## Population Model for Black Mount WHOLE GROUP using Bidwells Model

updated at March 2019 (nearly all 2018 foot count, almost all culls to 2019)

Area 845.75 sq km

| Year | | Stags | Hind | Calves | Total | Density |
|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Count** | 1472 | 3557 | 1071 | **6100** | 7.2 |
| | Recruitment | 536 | 536 | | | |
| | Summer (post calving) | 2008 | 4093 | 1067 | 7167 | 8.5 |
| | Cull | 264 | 365 | 123 | 752 | 0.9 |
| | Winter mortality | 40 | 82 | 72 | 194 | |
| | **Spring 2016 estimate** | **1703** | **3646** | **872** | **6221** | 7.4 |
| 2019/20 | **Spring 2016 estimate** | **1703** | **3646** | **872** | **6221** | 7.4 |
| | Recruitment | 436 | 436 | | | |
| | Summer (post calving) | 2139 | 4082 | 1094 | 7315 | 8.6 |
| | Cull | 282 | 413 | 148 | 843 | 1.0 |
| | Winter mortality | 43 | 82 | 79 | 203 | |
| | **Spring 2017 estimate** | **1815** | **3587** | **867** | **6268** | 7.4 |
| 2020/21 | **Spring 2017 estimate** | **1815** | **3587** | **867** | **6268** | 7.4 |
| | Recruitment | 433 | 433 | | | |
| | Summer (post calving) | 2248 | 4020 | 1076 | 7344 | 8.7 |
| | Cull | 283 | 409 | 167 | 859 | 1.0 |
| | Winter mortality | 45 | 80 | 79 | 204 | |
| | **Spring 2018 estimate** | **1920** | **3531** | **830** | **6281** | 7.4 |
| 2021/22 | **Spring 2018 estimate** | **1920** | **3531** | **830** | **6281** | 7.4 |
| | Recruitment | 415 | 415 | | | |
| | Summer (post calving) | 2335 | 3946 | 1059 | 7340 | 8.7 |
| | Cull | 312 | 385 | 160 | 857 | 1.0 |
| | Winter mortality | 47 | 79 | 79 | 205 | |
| | **Spring 2019 estimate** | **1976** | **3482** | **820** | **6279** | 7.4 |
| 2022/23 | **Spring estimate** | **1976** | **3482** | **820** | **6279** | 7.4 |
| | Recruitment | 410 | 410 | | | |
| | Summer (post calving) | 2387 | 3892 | 1045 | 7323 | 8.7 |
| | Cull | 309 | 390 | 161 | 860 | 1.0 |
| | Winter mortality | 48 | 78 | 80 | 206 | |
| | **Spring 2020 estimate** | **2030** | **3424** | **804** | **6258** | 7.4 |
| 2023/24 | **Spring 2019 estimate** | **2030** | **3424** | **804** | **6258** | 7.4 |
| | Recruitment | 402 | 402 | | | |
| | Summer (post calving) | 2432 | 3826 | 1027 | 7285 | 8.6 |
| | Cull | 308 | 391 | 161 | 860 | 1.0 |
| | Winter mortality | 49 | 77 | 80 | 205 | |
| | **Spring 2021 estimate** | **2075** | **3359** | **786** | **6220** | 7.4 |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Ardchattan using Bidwells Model

Area 70.92 sq km

Aspirational Density
4 - 8 per sq km

| Year | | Stags | Hind | Calves | Total | Density | |
|---|---|---|---|---|---|---|---|
| 2018 to 2019 | **January 2015 Count** | **116** | **253** | **85** | **454** | 6.4 | |
| | Recruitment | 43 | 43 | | | | |
| | Summer (post calving) | 159 | 296 | 76 | 530 | 7.5 | |
| | Cull | 20 | 31 | 7 | 58 | 0.8 | Actual |
| | Winter mortality | 3 | 6 | | 9 | | |
| | **Spring 2019 Estimate** | **135** | **259** | **69** | **463** | 6.5 | |
| 2019/20 | **Spring estimate** | **135** | **259** | **69** | **463** | 6.5 | |
| | Recruitment | 34 | 34 | | | | |
| | Summer (post calving) | 170 | 293 | 78 | 540 | 7.6 | |
| | Cull | 20 | 31 | 7 | 58 | 0.8 | |
| | Winter mortality | 3 | 6 | | 9 | | |
| | **Spring 2020 estimate** | **146** | **256** | **71** | **473** | 6.7 | |
| 2020/21 | **Spring estimate** | **146** | **256** | **71** | **473** | 6.7 | |
| | Recruitment | 35 | 35 | | | | |
| | Summer (post calving) | 182 | 291 | 77 | 550 | 7.8 | |
| | Cull | 20 | 31 | 7 | 58 | 0.8 | |
| | Winter mortality | 4 | 6 | | 9 | | |
| | **Spring 2021 estimate** | **158** | **255** | **70** | **483** | 6.8 | |
| 2021/22 | **Spring estimate** | **158** | **255** | **70** | **483** | 6.8 | |
| | Recruitment | 35 | 35 | | | | |
| | Summer (post calving) | 193 | 290 | 76 | 559 | 7.9 | |
| | Cull | 20 | 31 | 7 | 58 | 0.8 | |
| | Winter mortality | 4 | 6 | | 10 | | |
| | **Spring 2022 Estimate** | **169** | **253** | **69** | **491** | 6.9 | |
| 2022/23 | **Spring estimate** | **169** | **253** | **69** | **491** | 6.9 | |
| | Recruitment | 35 | 35 | | | | |
| | Summer (post calving) | 204 | 287 | 76 | 567 | 8.0 | |
| | Cull | 20 | 31 | 7 | 58 | 0.8 | |
| | Winter mortality | 4 | 6 | | 10 | | |
| | **Spring 2023 Estimate** | **180** | **251** | **69** | **499** | 7.0 | |
| 2023/24 | **Spring estimate** | **180** | **251** | **69** | **499** | 7.0 | |
| | Recruitment | 34 | 34 | | | | |
| | Summer (post calving) | 214 | 285 | 75 | 574 | 8.1 | |
| | Cull | 20 | 31 | 7 | 58 | 0.8 | |
| | Winter mortality | 4 | 6 | | 10 | | |
| | **Spring 2024 Estimate** | **190** | **248** | **68** | **507** | 7.1 | |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Black Corries using Bidwells Model

Area 80.98 sq km

Aspirational Density
East: 4 - 8 per sq km
West 14+ (tbc)

| Year | | Stags | Hind | Calves | Total | Density |
|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **133** | **399** | **112** | **644** | 8.0 |
| | Recruitment | 56 | 56 | | | |
| | Summer (post calving) | 189 | 455 | 120 | 764 | 9.4 |
| | Cull | 40 | 47 | 11 | 98 | 1.2 |
| | Winter mortality | 4 | 9 | | 13 | |
| | **Spring 2019 Estimate** | **145** | **399** | **109** | **653** | 8.1 |
| 2019/20 | **Spring estimate** | **145** | **399** | **109** | **653** | 8.1 |
| | Recruitment | 54 | 54 | | | |
| | Summer (post calving) | 200 | 453 | 120 | 772 | 9.5 |
| | Cull | 40 | 47 | 38 | 125 | 1.5 |
| | Winter mortality | 4 | 9 | | 13 | |
| | **Spring 2020 estimate** | **156** | **397** | **82** | **634** | 7.8 |
| 2020/21 | **Spring estimate** | **156** | **397** | **82** | **634** | 7.8 |
| | Recruitment | 41 | 41 | | | |
| | Summer (post calving) | 196 | 438 | 119 | 754 | 9.3 |
| | Cull | 40 | 50 | 38 | 128 | 1.6 |
| | Winter mortality | 4 | 9 | | 13 | |
| | **Spring 2021 estimate** | **152** | **379** | **81** | **613** | 7.6 |
| 2021/22 | **Spring estimate** | **152** | **379** | **81** | **613** | 7.6 |
| | Recruitment | 41 | 41 | | | |
| | Summer (post calving) | 193 | 420 | 114 | 727 | 9.0 |
| | Cull | 40 | 50 | 38 | 128 | 1.6 |
| | Winter mortality | 4 | 8 | | 12 | |
| | **Spring 2022 Estimate** | **149** | **361** | **76** | **586** | 7.2 |
| 2022/23 | **Spring estimate** | **149** | **361** | **76** | **586** | 7.2 |
| | Recruitment | 38 | 38 | | | |
| | Summer (post calving) | 187 | 399 | 108 | 695 | 8.6 |
| | Cull | 40 | 50 | 38 | 128 | 1.6 |
| | Winter mortality | 4 | 8 | | 12 | |
| | **Spring 2023 Estimate** | **143** | **341** | **70** | **555** | 6.9 |
| 2023/24 | **Spring estimate** | **143** | **341** | **70** | **555** | 6.9 |
| | Recruitment | 35 | 35 | | | |
| | Summer (post calving) | 179 | 377 | 102 | 658 | 8.1 |
| | Cull | 40 | 50 | 40 | 130 | 1.6 |
| | Winter mortality | 4 | 8 | | 11 | |
| | **Spring 2024 Estimate** | **135** | **319** | **62** | **516** | 6.4 |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

**Population Model for Black Mount using Bidwells Model**

Area 245.31 sq km (includes Clashgour)

| Year | | Stags | Hind | Calves | Total | Density | |
|---|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **375** | **743** | **203** | **1321** | 5.4 | |
| | Recruitment | 102 | 102 | | | | |
| | Summer (post calving) | 477 | 845 | 223 | 1544 | 6.3 | |
| | Cull | 76 | 77 | 8 | 161 | 0.7 | actual |
| | Winter mortality | 10 | 17 | | 26 | | |
| | **Spring 2019 Estimate** | **391** | **751** | **215** | **1356** | 5.5 | |
| 2019/20 | **Spring estimate** | **391** | **751** | **215** | **1356** | 5.5 | |
| | Recruitment | 107 | 107 | | | | |
| | Summer (post calving) | 498 | 858 | 225 | 1582 | 6.4 | |
| | Cull | 76 | 77 | 8 | 161 | 0.7 | |
| | Winter mortality | 10 | 17 | | 27 | | |
| | **Spring 2020 estimate** | **412** | **764** | **217** | **1394** | 5.7 | |
| 2020/21 | **Spring estimate** | **412** | **764** | **217** | **1394** | 5.7 | |
| | Recruitment | 109 | 109 | | | | |
| | Summer (post calving) | 521 | 872 | 229 | 1623 | 6.6 | |
| | Cull | 76 | 77 | 8 | 161 | 0.7 | |
| | Winter mortality | 10 | 17 | | 28 | | |
| | **Spring 2021 estimate** | **435** | **778** | **221** | **1434** | 5.8 | |
| 2021/22 | **Spring estimate** | **435** | **778** | **221** | **1434** | 5.8 | |
| | Recruitment | 111 | 111 | | | | |
| | Summer (post calving) | 545 | 889 | 233 | 1667 | 6.8 | |
| | Cull | 76 | 77 | 8 | 161 | 0.7 | |
| | Winter mortality | 11 | 18 | | 29 | | |
| | **Spring 2022 Estimate** | **458** | **794** | **225** | **1478** | 6.0 | |
| 2022/23 | **Spring estimate** | **458** | **794** | **225** | **1478** | 6.0 | |
| | Recruitment | 113 | 113 | | | | |
| | Summer (post calving) | 571 | 907 | 238 | 1716 | 7.0 | |
| | Cull | 76 | 77 | 8 | 161 | 0.7 | |
| | Winter mortality | 11 | 18 | | 30 | | |
| | **Spring 2023 Estimate** | **484** | **811** | **230** | **1525** | 6.2 | |
| 2023/24 | **Spring estimate** | **484** | **811** | **230** | **1525** | 6.2 | |
| | Recruitment | 115 | 115 | | | | |
| | Summer (post calving) | 599 | 927 | 243 | 1769 | 7.2 | |
| | Cull | 76 | 77 | 8 | 161 | 0.7 | |
| | Winter mortality | 12 | 19 | | 31 | | |
| | **Spring 2024 Estimate** | **511** | **831** | **235** | **1577** | 6.4 | |

**Aspirational Density**

| | |
|---|---|
| 9-13 per sq km | SE area (inc E rail) |
| 4-8 per sq km | Remainder of estate |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Crunachy using Bidwells Model

Area 7.58 sq km

| Year | | Stags | Hind | Calves | Total | Density |
|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **30** | **21** | **6** | **57** | 7.5 |
| | Recruitment | 3 | 3 | | | |
| | Summer (post calving) | 33 | 24 | 6 | 63 | 8.4 |
| | Cull | 0 | 0 | 0 | 0 | 0.0 |
| | Winter mortality | 1 | 0 | | 1 | |
| | **Spring 2019 Estimate** | **32** | **24** | **6** | **62** | 8.2 |
| 2019/20 | **Spring estimate** | **32** | **24** | **6** | **62** | 8.2 |
| | Recruitment | 3 | 3 | | | |
| | Summer (post calving) | 35 | 27 | 7 | 69 | 9.1 |
| | Cull | 1 | 3 | 0 | 4 | 0.5 |
| | Winter mortality | 1 | 1 | | 1 | |
| | **Spring 2020 estimate** | **34** | **23** | **7** | **64** | 8.4 |
| 2020/21 | **Spring estimate** | **34** | **23** | **7** | **64** | 8.4 |
| | Recruitment | 4 | 4 | | | |
| | Summer (post calving) | 37 | 27 | 7 | 71 | 9.4 |
| | Cull | 0 | 0 | 0 | 0 | 0.0 |
| | Winter mortality | 1 | 1 | | 1 | |
| | **Spring 2021 estimate** | **37** | **26** | **7** | **70** | 9.2 |
| 2021/22 | **Spring estimate** | **37** | **26** | **7** | **70** | 9.2 |
| | Recruitment | 3 | 3 | | | |
| | Summer (post calving) | 40 | 30 | 8 | 77 | 10.2 |
| | Cull | 2 | 1 | 0 | 3 | 0.4 |
| | Winter mortality | 1 | 1 | | 1 | |
| | **Spring 2022 Estimate** | **37** | **28** | **8** | **73** | 9.6 |
| 2022/23 | **Spring estimate** | **37** | **28** | **8** | **73** | 9.6 |
| | Recruitment | 4 | 4 | | | |
| | Summer (post calving) | 41 | 32 | 8 | 81 | 10.7 |
| | Cull | 0 | 1 | 1 | 2 | 0.3 |
| | Winter mortality | 1 | 1 | | 1 | |
| | **Spring 2023 Estimate** | **40** | **30** | **7** | **78** | 10.3 |
| 2023/24 | **Spring estimate** | **40** | **30** | **7** | **78** | 10.3 |
| | Recruitment | 4 | 4 | | | |
| | Summer (post calving) | 44 | 34 | 9 | 87 | 11.5 |
| | Cull | 0 | 2 | 1 | 3 | 0.4 |
| | Winter mortality | 1 | 1 | | 2 | |
| | **Spring 2024 Estimate** | **43** | **31** | **8** | **83** | 10.9 |

**Aspirational Density**
9-13 per sq km

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Dalness using Bidwells Model

Area 50.38 sq km

| Year | | Stags | Hind | Calves | Total | Density | |
|---|---|---|---|---|---|---|---|
| 2018 | **Spring 2018 Foot Count** | **75** | **202** | **62** | **339** | 6.7 | **Aspirational Density** |
| to 2019 | Recruitment | 31 | 31 | | | | 9-13 per sq km |
| | Summer (post calving) | 106 | 233 | 61 | 400 | 7.9 | |
| | Cull | 15 | 30 | 7 | 52 | 1.0 | Example |
| | Winter mortality | 2 | 5 | | 7 | | |
| | **Spring 2019 Estimate** | **89** | **198** | **54** | **341** | 6.8 | |
| 2019/20 | **Spring estimate** | **89** | **198** | **54** | **341** | 6.8 | |
| | Recruitment | 27 | 27 | | | | |
| | Summer (post calving) | 116 | 225 | 60 | 400 | 7.9 | |
| | Cull | 12 | 34 | 6 | 52 | 1.0 | |
| | Winter mortality | 2 | 5 | | 7 | | |
| | **Spring 2020 estimate** | **101** | **187** | **54** | **342** | 6.8 | |
| 2020/21 | **Spring estimate** | **101** | **187** | **54** | **342** | 6.8 | |
| | Recruitment | 27 | 27 | | | | |
| | Summer (post calving) | 128 | 213 | 56 | 397 | 7.9 | |
| | Cull | 15 | 30 | 7 | 52 | 1.0 | |
| | Winter mortality | 3 | 4 | | 7 | | |
| | **Spring 2021 estimate** | **111** | **179** | **49** | **339** | 6.7 | |
| 2021/22 | **Spring estimate** | **111** | **179** | **49** | **339** | 6.7 | |
| | Recruitment | 24 | 24 | | | | |
| | Summer (post calving) | 135 | 204 | 54 | 392 | 7.8 | |
| | Cull | 15 | 30 | 7 | 52 | 1.0 | |
| | Winter mortality | 3 | 4 | | 7 | | |
| | **Spring 2022 Estimate** | **117** | **170** | **47** | **334** | 6.6 | |
| 2022/23 | **Spring estimate** | **117** | **170** | **47** | **334** | 6.6 | |
| | Recruitment | 23 | 23 | | | | |
| | Summer (post calving) | 141 | 193 | 51 | 384 | 7.6 | |
| | Cull | 15 | 30 | 7 | 52 | 1.0 | |
| | Winter mortality | 3 | 4 | | 7 | | |
| | **Spring 2023 Estimate** | **123** | **159** | **44** | **326** | 6.5 | |
| 2023/24 | **Spring estimate** | **123** | **159** | **44** | **326** | 6.5 | |
| | Recruitment | 22 | 22 | | | | |
| | Summer (post calving) | 145 | 181 | 48 | 374 | 7.4 | |
| | Cull | 15 | 30 | 7 | 52 | 1.0 | |
| | Winter mortality | 3 | 4 | | 7 | | |
| | **Spring 2024 Estimate** | **127** | **147** | **41** | **315** | 6.3 | |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Glen Etive using Bidwells Model

Area 57.57 sq km

| Year | | Stags | Hind | Calves | Total | Density | Aspirational Density |
|---|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **149** | **294** | **52** | **495** | 8.6 | 4-8 per sq km |
| | Recruitment | 26 | 26 | | | | |
| | Summer (post calving) | 175 | 320 | 88 | 583 | 10.1 | |
| | Cull | 22 | 26 | 5 | 53 | 0.9 actual | |
| | Winter mortality | 4 | 6 | | 10 | | |
| | **Spring 2019 Estimate** | **150** | **288** | **83** | **520** | 9.0 | |
| 2019/20 | **Spring estimate** | **150** | **288** | **83** | **520** | 9.0 | |
| | Recruitment | 42 | 42 | | | | |
| | Summer (post calving) | 191 | 329 | 86 | 607 | 10.5 | |
| | Cull | 24 | 30 | 20 | 74 | 1.3 | |
| | Winter mortality | 4 | 7 | | 10 | | |
| | **Spring 2020 estimate** | **163** | **293** | **66** | **522** | 9.1 | |
| 2020/21 | **Spring estimate** | **163** | **293** | **66** | **522** | 9.1 | |
| | Recruitment | 33 | 33 | | | | |
| | Summer (post calving) | 196 | 326 | 88 | 610 | 10.6 | |
| | Cull | 24 | 30 | 20 | 74 | 1.3 | |
| | Winter mortality | 4 | 7 | | 10 | | |
| | **Spring 2021 estimate** | **168** | **289** | **68** | **526** | 9.1 | |
| 2021/22 | **Spring estimate** | **168** | **289** | **68** | **526** | 9.1 | |
| | Recruitment | 34 | 34 | | | | |
| | Summer (post calving) | 202 | 323 | 87 | 612 | 10.6 | |
| | Cull | 24 | 30 | 20 | 74 | 1.3 | |
| | Winter mortality | 4 | 6 | | 11 | | |
| | **Spring 2022 Estimate** | **174** | **287** | **67** | **528** | 9.2 | |
| 2022/23 | **Spring estimate** | **174** | **287** | **67** | **528** | 9.2 | |
| | Recruitment | 33 | 33 | | | | |
| | Summer (post calving) | 208 | 320 | 86 | 614 | 10.7 | |
| | Cull | 24 | 30 | 20 | 74 | 1.3 | |
| | Winter mortality | 4 | 6 | | 11 | | |
| | **Spring 2023 Estimate** | **180** | **284** | **66** | **529** | 9.2 | |
| 2023/24 | **Spring estimate** | **180** | **284** | **66** | **529** | 9.2 | |
| | Recruitment | 33 | 33 | | | | |
| | Summer (post calving) | 213 | 317 | 85 | 614 | 10.7 | |
| | Cull | 24 | 30 | 20 | 74 | 1.3 | |
| | Winter mortality | 4 | 6 | | 11 | | |
| | **Spring 2024 Estimate** | **184** | **280** | **65** | **530** | 9.2 | |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Glen Noe using Bidwells Model

Area 22.51 sq km

| Year | | Stags | Hind | Calves | Total | Density | Aspirational Density |
|---|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **3** | **27** | **12** | **42** | 1.9 | 0-3 per sq km |
| | Recruitment | 6 | 6 | | | | |
| | Summer (post calving) | 9 | 33 | 8 | 50 | 2.2 | |
| | Cull | 5 | 2 | 1 | 8 | 0.4 | |
| | Winter mortality | 0 | 1 | | 1 | | |
| | **Spring 2019 Estimate** | **4** | **30** | **7** | **41** | 1.8 | confirmed calving 30% |
| 2019/20 | **Spring estimate** | **4** | **30** | **7** | **41** | 1.8 | |
| | Recruitment | 4 | 4 | | | | |
| | Summer (post calving) | 7 | 34 | 9 | 50 | 2.2 | |
| | Cull | 5 | 2 | 2 | 9 | 0.4 | |
| | Winter mortality | 0 | 1 | | 1 | | |
| | **Spring 2020 estimate** | **2** | **31** | **7** | **41** | 1.8 | |
| 2020/21 | **Spring estimate** | **2** | **31** | **7** | **41** | 1.8 | |
| | Recruitment | 4 | 4 | | | | |
| | Summer (post calving) | 6 | 35 | 9 | 50 | 2.2 | |
| | Cull | 4 | 2 | 2 | 8 | 0.4 | |
| | Winter mortality | 0 | 1 | | 1 | | |
| | **Spring 2021 estimate** | **2** | **32** | **7** | **41** | 1.8 | |
| 2021/22 | **Spring estimate** | **2** | **32** | **7** | **41** | 1.8 | |
| | Recruitment | 4 | 4 | | | | |
| | Summer (post calving) | 5 | 36 | 10 | 51 | 2.3 | |
| | Cull | 2 | 0 | 1 | 3 | 0.1 | |
| | Winter mortality | 0 | 1 | | 1 | | |
| | **Spring 2022 Estimate** | **3** | **35** | **9** | **47** | 2.1 | |
| 2022/23 | **Spring estimate** | **3** | **35** | **9** | **47** | 2.1 | |
| | Recruitment | 4 | 4 | | | | |
| | Summer (post calving) | 8 | 39 | 11 | 57 | 2.5 | |
| | Cull | 1 | 5 | 1 | 7 | 0.3 | |
| | Winter mortality | 0 | 1 | | 1 | | |
| | **Spring 2023 Estimate** | **6** | **34** | **10** | **49** | 2.2 | |
| 2023/24 | **Spring estimate** | **6** | **34** | **10** | **49** | 2.2 | |
| | Recruitment | 5 | 5 | | | | |
| | Summer (post calving) | 11 | 38 | 10 | 60 | 2.6 | |
| | Cull | 0 | 0 | 0 | 0 | 0.0 | |
| | Winter mortality | 0 | 1 | | 1 | | |
| | **Spring 2024 Estimate** | **11** | **38** | **10** | **59** | 2.6 | |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Glencreran using Bidwells Model

Area 45.79 sq km

| Year | | Stags | Hind | Calves | Total | Density | Aspirational Density |
|---|---|---|---|---|---|---|---|
| 2018 to 2019 | **January 2015 Count** | **60** | **421** | **158** | **639** | 14.0 | ?? |
| | Recruitment | 79 | 79 | | | | |
| | Summer (post calving) | 139 | 500 | 126 | 765 | 16.7 | |
| | Cull | 24 | 19 | 26 | 69 | 1.5 actual | |
| | Winter mortality | 3 | 10 | | 13 | | |
| | **Spring 2019 Estimate** | **112** | **471** | **100** | **684** | 14.9 | |
| 2019/20 | **Spring estimate** | **112** | **471** | **100** | **684** | 14.9 | |
| | Recruitment | 50 | 50 | | | | |
| | Summer (post calving) | 162 | 521 | 141 | 825 | 18.0 | |
| | Cull | 34 | 41 | 10 | 85 | 1.9 | |
| | Winter mortality | 3 | 10 | | 14 | | |
| | **Spring 2020 estimate** | **125** | **470** | **131** | **726** | 15.9 | |
| 2020/21 | **Spring estimate** | **125** | **470** | **131** | **726** | 15.9 | |
| | Recruitment | 66 | 66 | | | | |
| | Summer (post calving) | 191 | 535 | 141 | 867 | 18.9 | |
| | Cull | 34 | 41 | 10 | 85 | 1.9 | |
| | Winter mortality | 4 | 11 | | 15 | | |
| | **Spring 2021 estimate** | **153** | **484** | **131** | **768** | 16.8 | |
| 2021/22 | **Spring estimate** | **153** | **484** | **131** | **768** | 16.8 | |
| | Recruitment | 65 | 65 | | | | |
| | Summer (post calving) | 218 | 549 | 145 | 913 | 19.9 | |
| | Cull | 34 | 41 | 10 | 85 | 1.9 | |
| | Winter mortality | 4 | 11 | | 15 | | |
| | **Spring 2022 Estimate** | **180** | **497** | **135** | **812** | 17.7 | |
| 2022/23 | **Spring estimate** | **180** | **497** | **135** | **812** | 17.7 | |
| | Recruitment | 68 | 68 | | | | |
| | Summer (post calving) | 248 | 565 | 149 | 961 | 21.0 | |
| | Cull | 34 | 41 | 10 | 85 | 1.9 | |
| | Winter mortality | 5 | 11 | | 16 | | |
| | **Spring 2023 Estimate** | **209** | **512** | **139** | **860** | 18.8 | |
| 2023/24 | **Spring estimate** | **209** | **512** | **139** | **860** | 18.8 | |
| | Recruitment | 70 | 70 | | | | |
| | Summer (post calving) | 278 | 582 | 154 | 1014 | 22.1 | |
| | Cull | 34 | 41 | 10 | 85 | 1.9 | |
| | Winter mortality | 6 | 12 | | 17 | | |
| | **Spring 2024 Estimate** | **239** | **529** | **144** | **912** | 19.9 | |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Glenkinglass using Bidwells Model

Area 84.49 sq km

| Year | | Stags | Hind | Calves | Total | Density |
|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **191** | **376** | **120** | **687** | 8.1 |
| | Recruitment | 60 | 60 | | | |
| | Summer (post calving) | 251 | 436 | 113 | 800 | 9.5 |
| | Cull | 22 | 36 | 12 | 70 | 0.8 |
| | Winter mortality | 5 | 9 | | 14 | |
| | **Spring 2019 Estimate** | **224** | **391** | **101** | **716** | 8.5 |
| 2019/20 | **Spring estimate** | **224** | **391** | **101** | **716** | 8.5 |
| | Recruitment | 50 | 50 | | | |
| | Summer (post calving) | 274 | 442 | 117 | 833 | 9.9 |
| | Cull | 22 | 36 | 12 | 70 | 0.8 |
| | Winter mortality | 5 | 9 | | 14 | |
| | **Spring 2020 estimate** | **247** | **397** | **105** | **749** | 8.9 |
| 2020/21 | **Spring estimate** | **247** | **397** | **105** | **749** | 8.9 |
| | Recruitment | 53 | 53 | | | |
| | Summer (post calving) | 300 | 450 | 119 | 868 | 10.3 |
| | Cull | 22 | 36 | 12 | 70 | 0.8 |
| | Winter mortality | 6 | 9 | | 15 | |
| | **Spring 2021 estimate** | **272** | **405** | **107** | **783** | 9.3 |
| 2021/22 | **Spring estimate** | **272** | **405** | **107** | **783** | 9.3 |
| | Recruitment | 54 | 54 | | | |
| | Summer (post calving) | 325 | 458 | 121 | 905 | 10.7 |
| | Cull | 30 | 35 | 12 | 77 | 0.9 |
| | Winter mortality | 7 | 9 | | 16 | |
| | **Spring 2022 Estimate** | **289** | **414** | **109** | **812** | 9.6 |
| 2022/23 | **Spring estimate** | **289** | **414** | **109** | **812** | 9.6 |
| | Recruitment | 55 | 55 | | | |
| | Summer (post calving) | 343 | 469 | 124 | 936 | 11.1 |
| | Cull | 30 | 35 | 12 | 77 | 0.9 |
| | Winter mortality | 7 | 9 | | 16 | |
| | **Spring 2023 Estimate** | **306** | **424** | **112** | **843** | 10.0 |
| 2023/24 | **Spring estimate** | **306** | **424** | **112** | **843** | 10.0 |
| | Recruitment | 56 | 56 | | | |
| | Summer (post calving) | 363 | 480 | 127 | 970 | 11.5 |
| | Cull | 35 | 40 | 12 | 87 | 1.0 |
| | Winter mortality | 7 | 10 | | 17 | |
| | **Spring 2024 Estimate** | **320** | **431** | **115** | **866** | 10.3 |

**Aspirational Density**
0-3 per sq km

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Glenstrae using Bidwells Model

Area 39.95 sq km

| Year | | Stags | Hind | Calves | Total | Density |
|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **47** | **337** | **90** | **474** | 11.9 |
| | Recruitment | 45 | 45 | | | |
| | Summer (post calving) | 92 | 382 | 101 | 575 | 14.4 |
| | Cull | 11 | 8 | 12 | 31 | 0.8 actual |
| | Winter mortality | 2 | 8 | | 9 | |
| | **Spring 2019 Estimate** | **79** | **366** | **89** | **535** | 13.4 |
| 2019/20 | **Spring estimate** | **79** | **366** | **89** | **535** | 13.4 |
| | Recruitment | 45 | 45 | | | |
| | Summer (post calving) | 124 | 411 | 110 | 645 | 16.1 |
| | Cull | 14 | 11 | 6 | 31 | 0.8 |
| | Winter mortality | 2 | 8 | | 11 | |
| | **Spring 2020 estimate** | **107** | **392** | **104** | **603** | 15.1 |
| 2020/21 | **Spring estimate** | **107** | **392** | **104** | **603** | 15.1 |
| | Recruitment | 52 | 52 | | | |
| | Summer (post calving) | 159 | 444 | 118 | 720 | 18.0 |
| | Cull | 13 | 12 | 12 | 37 | 0.9 |
| | Winter mortality | 3 | 9 | | 12 | |
| | **Spring 2021 estimate** | **143** | **423** | **106** | **671** | 16.8 |
| 2021/22 | **Spring estimate** | **143** | **423** | **106** | **671** | 16.8 |
| | Recruitment | 53 | 53 | | | |
| | Summer (post calving) | 196 | 476 | 127 | 798 | 20.0 |
| | Cull | 24 | 16 | 14 | 54 | 1.4 |
| | Winter mortality | 4 | 10 | | 13 | |
| | **Spring 2022 Estimate** | **168** | **450** | **113** | **731** | 18.3 |
| 2022/23 | **Spring estimate** | **168** | **450** | **113** | **731** | 18.3 |
| | Recruitment | 56 | 56 | | | |
| | Summer (post calving) | 224 | 506 | 135 | 866 | 21.7 |
| | Cull | 24 | 16 | 14 | 54 | 1.4 |
| | Winter mortality | 4 | 10 | | 15 | |
| | **Spring 2023 Estimate** | **196** | **480** | **121** | **797** | 20.0 |
| 2023/24 | **Spring estimate** | **196** | **480** | **121** | **797** | 20.0 |
| | Recruitment | 61 | 61 | | | |
| | Summer (post calving) | 256 | 541 | 144 | 941 | 23.6 |
| | Cull | 24 | 16 | 14 | 54 | 1.4 |
| | Winter mortality | 5 | 11 | | 16 | |
| | **Spring 2024 Estimate** | **227** | **514** | **130** | **871** | 21.8 |

**Aspirational Density**
14+ per sq km
4-8 on lower ground

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Inverliever using Bidwells Model

Area 14.45 sq km

| Year | | Stags | Hind | Calves | Total | Density |
|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **9** | **78** | **16** | **103** | 7.1 |
| | Recruitment | 8 | 8 | | | |
| | Summer (post calving) | 17 | 86 | 23 | 126 | 8.7 |
| | Cull | 2 | 5 | 0 | 7 | 0.5 |
| | Winter mortality | 0 | 2 | | 2 | |
| | **Spring 2019 Estimate** | **15** | **79** | **23** | **117** | 8.1 |
| 2019/20 | **Spring estimate** | **15** | **79** | **23** | **117** | 8.1 |
| | Recruitment | 12 | 12 | | | |
| | Summer (post calving) | 26 | 91 | 24 | 141 | 9.8 |
| | Cull | 4 | 15 | 7 | 26 | 1.8 |
| | Winter mortality | 1 | 2 | | 2 | |
| | **Spring 2020 estimate** | **22** | **74** | **17** | **113** | 7.8 |
| 2020/21 | **Spring estimate** | **22** | **74** | **17** | **113** | 7.8 |
| | Recruitment | 8 | 8 | | | |
| | Summer (post calving) | 30 | 83 | 22 | 135 | 9.3 |
| | Cull | 4 | 14 | 8 | 26 | 1.8 |
| | Winter mortality | 1 | 2 | | 2 | |
| | **Spring 2021 estimate** | **26** | **67** | **14** | **107** | 7.4 |
| 2021/22 | **Spring estimate** | **26** | **67** | **14** | **107** | 7.4 |
| | Recruitment | 7 | 7 | | | |
| | Summer (post calving) | 33 | 74 | 20 | 127 | 8.8 |
| | Cull | 3 | 5 | 3 | 11 | 0.8 |
| | Winter mortality | 1 | 1 | | 2 | |
| | **Spring 2022 Estimate** | **29** | **68** | **17** | **114** | 7.9 |
| 2022/23 | **Spring estimate** | **29** | **68** | **17** | **114** | 7.9 |
| | Recruitment | 9 | 9 | | | |
| | Summer (post calving) | 38 | 76 | 20 | 134 | 9.3 |
| | Cull | 2 | 5 | 3 | 10 | 0.7 |
| | Winter mortality | 1 | 2 | | 2 | |
| | **Spring 2023 Estimate** | **35** | **70** | **17** | **122** | 8.4 |
| 2023/24 | **Spring estimate** | **35** | **70** | **17** | **122** | 8.4 |
| | Recruitment | 9 | 9 | | | |
| | Summer (post calving) | 44 | 78 | 21 | 143 | 9.9 |
| | Cull | 2 | 5 | 3 | 10 | 0.7 |
| | Winter mortality | 1 | 2 | | 2 | |
| | **Spring 2024 Estimate** | **41** | **72** | **18** | **130** | 9.0 |

**Aspirational Density**
0-3 per sq km

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for National Trust for Scotland Using Bidwells Model

Area 56.13 sq km

| Year | | Stags | Hind | Calves | Total | Density | Aspirational Density |
|---|---|---|---|---|---|---|---|
| 2018 | **January 2015 Count** | **271** | **353** | **138** | **762** | 13.6 | 0-3 per sq in lower G'coe |
| to 2019 | Recruitment | 69 | 69 | | | | 9-13 per s elsewhere |
| | Summer (post calving) | 340 | 422 | 106 | 868 | 15.5 | |
| | Cull | 19 | 75 | 31 | 125 | 2.2 | estimate from 2018 |
| | Winter mortality | 7 | 8 | | 15 | | |
| | **Spring 2019 Estimate** | **314** | **339** | **75** | **728** | 13.0 | |
| 2019/20 | **Spring estimate** | **314** | **339** | **75** | **728** | 13.0 | |
| | Recruitment | 37 | 37 | | | | |
| | Summer (post calving) | 352 | 376 | 102 | 829 | 14.8 | |
| | Cull | 19 | 75 | 31 | 125 | 2.2 | |
| | Winter mortality | 7 | 8 | | 15 | | |
| | **Spring 2020 estimate** | **326** | **293** | **71** | **690** | 12.3 | |
| 2020/21 | **Spring estimate** | **326** | **293** | **71** | **690** | 12.3 | |
| | Recruitment | 35 | 35 | | | | |
| | Summer (post calving) | 361 | 329 | 88 | 778 | 13.9 | |
| | Cull | 19 | 75 | 31 | 125 | 2.2 | |
| | Winter mortality | 7 | 7 | | 14 | | |
| | **Spring 2021 estimate** | **335** | **247** | **57** | **639** | 11.4 | |
| 2021/22 | **Spring estimate** | **335** | **247** | **57** | **639** | 11.4 | |
| | Recruitment | 29 | 29 | | | | |
| | Summer (post calving) | 363 | 276 | 74 | 713 | 12.7 | |
| | Cull | 30 | 55 | 27 | 112 | 2.0 | |
| | Winter mortality | 7 | 6 | | 13 | | |
| | **Spring 2022 Estimate** | **326** | **215** | **47** | **588** | 10.5 | |
| 2022/23 | **Spring estimate** | **326** | **215** | **47** | **588** | 10.5 | |
| | Recruitment | 24 | 24 | | | | |
| | Summer (post calving) | 350 | 239 | 65 | 653 | 11.6 | |
| | Cull | 30 | 55 | 27 | 112 | 2.0 | |
| | Winter mortality | 7 | 5 | | 12 | | |
| | **Spring 2023 Estimate** | **313** | **179** | **38** | **529** | 9.4 | |
| 2023/24 | **Spring estimate** | **313** | **179** | **38** | **529** | 9.4 | |
| | Recruitment | 19 | 19 | | | | |
| | Summer (post calving) | 331 | 198 | 54 | 583 | 10.4 | |
| | Cull | 25 | 55 | 27 | 107 | 1.9 | |
| | Winter mortality | 7 | 4 | | 11 | | |
| | **Spring 2024 Estimate** | **300** | **139** | **27** | **465** | 8.3 | |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Auch using Bidwells Model

| | | | | Area | 34.87 | sq km |
|---|---|---|---|---|---|---|
| **Year** | | Stags | Hind | Calves | Total | Density |
| 2018 | **January 2015 Count** | **2** | **27** | **6** | **35** | 1.0 |
| to 2019 | Recruitment | 3 | 3 | | | |
| | Summer (post calving) | 5 | 30 | 8 | 43 | 1.2 |
| | Cull | 7 | 8 | 2 | 17 | 0.5 |
| | Winter mortality | 0 | 1 | | 1 | |
| | **Spring 2019 Estimate** | **-2** | **21** | **6** | **25** | 0.7 |
| 2019/20 | **Spring estimate** | **-2** | **21** | **6** | **25** | 0.7 |
| | Recruitment | 3 | 3 | | | |
| | Summer (post calving) | 1 | 24 | 6 | 32 | 0.9 |
| | Cull | 10 | 10 | | 20 | 0.6 |
| | Winter mortality | 0 | 0 | | 1 | |
| | **Spring 2020 estimate** | **-9** | **14** | **6** | **11** | 0.3 |
| 2020/21 | **Spring estimate** | **-9** | **14** | **6** | **11** | 0.3 |
| | Recruitment | 3 | 3 | | | |
| | Summer (post calving) | -6 | 17 | 4 | 16 | 0.4 |
| | Cull | 10 | 10 | 11 | 31 | 0.9 |
| | Winter mortality | 0 | 0 | | 0 | |
| | **Spring 2021 estimate** | **-16** | **7** | **-7** | **-16** | -0.5 |
| 2021/22 | **Spring estimate** | **-16** | **7** | **-7** | **-16** | -0.5 |
| | Recruitment | -3 | -3 | | | |
| | Summer (post calving) | -19 | 3 | 2 | -14 | -0.4 |
| | Cull | 10 | 10 | 11 | 31 | 0.9 |
| | Winter mortality | 0 | 0 | | 0 | |
| | **Spring 2022 Estimate** | **-29** | **-7** | **-9** | **-44** | -1.3 |
| 2022/23 | **Spring estimate** | **-29** | **-7** | **-9** | **-44** | -1.3 |
| | Recruitment | -4 | -4 | | | |
| | Summer (post calving) | -33 | -11 | -2 | -46 | -1.3 |
| | Cull | 10 | 10 | 11 | 31 | 0.9 |
| | Winter mortality | -1 | 0 | | -1 | |
| | **Spring 2023 Estimate** | **-43** | **-21** | **-13** | **-76** | -2.2 |
| 2023/24 | **Spring estimate** | **-43** | **-21** | **-13** | **-76** | -2.2 |
| | Recruitment | -6 | -6 | | | |
| | Summer (post calving) | -49 | -27 | -6 | -83 | -2.4 |
| | Cull | 10 | 10 | 11 | 31 | 0.9 |
| | Winter mortality | -1 | -1 | | -2 | |
| | **Spring 2024 Estimate** | **-58** | **-37** | **-17** | **-112** | -3.2 |

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae

## Population Model for Castles using Bidwells Model

Area 34.82 sq km

| Year | | Stags | Hind | Calves | Total | Density |
|---|---|---|---|---|---|---|
| 2018 to 2019 | **Spring 2018 Foot Cour** | **11** | **26** | **11** | **48** | 1.4 |
| | Recruitment | 6 | 6 | | | |
| | Summer (post calving) | 17 | 32 | 8 | 56 | 1.6 |
| | Cull | 1 | 1 | 1 | 3 | 0.1 |
| | Winter mortality | 0 | 1 | | 1 | |
| | **Spring 2019 Estimate** | **15** | **30** | **7** | **52** | 1.5 |
| 2019/20 | **Spring estimate** | **15** | **30** | **7** | **52** | 1.5 |
| | Recruitment | 3 | 3 | | | |
| | Summer (post calving) | 19 | 33 | 9 | 61 | 1.7 |
| | Cull | 1 | 1 | 1 | 3 | 0.1 |
| | Winter mortality | 0 | 1 | | 1 | |
| | **Spring 2020 estimate** | **17** | **32** | **8** | **57** | 1.6 |
| 2020/21 | **Spring estimate** | **17** | **32** | **8** | **57** | 1.6 |
| | Recruitment | 4 | 4 | | | |
| | Summer (post calving) | 21 | 36 | 9 | 66 | 1.9 |
| | Cull | 2 | 1 | 1 | 4 | 0.1 |
| | Winter mortality | 0 | 1 | | 1 | |
| | **Spring 2021 estimate** | **19** | **34** | **8** | **61** | 1.8 |
| 2021/22 | **Spring estimate** | **19** | **34** | **8** | **61** | 1.8 |
| | Recruitment | 4 | 4 | | | |
| | Summer (post calving) | 23 | 38 | 10 | 71 | 2.0 |
| | Cull | 2 | 4 | 2 | 8 | 0.2 |
| | Winter mortality | 0 | 1 | | 1 | |
| | **Spring 2022 Estimate** | **21** | **33** | **8** | **62** | 1.8 |
| 2022/23 | **Spring estimate** | **21** | **33** | **8** | **62** | 1.8 |
| | Recruitment | 4 | 4 | | | |
| | Summer (post calving) | 25 | 37 | 10 | 72 | 2.1 |
| | Cull | 3 | 4 | 2 | 9 | 0.3 |
| | Winter mortality | 0 | 1 | | 1 | |
| | **Spring 2023 Estimate** | **21** | **33** | **8** | **62** | 1.8 |
| 2023/24 | **Spring estimate** | **21** | **33** | **8** | **62** | 1.8 |
| | Recruitment | 4 | 4 | | | |
| | Summer (post calving) | 25 | 37 | 10 | 72 | 2.1 |
| | Cull | 3 | 4 | 1 | 8 | 0.2 |
| | Winter mortality | 1 | 1 | | 1 | |
| | **Spring 2024 Estimate** | **22** | **32** | **9** | **62** | 1.8 |

**Aspirational Density**
4-8 per sq km

**Notes:**

Calves = 30% calving rate used

Recruitment = 50% stags, 50% hinds from Sping Calves Estimate

Mortality = No formula given. 2% of Summer population for Stags & Hinds

Assumed there is no immgration or emigration

= blue cells are manually entered numbers

= grey cells contain formulae