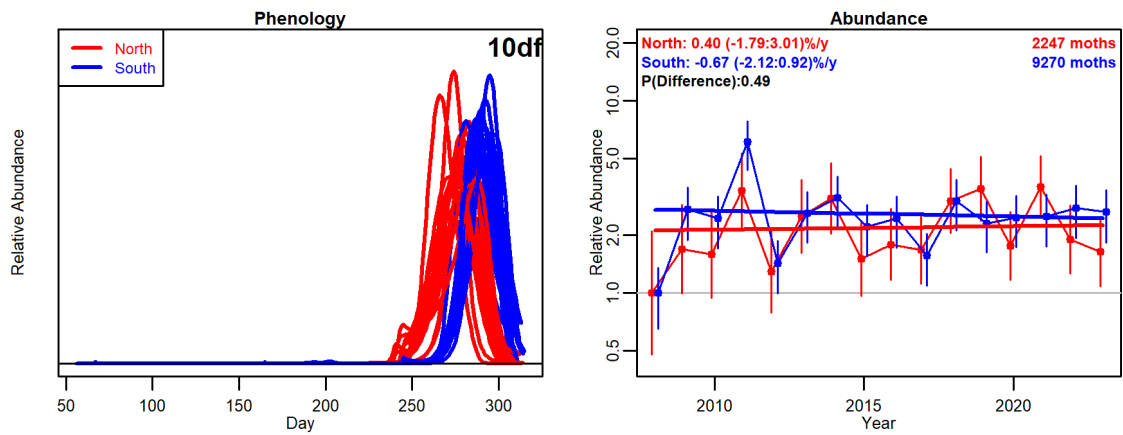
73.017: Plain Golden Y (*Autographa jota*)

Figure 65



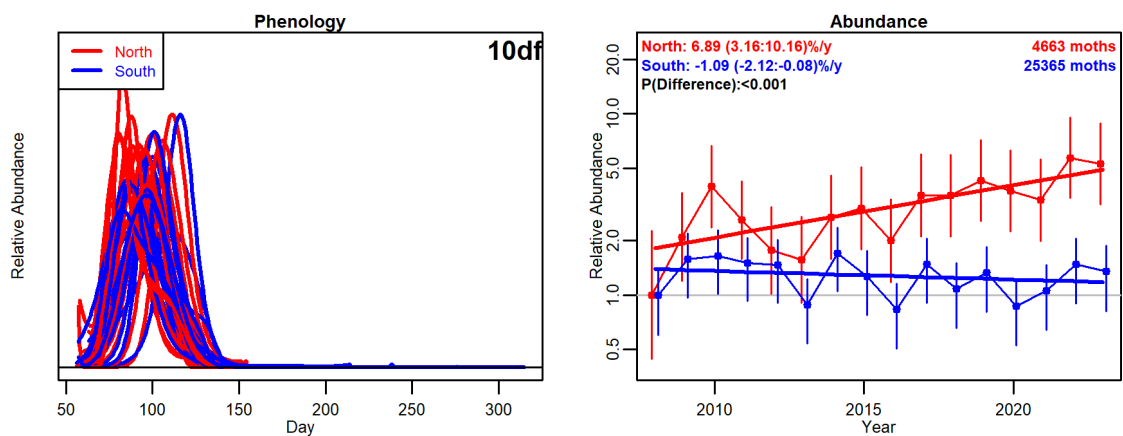
73.064: Mouse Moth (*Amphipyra tragopoginis*)

Figure 66



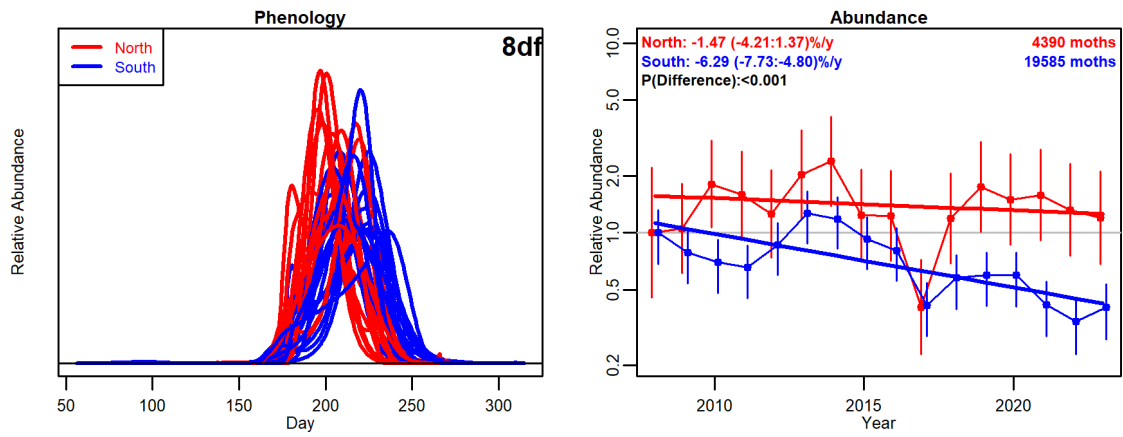
73.068: Green-brindled Crescent (*Allophytes oxyacanthae*)

Figure 67



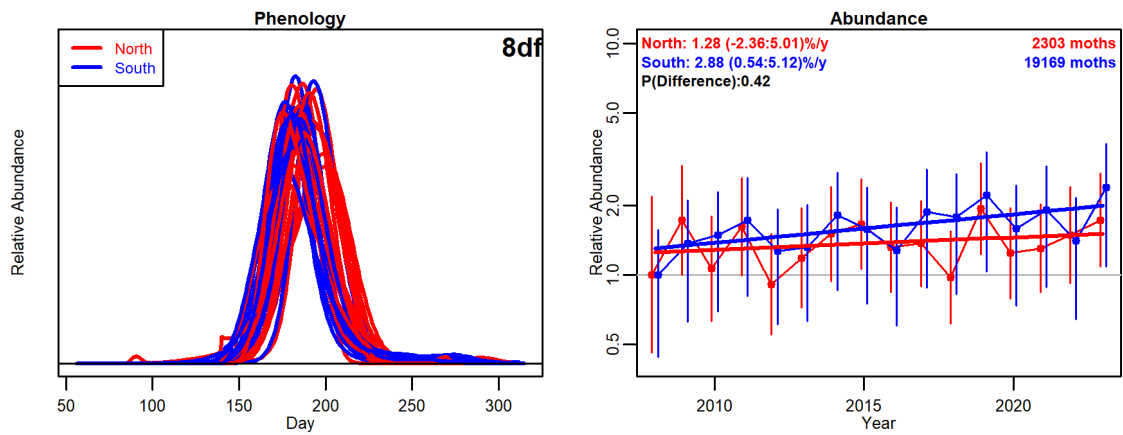
73.069: Early Grey (*Xylocampa areola*)

Figure 68



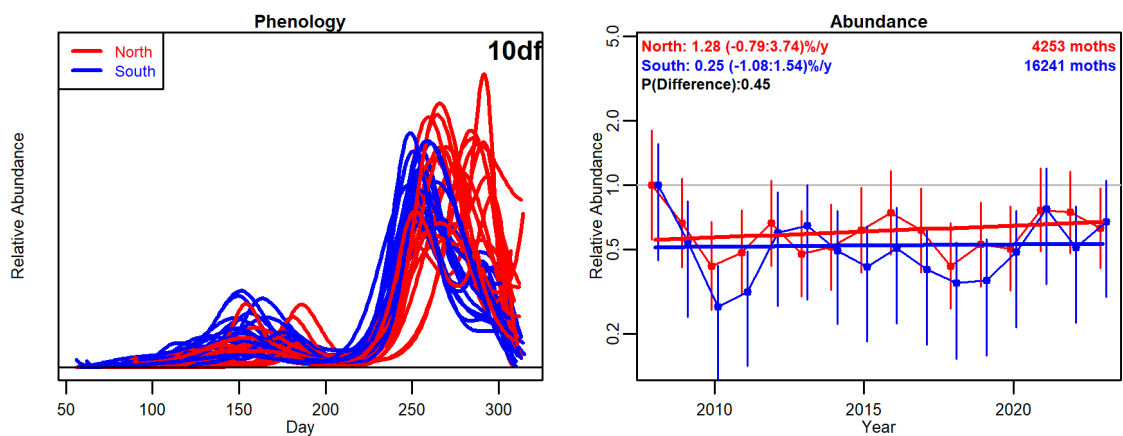
73.084: Marbled Beauty (*Bryophila domestica*)

Figure 69



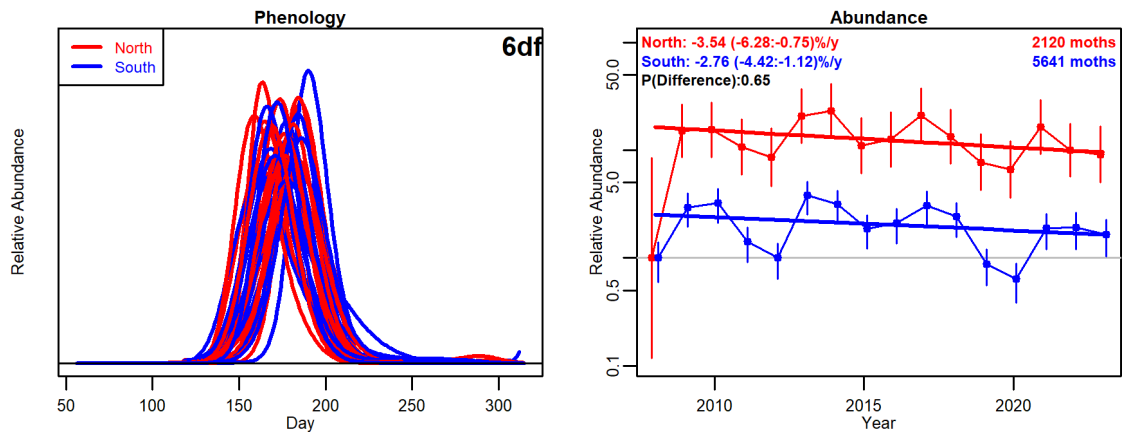
73.092: Mottled Rustic (*Caradrina morpheus*)

Figure 70



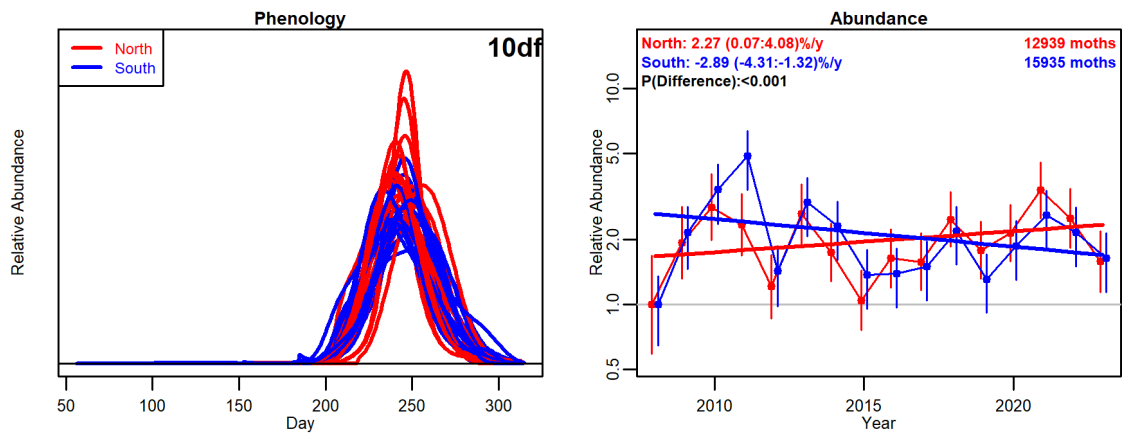
73.113: Angle Shades (*Phlogophora meticulosa*)

Figure 71



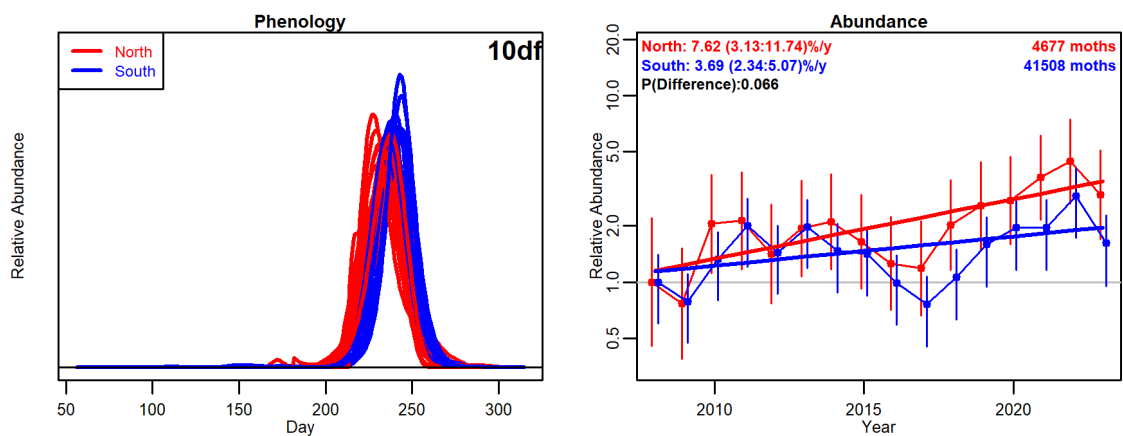
73.114: Small Angle Shades (*Euplexia lucipara*)

Figure 72



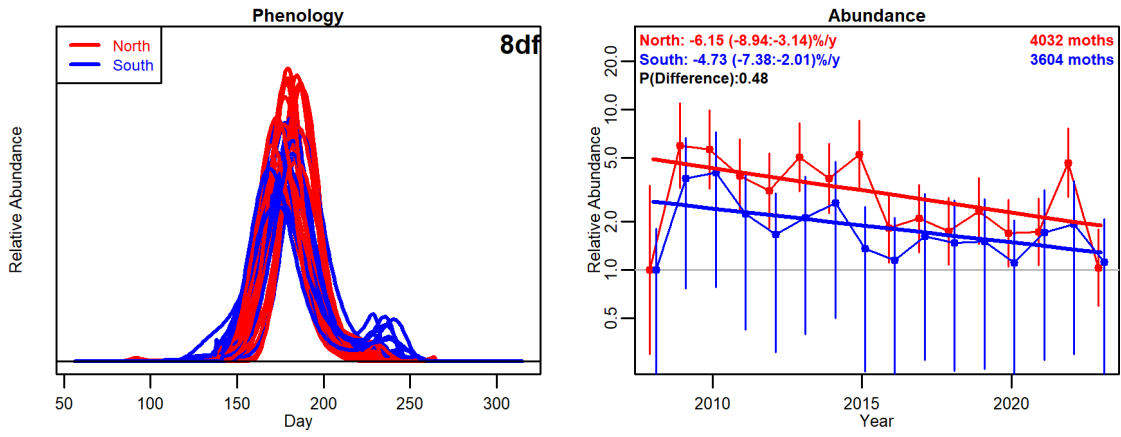
73.123: Rosy Rustic (*Hydraecia micacea*)

Figure 73



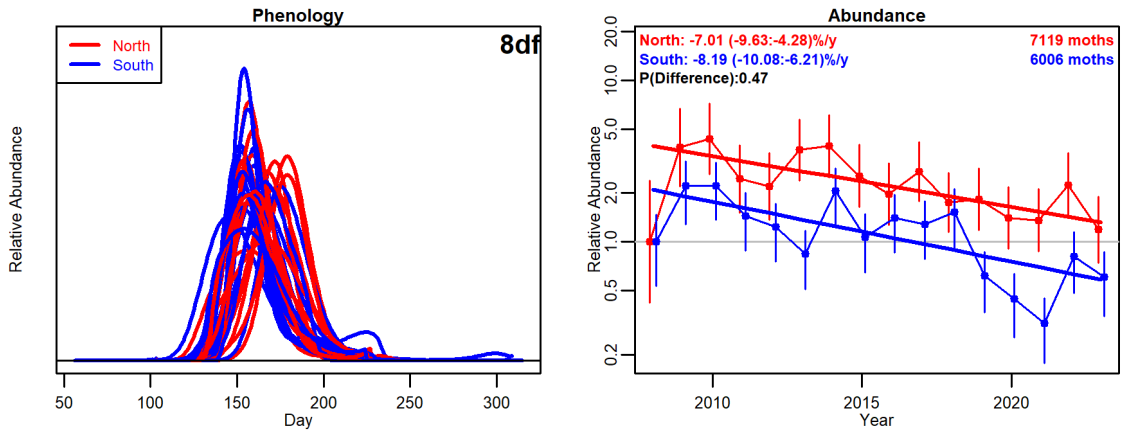
73.131: Flounced Rustic (*Luperina testacea*)

Figure 74



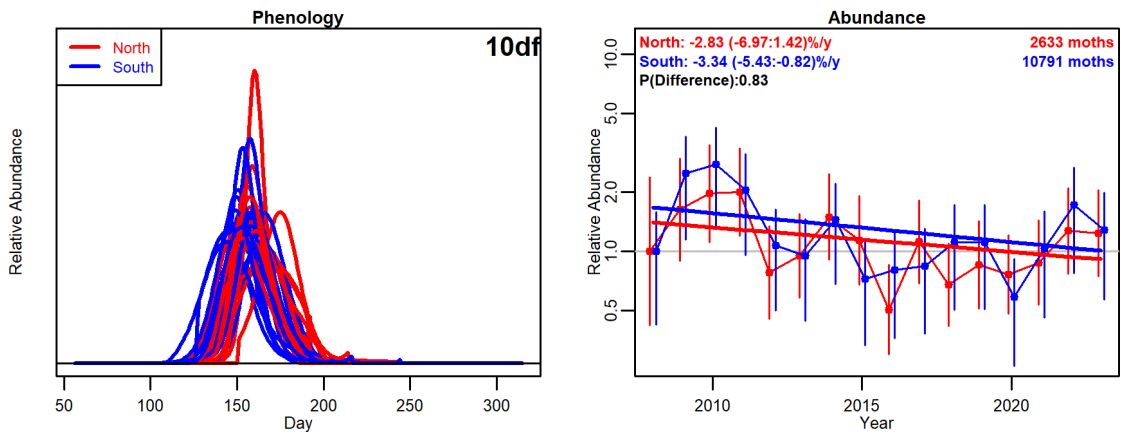
73.154: Dusky Brocade (*Apamea remissa*)

Figure 75



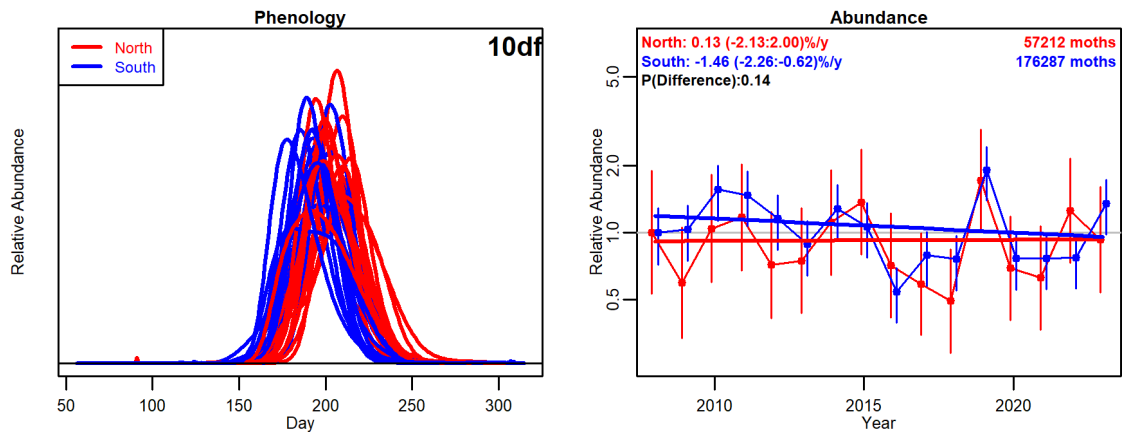
73.156: Clouded-bordered Brindle (*Apamea crenata*)

Figure 76



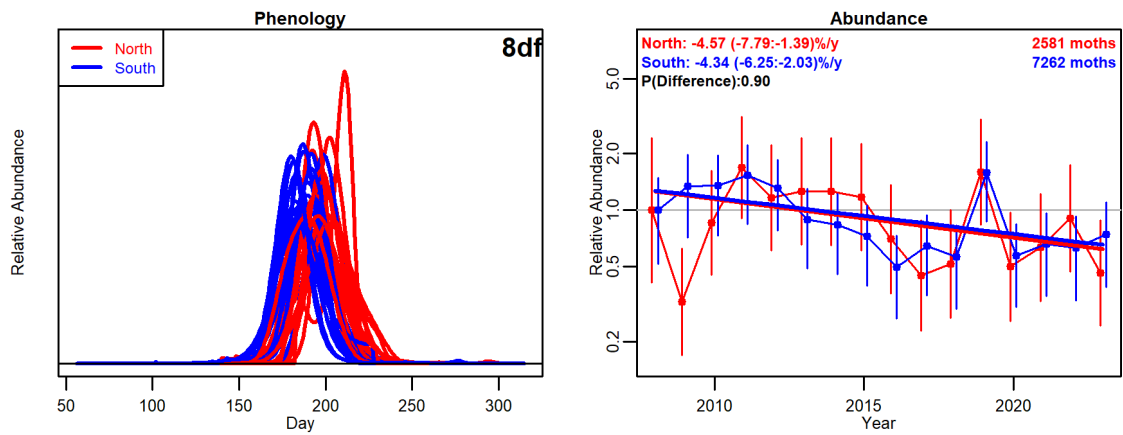
73.158: Rustic Shoulder-knot (*Apamea sordens*)

Figure 77



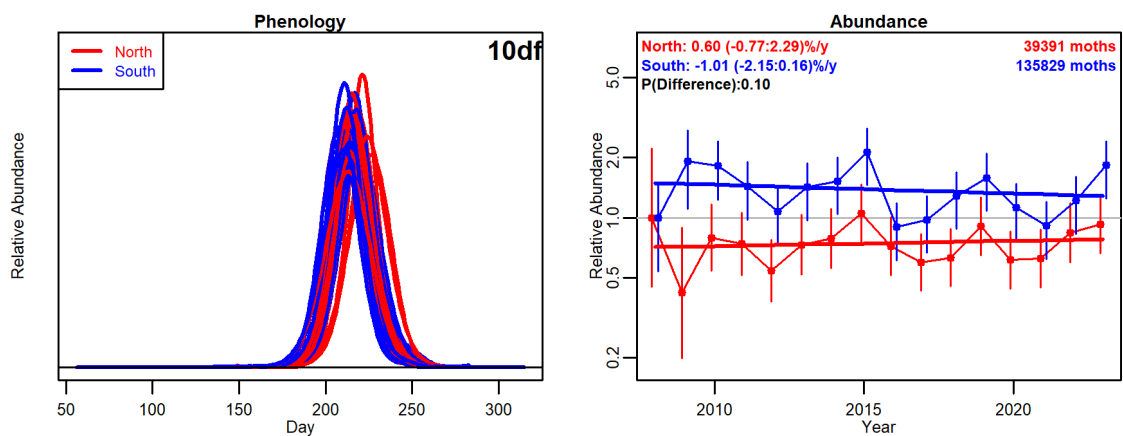
73.162: Dark Arches (*Apamea monoglypha*)

Figure 78



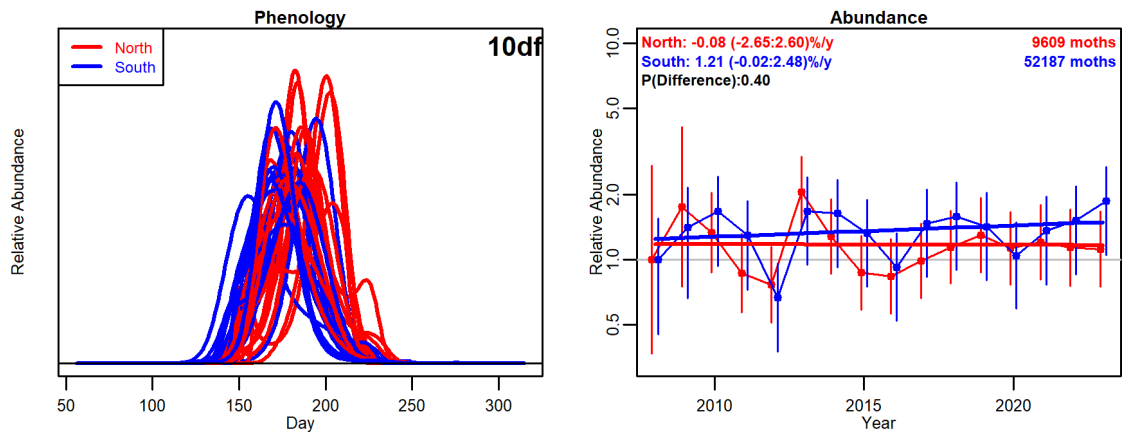
73.163: Light Arches (*Apamea lithoxylaea*)

Figure 79



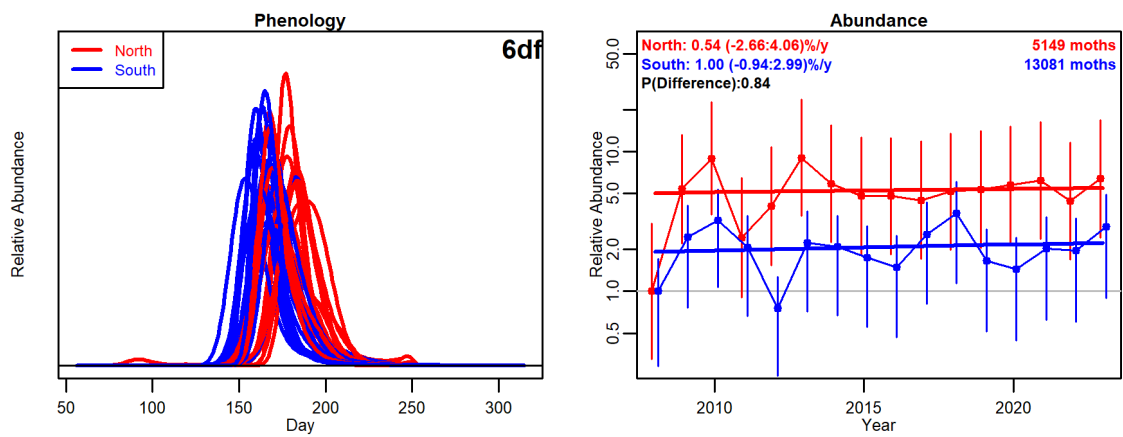
73.169x: Common Rustic agg. (*Mesapamea secalis* agg.)

Figure 80



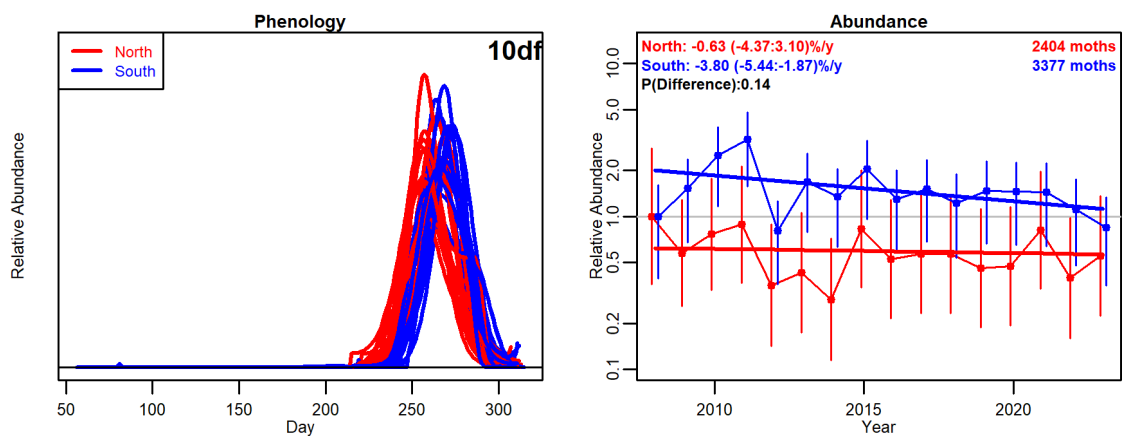
73.173x: Marbled Minor agg. (*Oligia strigilis* agg.)

Figure 81



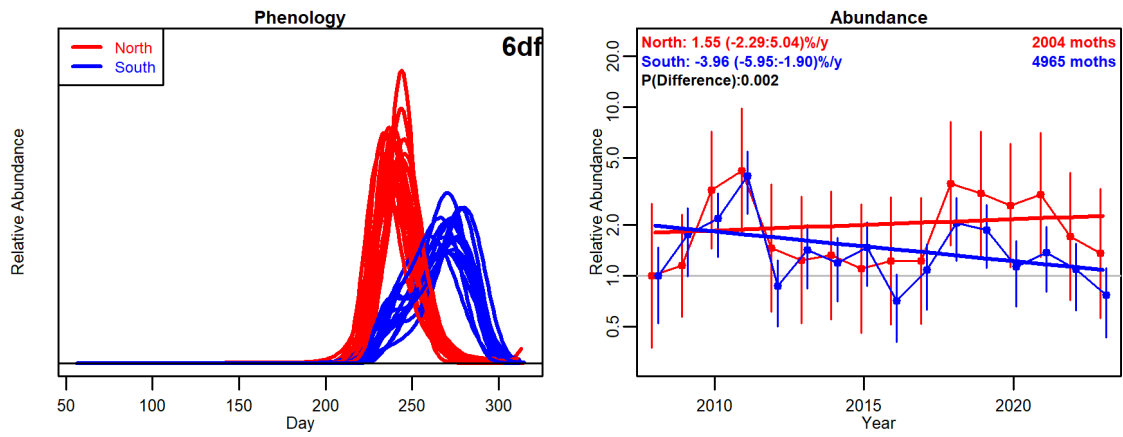
73.176: Middle-barred Minor (*Oligia fasciuncula*)

Figure 82



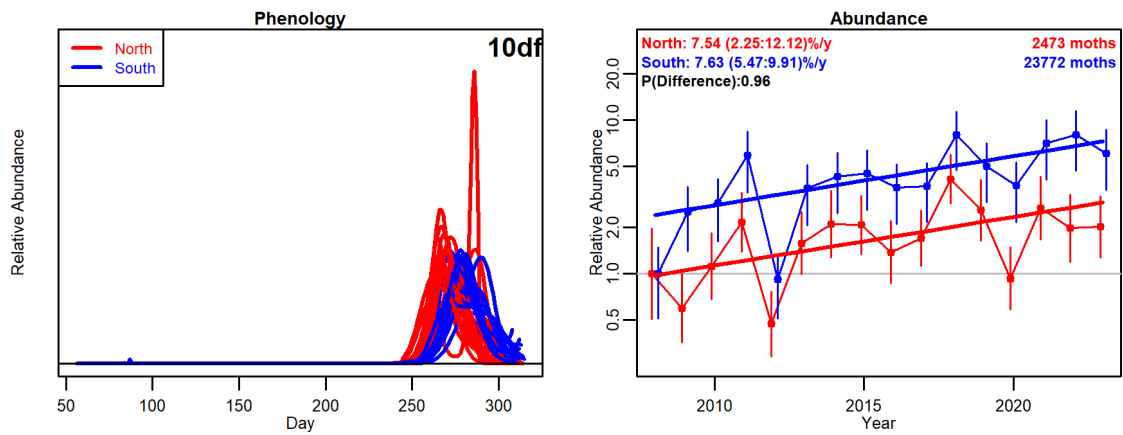
73.181: Pink-barred Sallow (*Xanthia togata*)

Figure 83



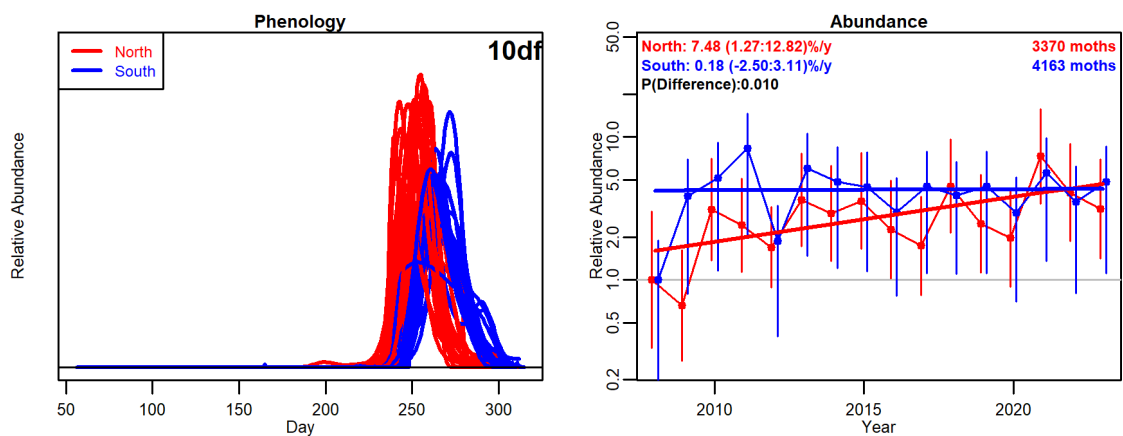
73.182: Sallow (*Cirrha icteritia*)

Figure 84



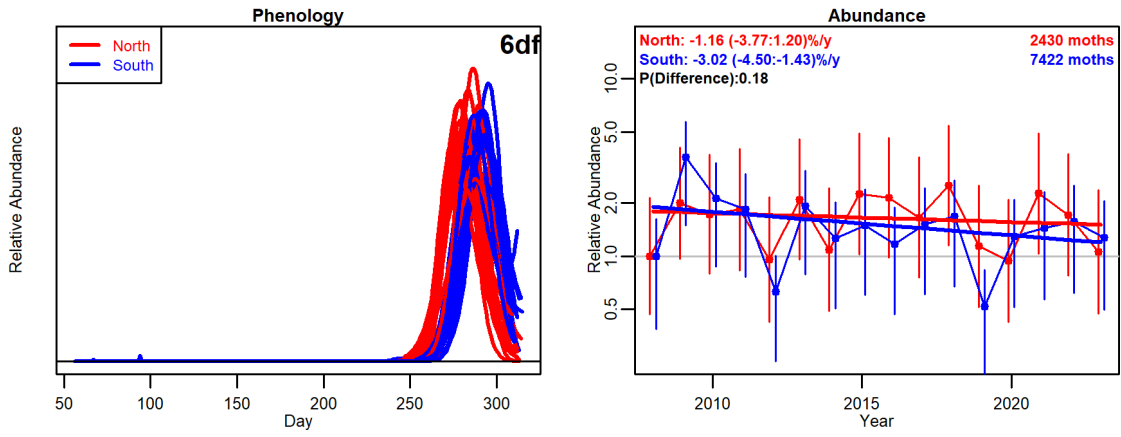
73.186: Beaded Chestnut (*Agrochola lychnidis*)

Figure 85



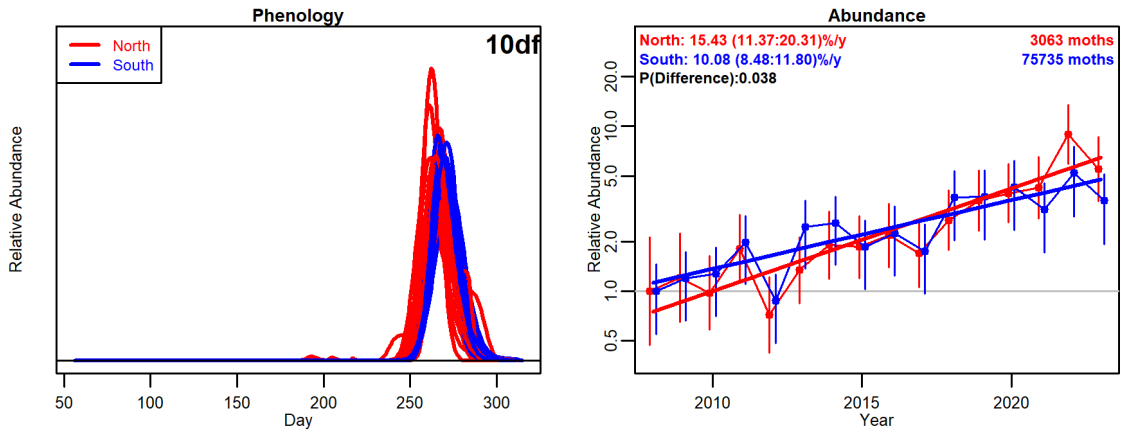
73.187: Brown-spot Pinion (*Anchoscelis litura*)

Figure 86



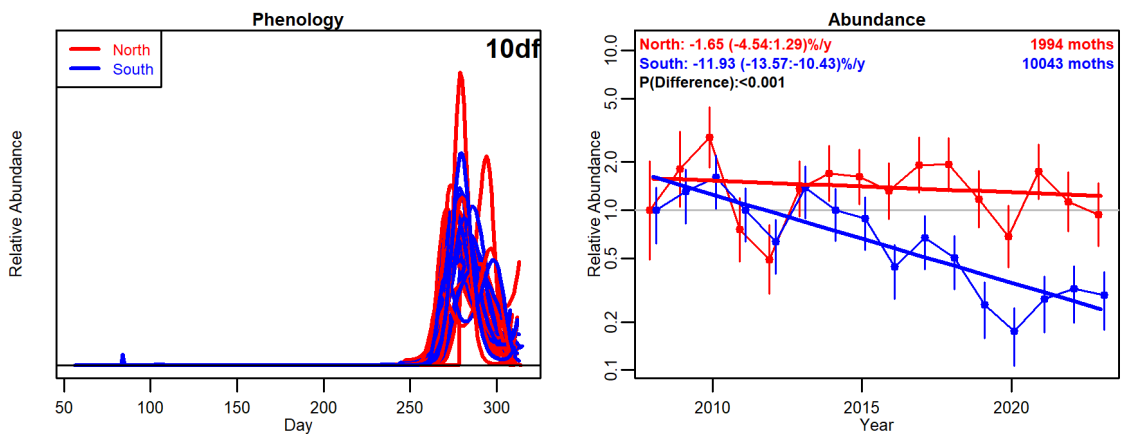
73.189: Red-line Quaker (*Leptologia lota*)

Figure 87



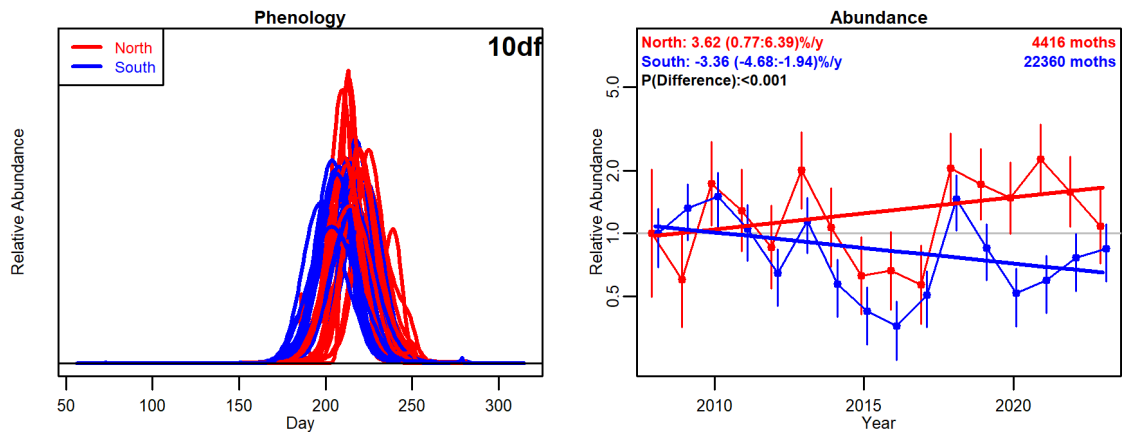
73.193: Lunar Underwing (*Anchoscelis lunosa*)

Figure 88



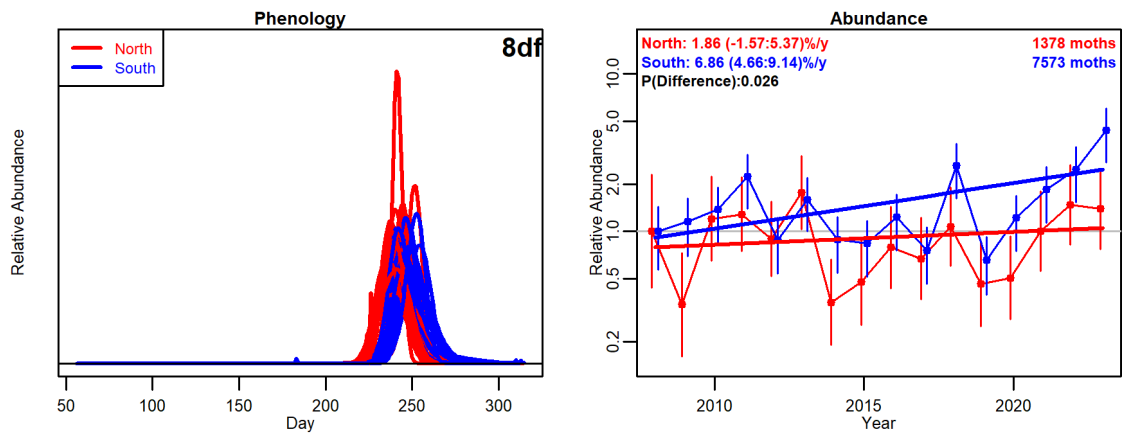
73.206: Blair's Shoulder-knot (*Lithophane leautieri*)

Figure 89



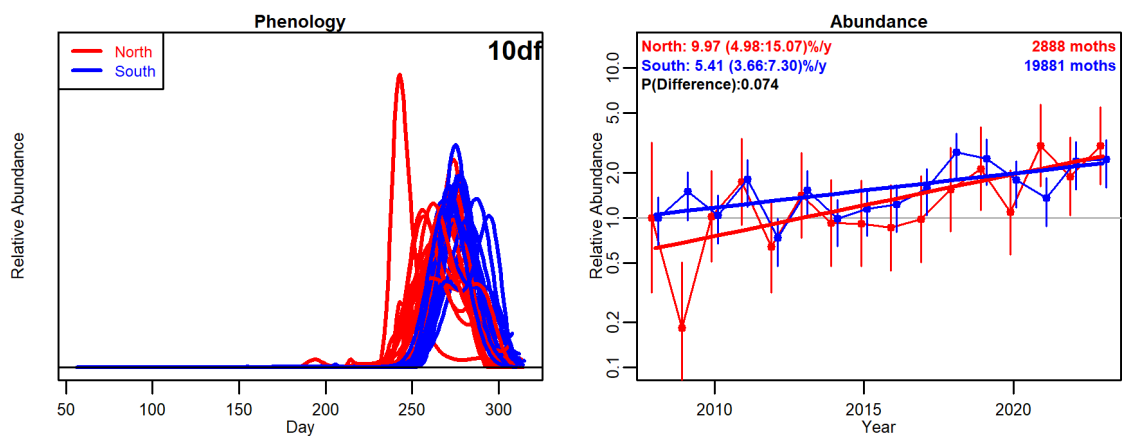
73.216: Dun-bar (*Cosmia trapezina*)

Figure 90



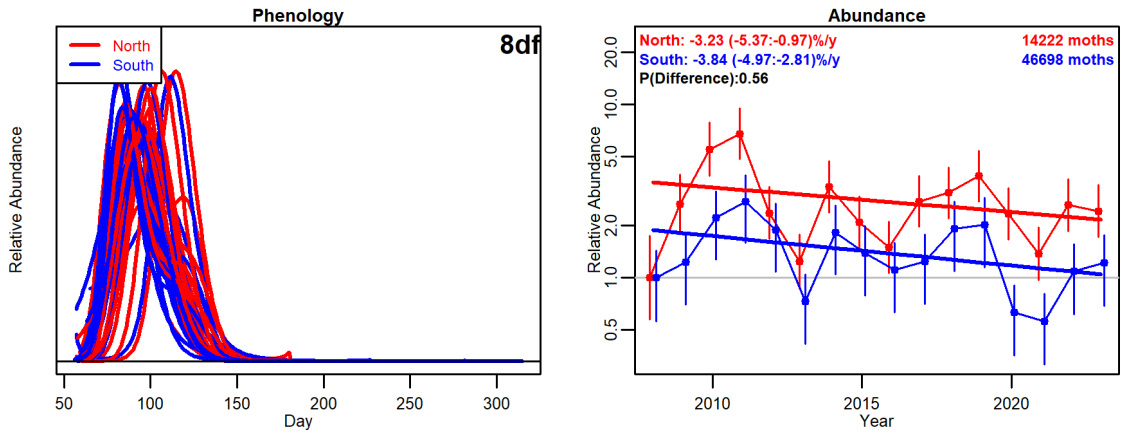
73.219: Centre-barred Sallow (*Atethmia centrago*)

Figure 91



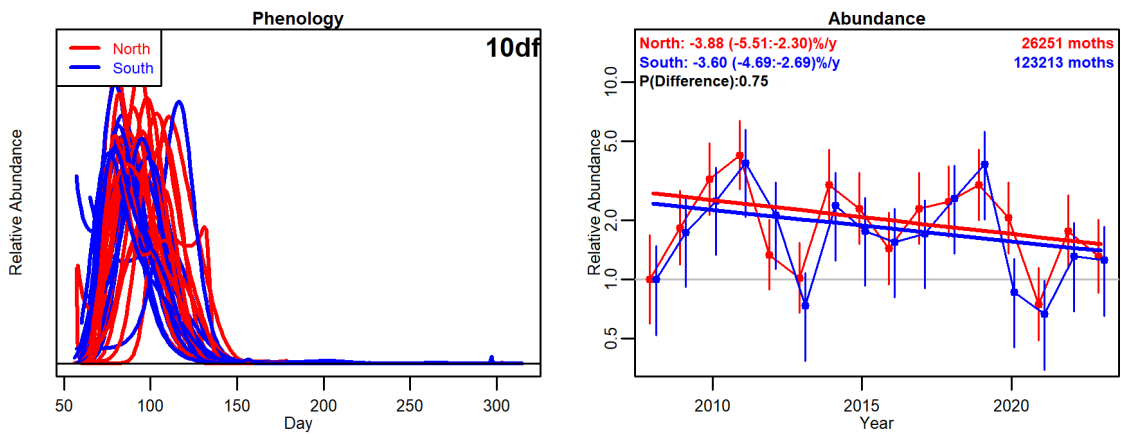
73.233: Black Rustic (*Aporophyla nigra*)

Figure 92



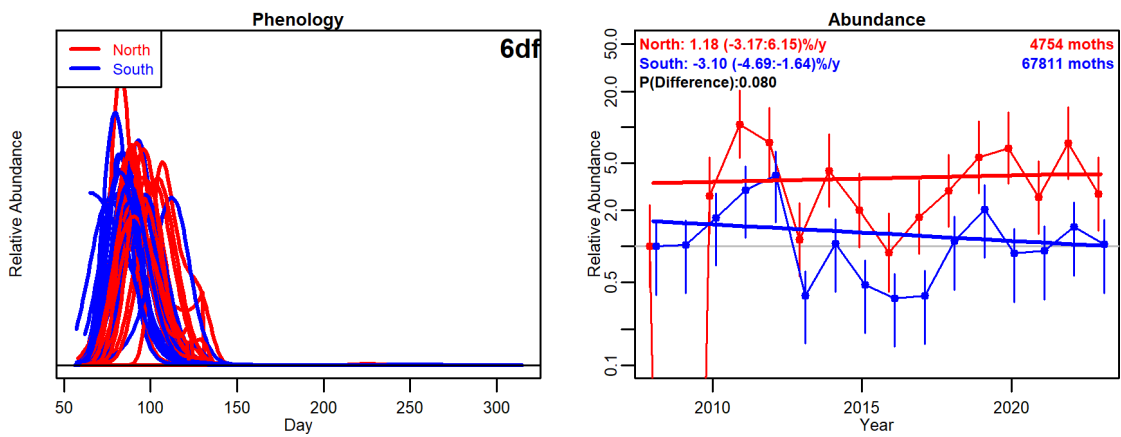
73.242: Clouded Drab (*Orthosia incerta*)

Figure 93



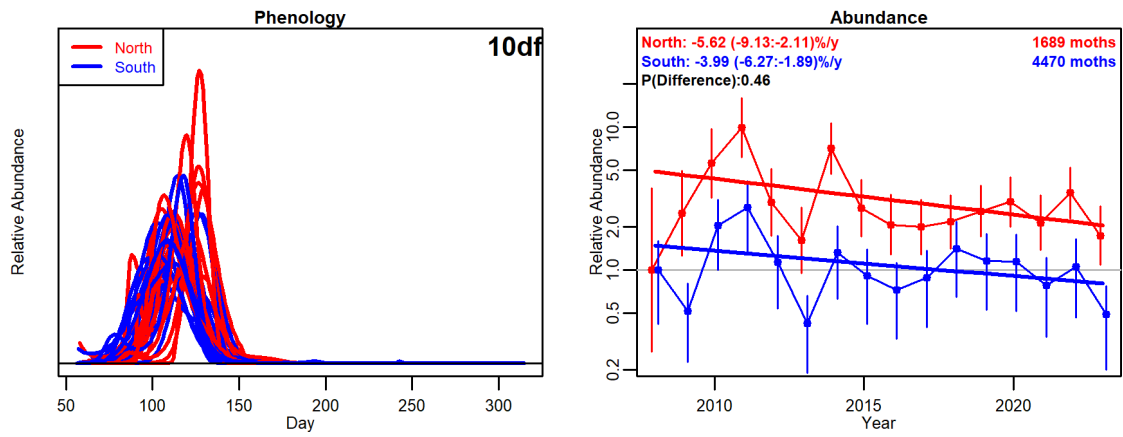
73.244: Common Quaker (*Orthosia cerasi*)

Figure 94



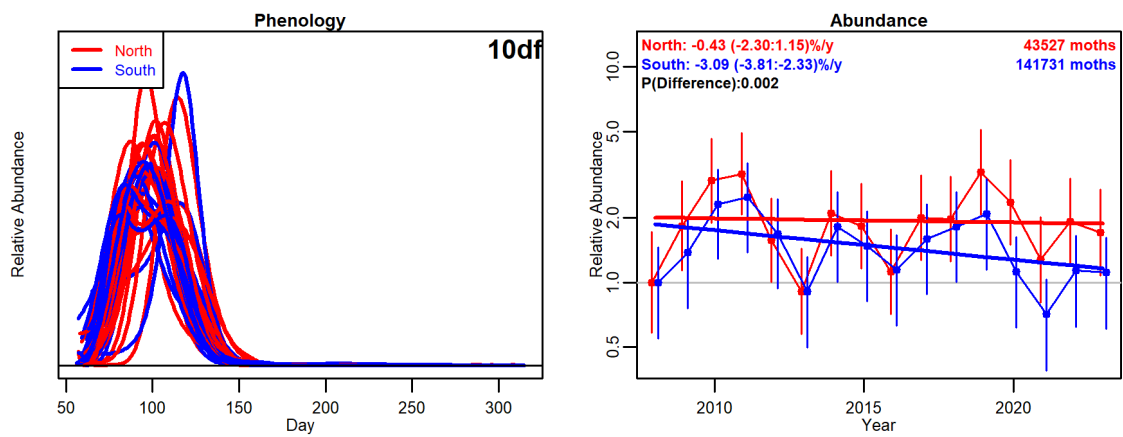
73.245: Small Quaker (*Orthosia cruda*)

Figure 95



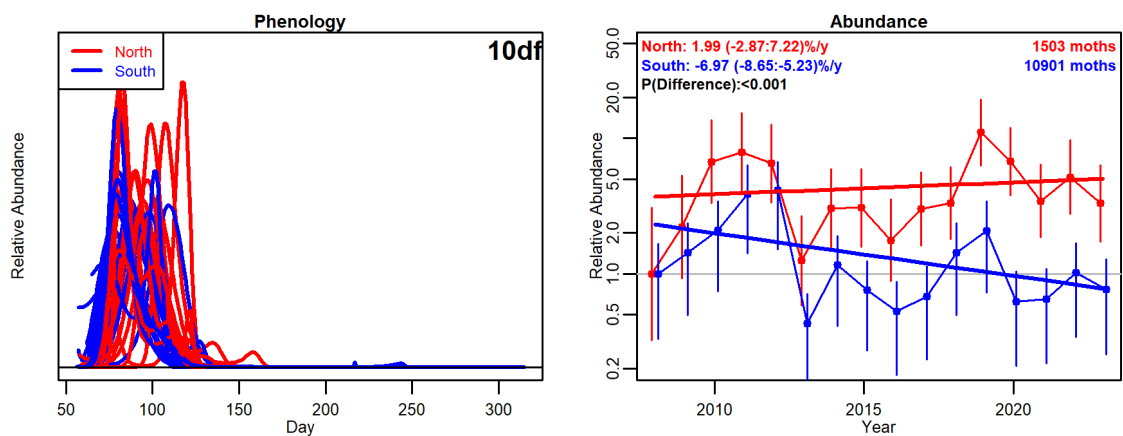
73.247: Powdered Quaker (*Orthosia gracilis*)

Figure 96



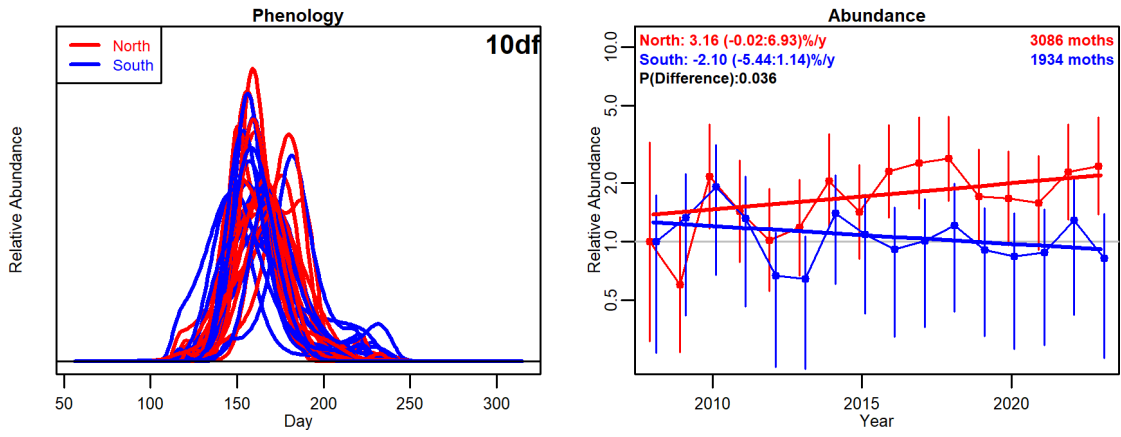
73.249: Hebrew Character (*Orthosia gothica*)

Figure 97



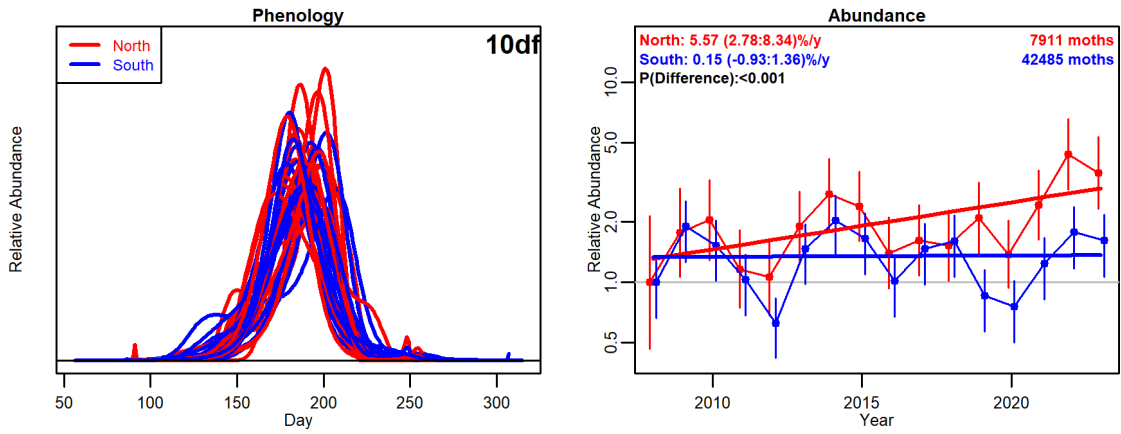
73.250: Twin-spotted Quaker (*Anorthoa munda*)

Figure 98



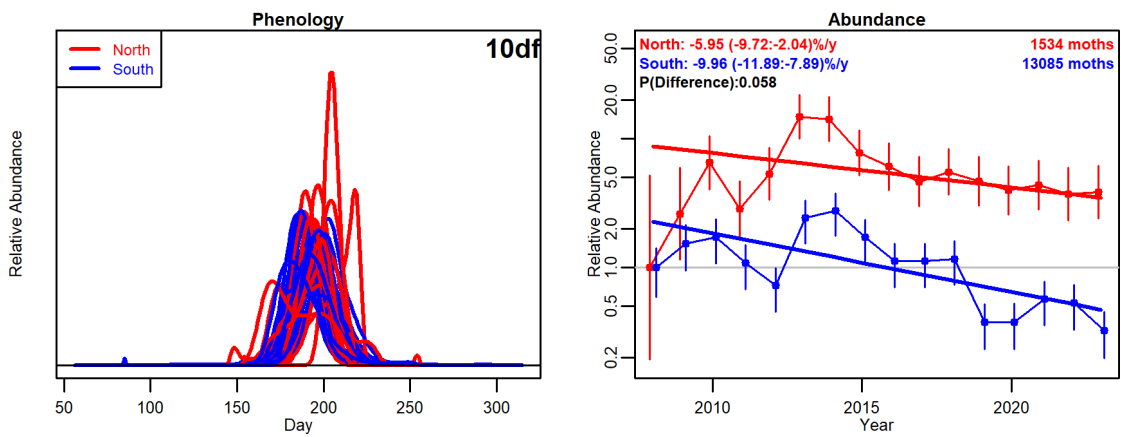
73.264: Pale-shouldered Brocade (*Lacanobia thalassina*)

Figure 99



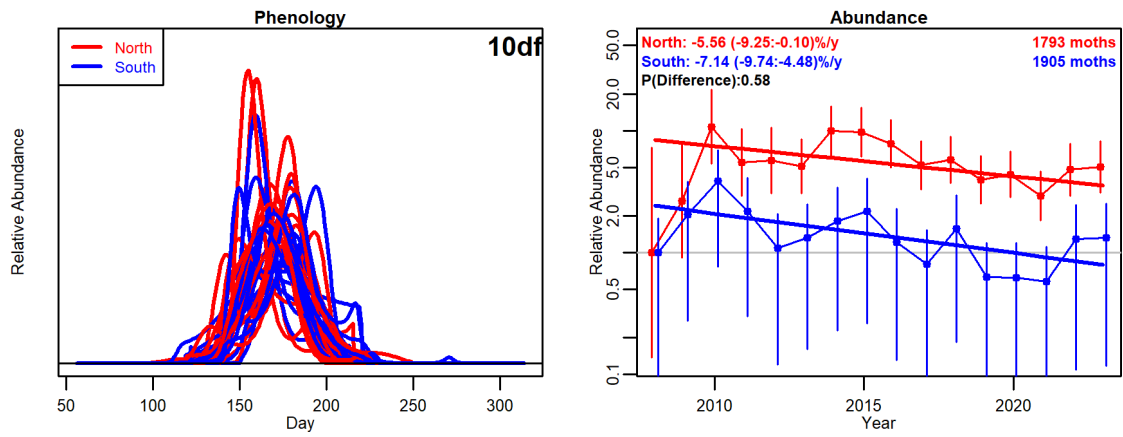
73.267: Bright-line Brown-eye (*Lacanobia oleracea*)

Figure 100



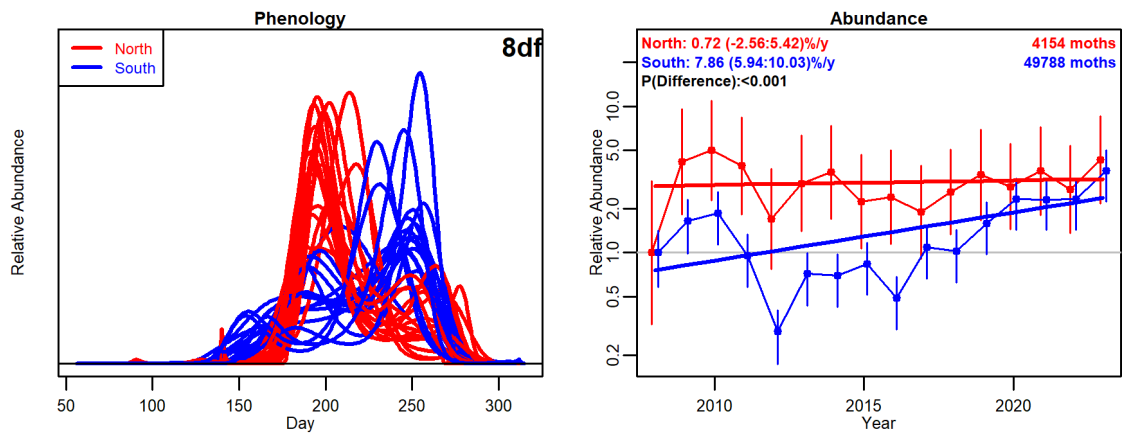
73.270: Dot Moth (*Melanchra persicariae*)

Figure 101



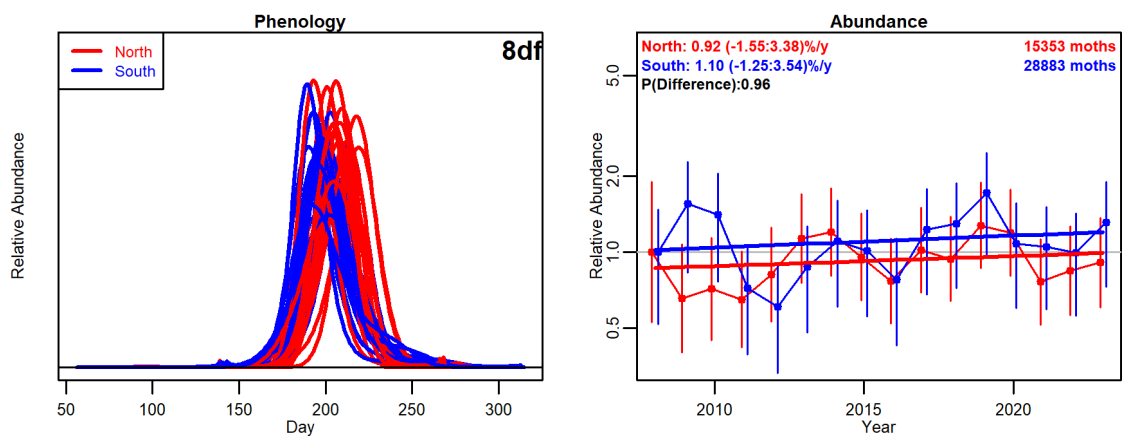
73.271: Broom Moth (*Ceramica pisi*)

Figure 102



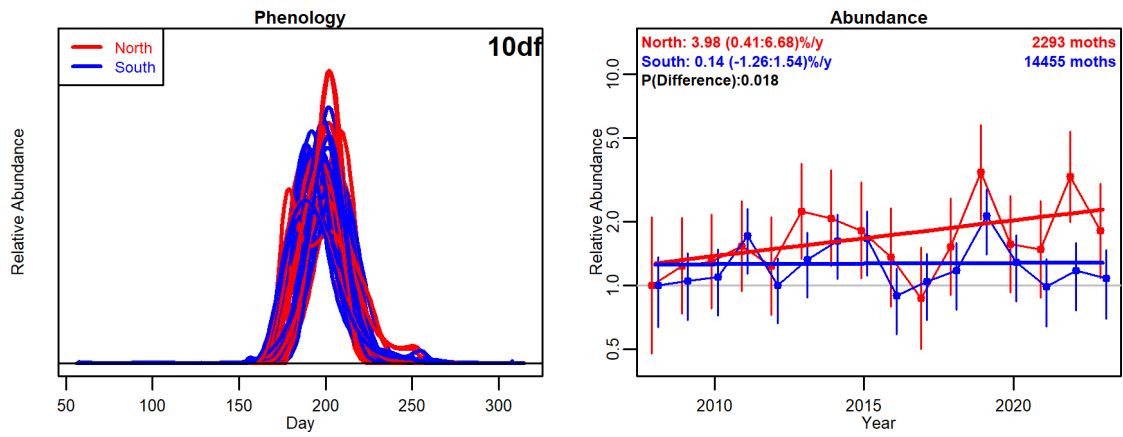
73.291: Common Wainscot (*Mythimna pallens*)

Figure 103



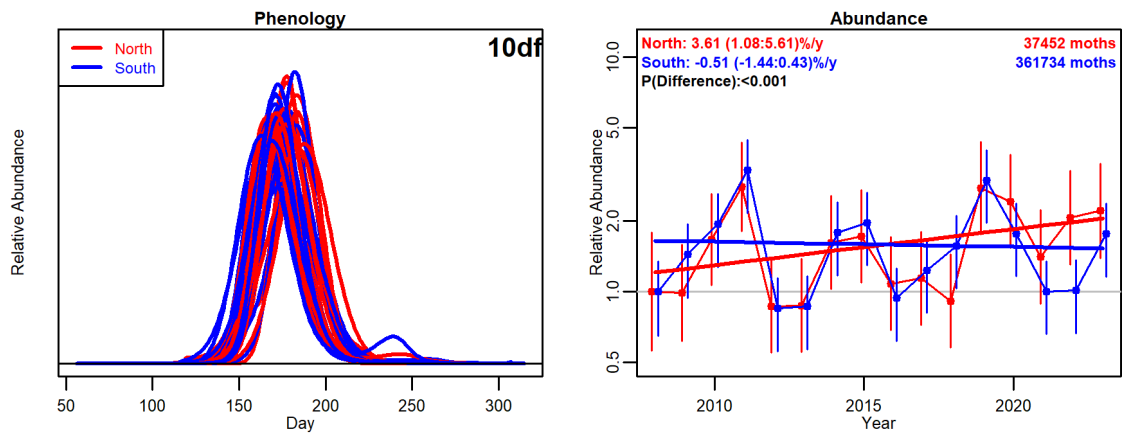
73.293: Smoky Wainscot (*Mythimna impura*)

Figure 104



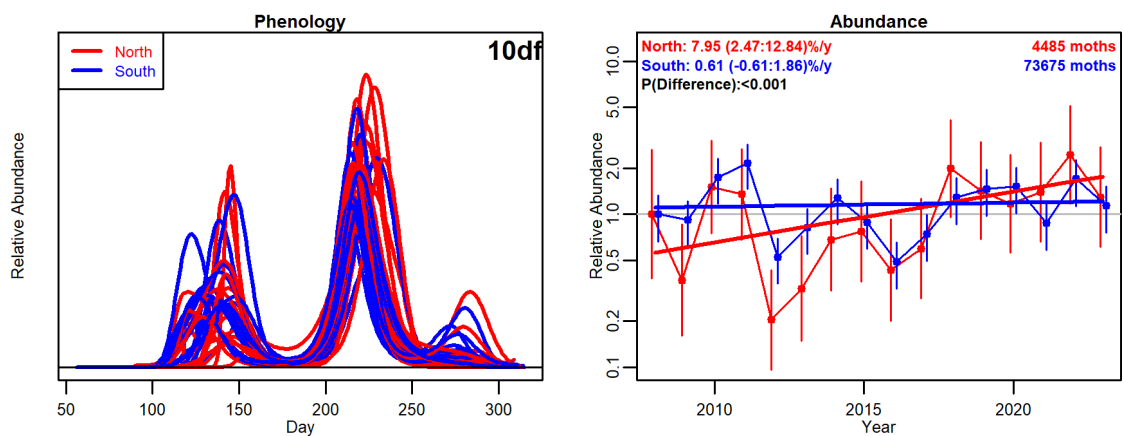
73.298: Clay (*Mythemna ferrago*)

Figure 105



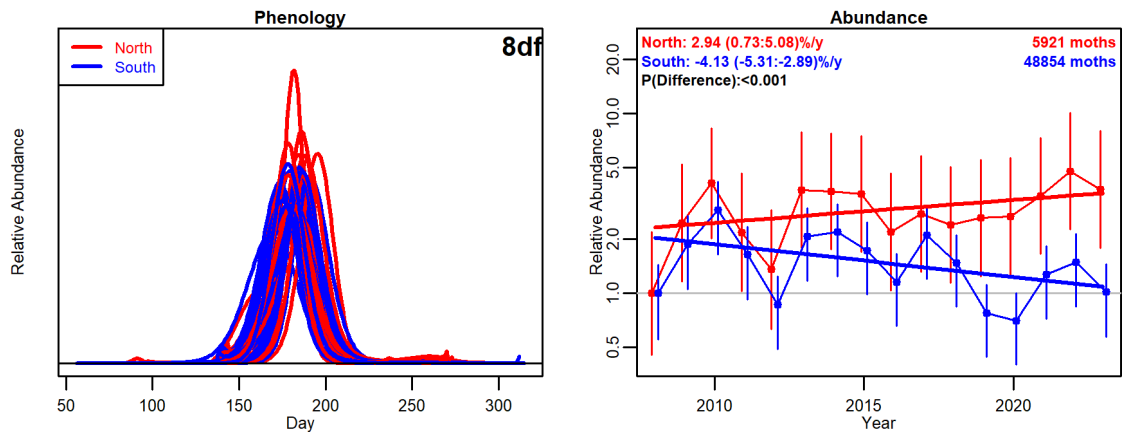
73.317: Heart and Dart (*Agrotis exclamatoris*)

Figure 106



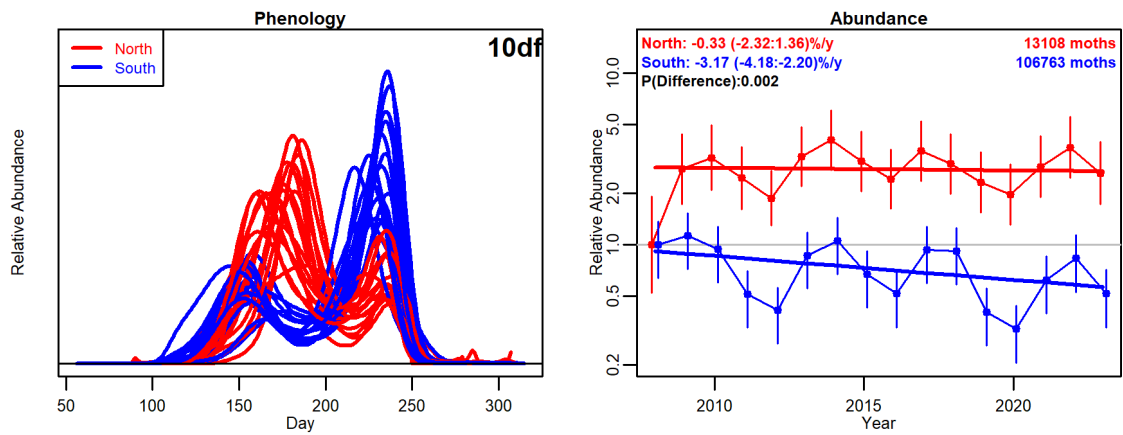
73.325: Shuttle-shaped Dart (*Agrotis puta*)

Figure 107



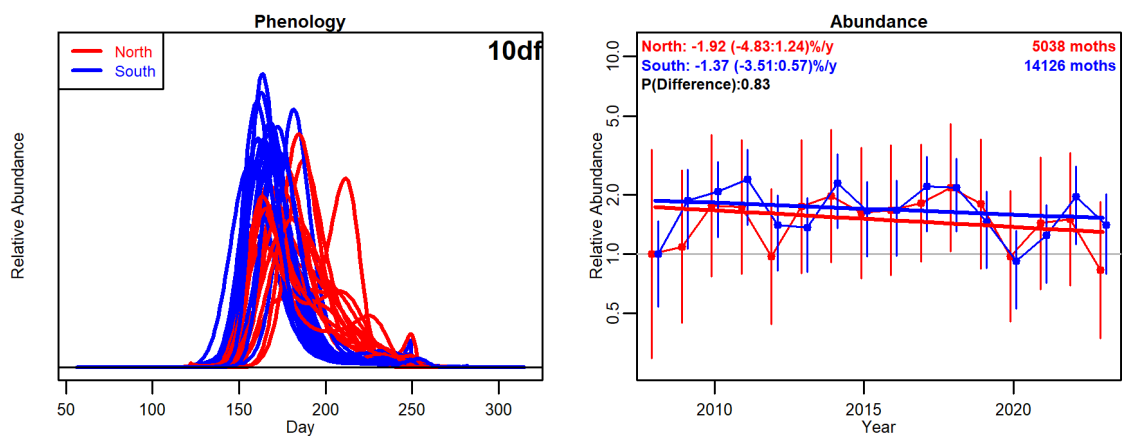
73.328: Flame (*Axylia putris*)

Figure 108



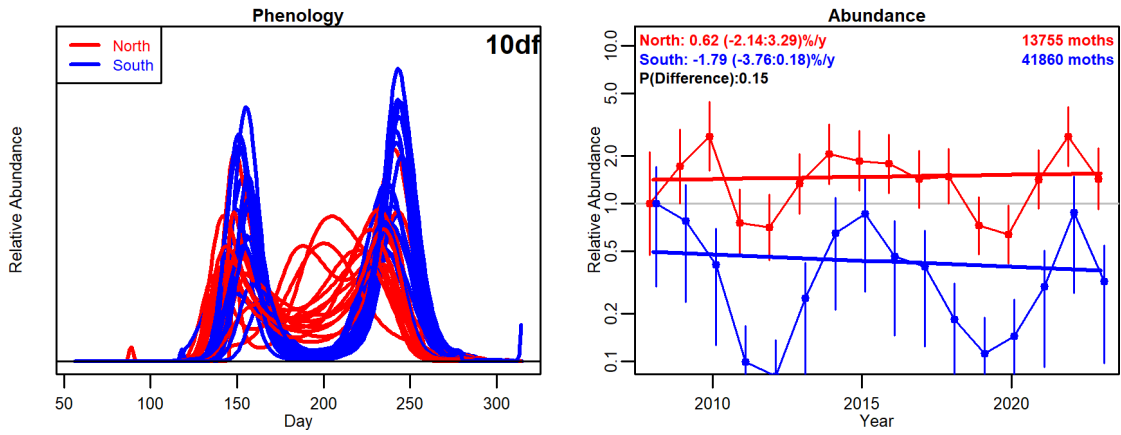
73.329: Flame Shoulder (*Ochropleura plecta*)

Figure 109



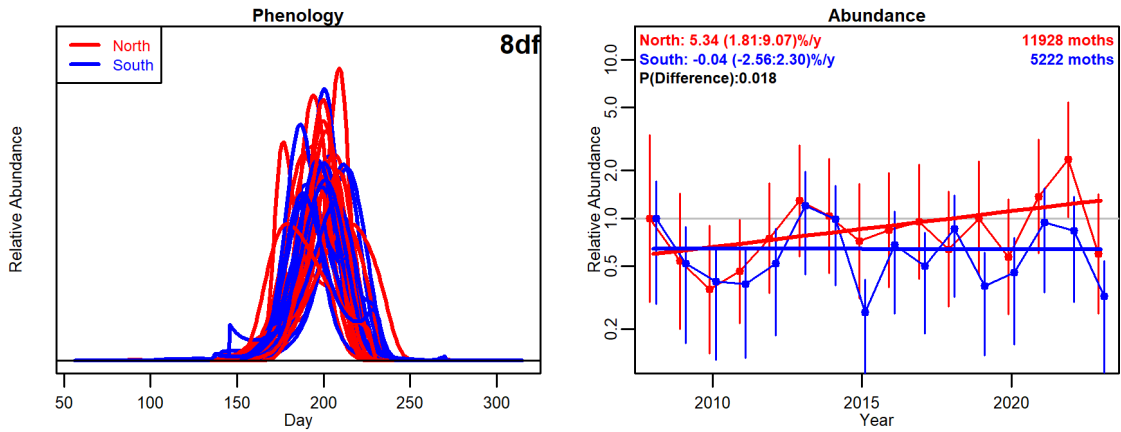
73.333: Ingrailed Clay (*Diarsia mendica*)

Figure 110



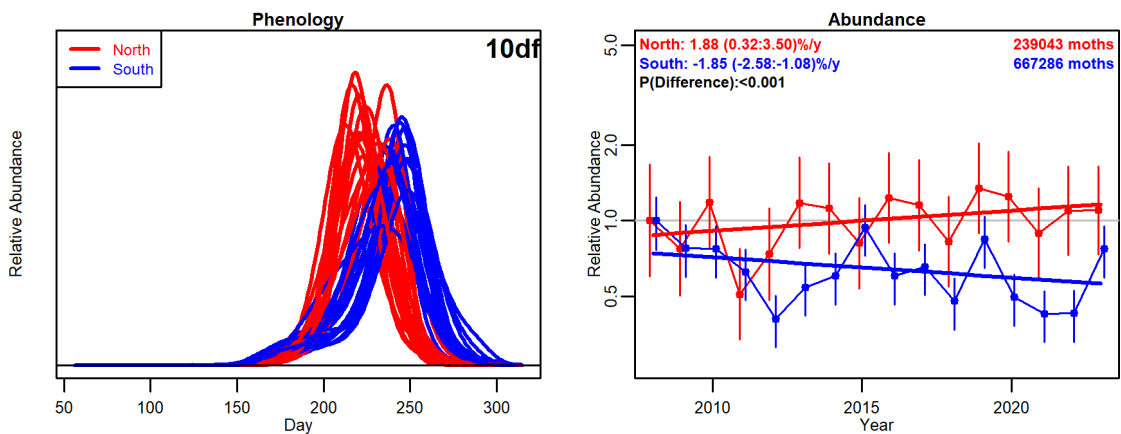
73.334: Small Square-spot (*Diarsia rubi*)

Figure 111



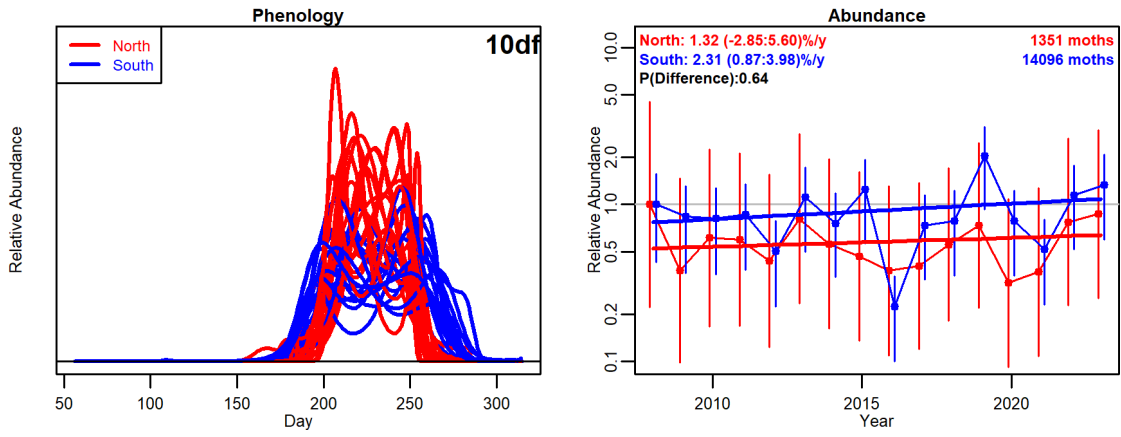
73.338: True Lover's Knot (*Lycophotia porphyrea*)

Figure 112



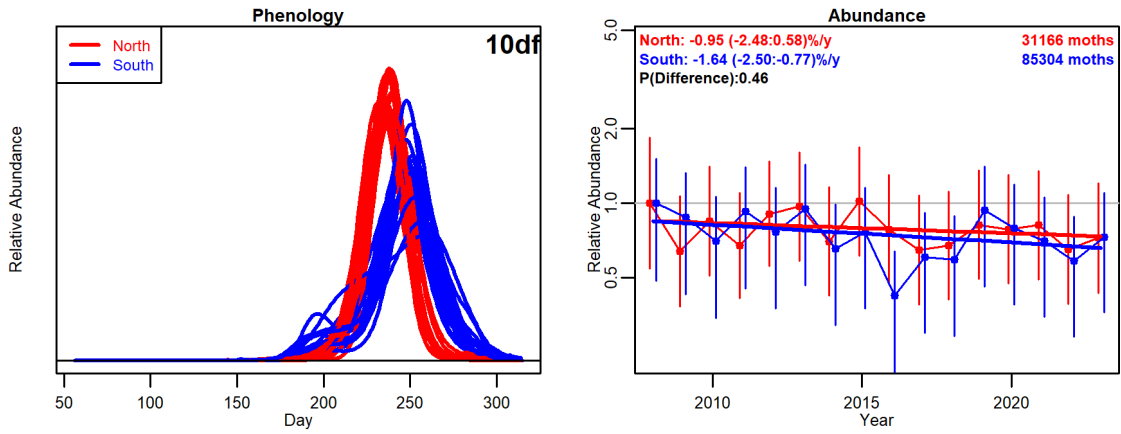
73.342: Large Yellow Underwing (*Noctua pronuba*)

Figure 113



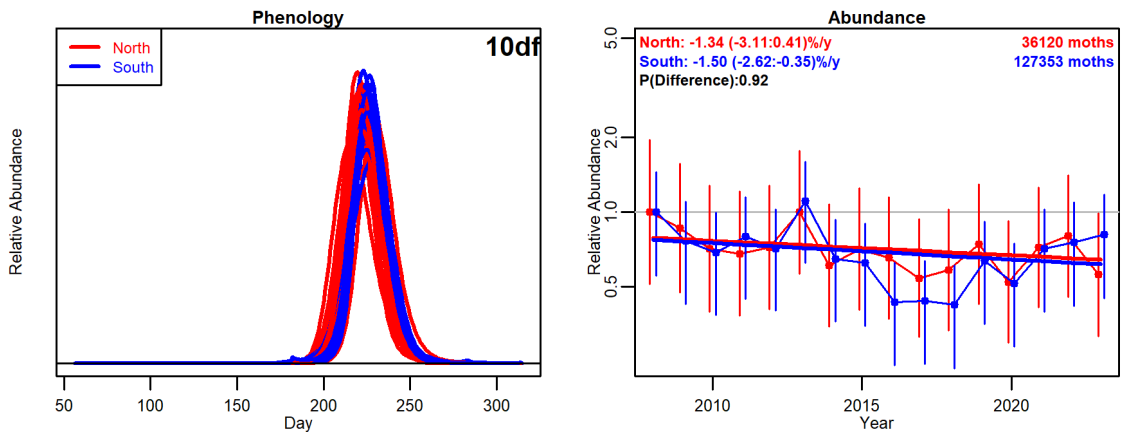
73.343: Broad-bordered Yellow Underwing (*Noctua fimbriata*)

Figure 114



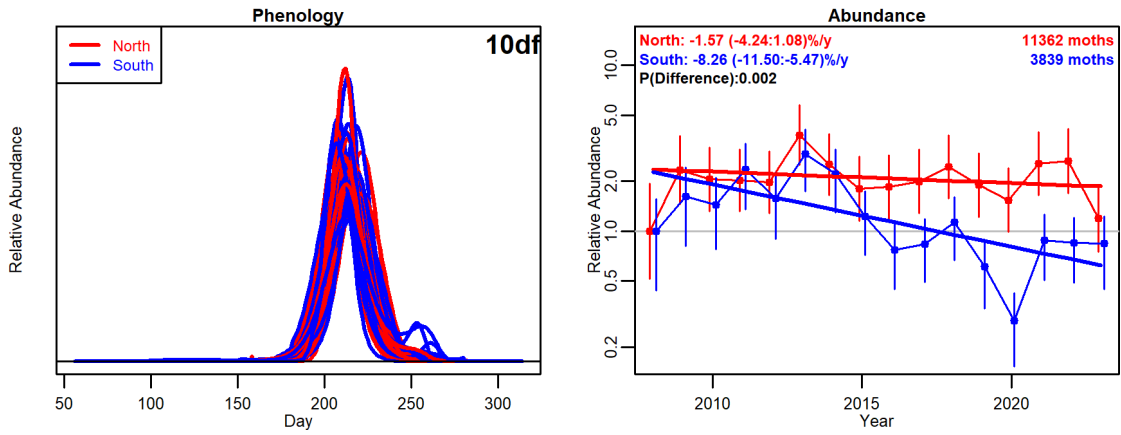
73.345: Lesser Yellow Underwing (*Noctua comes*)

Figure 115



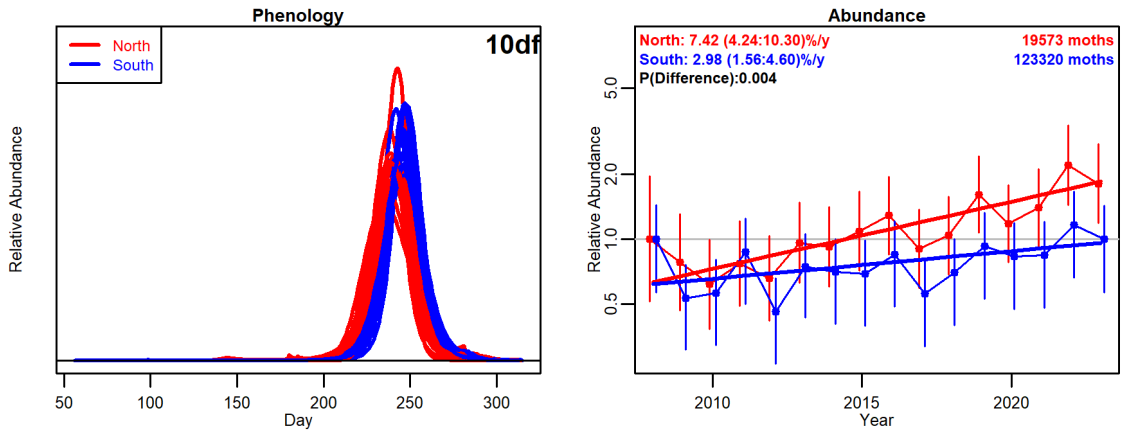
73.348: Lesser Broad-bordered Yellow Underwing (*Noctua janthe*)

Figure 116



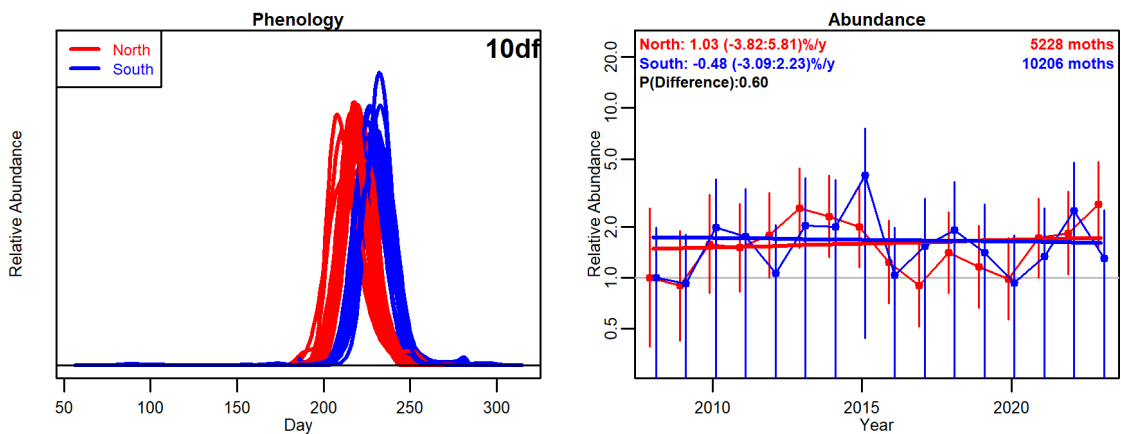
73.353: Dotted Clay (*Xestia baja*)

Figure 117



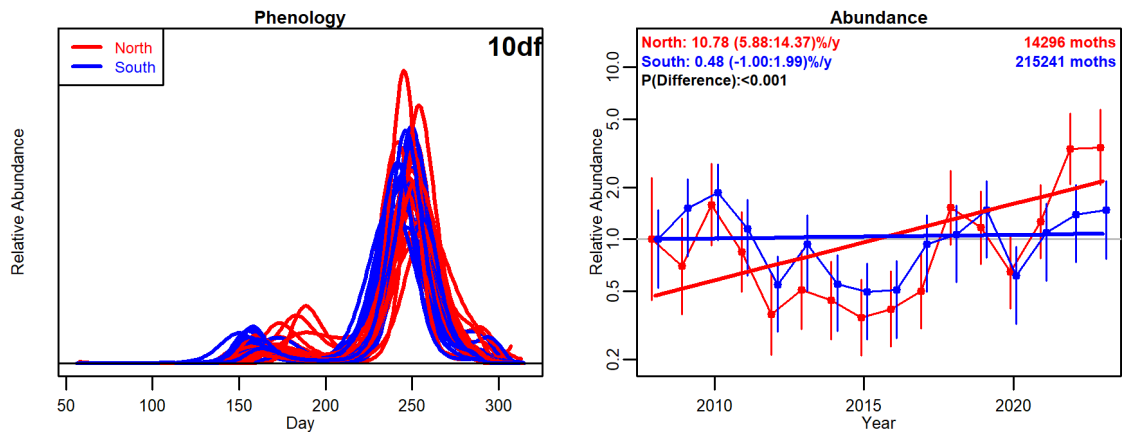
73.357: Square-spot Rustic (*Xestia xanthographa*)

Figure 118



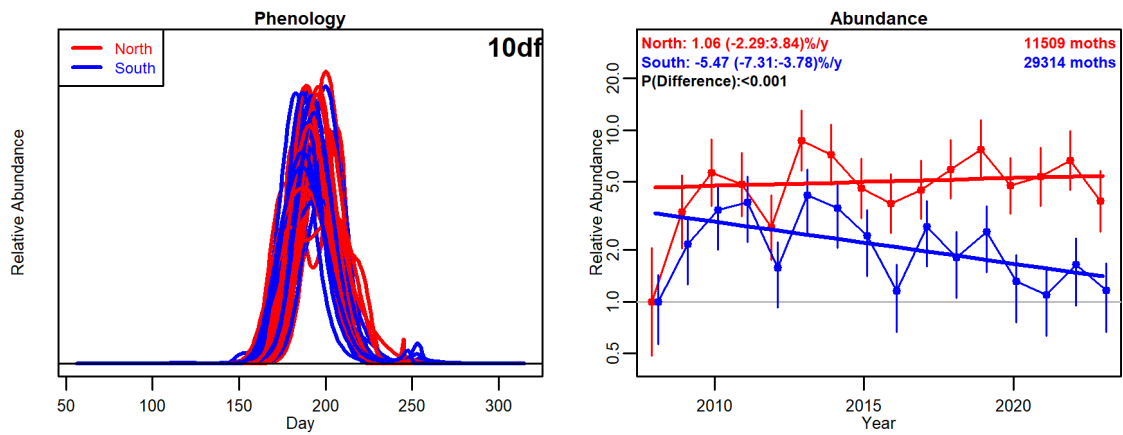
73.358: Six-striped Rustic (*Xestia sexstrigata*)

Figure 119



73.359: Setaceous Hebrew Character (*Xestia c-nigrum*)

Figure 120



73.361: Double Square-spot (*Xestia triangulum*)