# Multi-Criteria Decision Analysis (MCDA) for Natura 2000 Features in Wales – Conservation Needs Assessment

**Reference No:** CEN 4131

**Issued by:** ADAS UK Ltd

**Date:** 20 Jul 2015

**Submitted to:** LIFE Natura 2000 Programme, Natural Resources Wales

**Prepared by:** Michael Image, Environmental Assessment Consultant, ADAS UK Ltd.

LIFE Natura 2000 Programme for Wales

LIFE N2K Wales: LIFE 11 NAT/UK/385

Action A.9 Evidence Gaps

LIFE Natura 2000 Programme for Wales: Conservation Needs Assessment of Natura 2000 Features at a Wales level – Multi-Criteria Decision Analysis


LIFE N2K Wales: LIFE11 NAT/UK/385

Supported by LIFE, a financial instrument of the European Community

# Contents

# 1 Crynodeb Gweithredol

## Cyflwyniad

Mae'r Rhaglen LIFE Natura 2000 yn ceisio canfod a chytuno ar flaenoriaethau ar gyfer y gyfres Natura 2000 (N2K) yng Nghymru. Mae hyn yn cynnwys cynnal dadansoddiad o anghenion cadwraeth ar gyfer rhywogaethau a nodweddion cynefinoedd N2K, sef cynefinoedd Atodiad I a rhywogaethau Atodiad II y Gyfarwyddeb Cynefinoedd, yn ogystal ag adar Atodiad I y Gyfarwyddeb Adar a rhywogaethau mudol rheolaidd sydd wedi'u dynodi ar Ardaloedd Cadwraeth Arbennig ac Ardaloedd Gwarchodaeth Arbennig yng Nghymru. Caiff y Rhaglen ei rheoli gan Cyfoeth Naturiol Cymru (CNC) a'i hariannu ar y cyd gan LIFE+ Nature yr UE a bydd yn cael ei chwblhau ym mis Medi 2015.

Mae CNC wedi cyfarwyddo ADAS UK Ltd (ADAS) i gynnal Dadansoddiad Penderfyniad Meini Prawf Lluosog (*Multi-Criteria Decision Analysis (MCDA*)) o nodweddion N2K yng Nghymru. Mae'r MCDA yn ddull systematig o ddarganfod a mesur tystiolaeth ac ystyriaethau rhanddeiliaid ynglŷn â gwahanol ffactorau er mwyn cymharu a graddio gwahanol ffyrdd o weithredu. Y diben yn yr achos hwn yw sefydlu, yn y ffordd fwyaf gwrthrychol a gwyddonol bosibl, pa nodweddion sydd â'r anghenion a'r sbardunau mwyaf er mwyn eu rheoli a'u hadfer. Bydd hyn yn erfyn gwerthfawr ar gyfer ymarferwyr a phenderfynwyr i'w helpu i ganfod lle gellir cyfeirio adnoddau prin er mwyn cael yr effaith orau, a pha feysydd gwaith y dylid mynd i'r afael â nhw yn gyntaf.

Mae proses yr MCDA yn seiliedig ar fatrics (yn MS Excel) lle mae nodweddion N2K yn cael eu dosbarthu yn ôl meini prawf sy'n seiliedig ar anghenion a sbardunau cadwraeth, ac sy'n ymgorffori dewisiad pwysoli arbenigwyr ar rywogaethau a chynefinoedd yn CNC. Datblygwyd cyfres o dri matrics MCDA gan ADAS, a hynny ar gyfer cynefinoedd Atodiad I, rhywogaethau Atodiad II, ac adar Atodiad I.

Mae'r MCDA yn un o blith nifer o ddeunyddiau a ddatblygwyd gan Raglen LIFE Natura 2000 i gynorthwyo'r broses o ganfod blaenoriaethau strategol. Nid yw'r MCDA wedi cael ei fwriadu i'w ddefnyddio ar ei ben ei hun, nac fel rhestr swyddogol o flaenoriaethau cadwraeth, ond i'w ddefnyddio o fewn cyd-destun ehangach y deunyddiau sydd ar gael. Nodir y dull cyffredinol yn LIFE Natura 2000 Programme Approach to Prioritisation.

## Crynodeb o'r Fethodoleg

Ceir crynodeb o'r fethodoleg isod. Gellir cael manylion llawn ynghylch y fethodoleg yn yr adran fethodoleg o'r ddogfen.

Mae'r MCDA yn dilyn dull lle mae data crai ar nodweddion ar gyfer nifer o feini prawf yn cael ei gasglu a'i droi'n sgôr ar sail metrig cyffredin, lle mae sgoriau uchel yn dynodi bod angen mwy o ymyrraeth reolaethol. Yna, caiff y meini prawf eu pwysoli gan arbenigwyr ac mae sgoriau pob nodwedd yn cael eu cyfri i greu un sgôr gyffredinol sy'n sail i'r graddiad. Mae'r dull cyffredinol yn gyson â chanllawiau Llywodraeth y DU ar MCDA[1].

## Nodweddion a aseswyd

Mae nodweddion y safleoedd N2K, a aseswyd yn yr MCDA, yn cynrychioli rhywogaethau a chynefinoedd l sydd wedi'u dynodi ar un safle N2K o leiaf yng Nghymru.

[1] Adran Cymunedau a Llywodraeth Leol (2009). *Multi-criteria analysis: a manual.* Llundain, Hawlfraint y Goron.

## Meini prawf

I ddechrau, detholwyd y meini prawf gan dîm y Rhaglen LIFE N2K/staff CNC. Yna, aseswyd y rhain gan ADAS yn erbyn cyfres o ofynion (cyflawnder, maint, natur weithredol, gormodedd, a chyfrif ddwywaith) a mireiniwyd y set. Yna, cafodd y meini prawf eu fetio gan arbenigwyr technegol CNC mewn gweithdy a drefnwyd gan ADAS ym mis Mawrth 2015. Yn ystod y broses hon, cafodd y meini prawf eu grwpio yn "glystyrau" o berthnasedd thematig tebyg (Tablau 1, 2 a 3). Gwnaed hyn i gynorthwyo gweddill y broses o asesu'r meini prawf a hefyd mae'n ei gwneud yn haws rheoli'r broses bwysoli.

Tabl 1: Meini prawf a ddefnyddiwyd o fewn matricsau cynefinoedd

| Clwstwr | Meini prawf |
|---|---|
| Cyfreithiol/Polisi | Nodwedd Blaenoriaeth y Gyfarwyddeb Cynefinoedd |
| Cyfreithiol/Polisi | Cynefinoedd Adran 42 o'r pwys pennaf ar gyfer cadwraeth |
| Cyfreithiol/Polisi | Diddordeb nodwedd y Gyfarwyddeb Fframwaith Dŵr |
| Sylw | Cyfrifoldeb arbennig y DU |
| Sylw | Canran adnodd y DU yng Nghymru |
| Statws Cadwraeth | Statws adrodd y Gyfarwyddeb Cynefinoedd Erthygl 17 |
| Statws Cadwraeth | Cyflwr nodweddion N2K ar safleoedd yng Nghymru |
| Sensitifrwydd | Mynegai agored i newid yn yr hinsawdd |
| Gwerth | Ystod y ddarpariaeth gwasanaeth ecosystem |
| Prinder | Nifer y safleoedd a ddynodwyd ar gyfer y nodwedd hon |

Tabl 2: Meini prawf a ddefnyddiwyd o fewn matricsau rhywogaethau

| Clwstwr | Meini prawf |
|---|---|
| Cyfreithiol/Polisi | Rhywogaethau Adran 42 o'r pwys pennaf ar gyfer cadwraeth |
| Cyfreithiol/Polisi | Diddordeb nodwedd y Gyfarwyddeb Fframwaith Dŵr |
| Ardal | Cyfrifoldeb arbennig y DU |
| Ardal | Cyfrifoldeb arbennig Cymru |
| Statws Cadwraeth | Statws adrodd y Gyfarwyddeb Cynefinoedd Erthygl 17 |
| Statws Cadwraeth | Cyflwr nodweddion N2K ar safleoedd yng Nghymru |
| Statws Cadwraeth | Statws cadwraeth rhyngwladol |
| Sensitifrwydd | Mynegai agored i newid yn yr hinsawdd |
| Gwerth | Ystod y ddarpariaeth gwasanaeth ecosystem |
| Prinder | Amlder ar safleoedd N2K |

Tabl 3: Meini prawf a ddefnyddiwyd o fewn y matricsau adar

| Clwstwr | Meini prawf |
|---|---|
| Cyfreithiol/Polisi | Rhywogaethau Adran 42 o'r pwys pennaf ar gyfer cadwraeth |
| Cyfreithiol/Polisi | Diddordeb nodwedd y Gyfarwyddeb Fframwaith Dŵr |
| Ardal | Cyfrifoldeb arbennig i Gymru (% o boblogaeth y DU yng Nghymru) |
| Statws Cadwraeth | Rhestr o Adar o Bryder Cadwraethol (BOCC) |
| Statws Cadwraeth | Cyflwr Safleoedd N2K yng Nghymru |
| Statws Cadwraeth | Statws cadwraeth rhyngwladol |
| Sensitifrwydd | Mynegai agored i newid yn yr hinsawdd |
| Prinder | Amlder ar safleoedd N2K |
| Tueddiad Poblogaeth | Tueddiad poblogaeth yn y DU (Hirdymor) |
| Tueddiad Poblogaeth | Tueddiad poblogaeth yn y DU (Byrdymor) |

## Sgorio

Cafodd yr holl feini prawf eu sgorio'n wrthrychol yn erbyn set ddata waelodol. Defnyddiwyd y broses sgorio i droi'r data craidd trawsffurfiedig yn raddfa 0 – 100, lle mae sgôr o 0 i nodweddion ar faen prawf penodol yn cyfateb i sgôr isaf y data crai a 100 yw'r uchaf. Bwriad y broses a ddefnyddiwyd ar gyfer hyn yw bod yn dryloyw a threfnus. Mae hefyd yn dangos a yw'r sgoriau isaf ac uchaf yn adlewyrchu gwir amrediad y data a gyflwynwyd neu'r amrediad theoretig. Pan fo'r setiau data'n anghyflawn, mewnbynnwyd gwerthoedd yn eu lle ar sail y canllawiau ar gyfer data sydd ar goll[2].

| | | Legal and Policy Drivers | | | Coverage | | Con Stat | | Sensitivity | Value | Rarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Feature Type | Habitats Directive Priority Feature | WFD Feature Interest | S.42 | UK special responsibility | Wales special responsibility | Article 17 Reporting | Current Condition of N2K sites in Wales | Climate change vulnerability index | Extent of Ecosystem Service Provision | Frequency on N2K sites |
| Active raised bogs | Raised Bog, Mire, Fen | y | y | y | y | 10.7 | BD | 0 | High | Medium | 7 |
| Base-rich fens | Raised Bog, Mire, Fen | n | y | y | n | 3.6 | BI | 42.86 | High | High | 7 |
| Alder woodland on floodplains | Forests | y | y | y | n | 40 | BS | 45.45 | Medium | High | 11 |
| Alpine and sub-alpine heaths | Temperate Heath / Scrub | n | n | y | y | 0.1 | BS | 0 | Medium | Medium | 2 |
| Alpine and subalpine calcareous grasslands | Natural / Semi-Natural Grassland | n | n | y | n | 0.2 | BS | 100 | Medium | High | 1 |
| High-altitude plant communities associated with areas of water seepage | Raised Bog, Mire, Fen | y | y | y | n | 3.8 | BI | 100 | Medium | High | 1 |
| Annual vegetation of drift lines | Marine, Coastal, Halophytic | n | n | y | n | 8.1 | BS | 100 | Medium | High | 1 |

Troi data crai yn sgôr

[2] Gweler Carpenter, J. & Kenward, M. (n.d.). *Guidelines for handling missing data in Social Science Research*. Ar gael yn www.missingdata.org.uk

| | | | Legal and Policy Drivers | | | Coverage | | Con Stat | | Sensitivity | Value | Rarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Common Name | Feature Type | Habitats Directive Priority Feature | WFD Feature Interest | S.42 | UK special responsibility | Wales special responsibility | Article 17 Reporting | Current Condition of N2K sites in Wales | Climate change vulnerability index | Extent of Ecosystem Service Provision | Frequency on N2K sites |
| 21 | Active raised bogs | Raised Bog, Mire, Fen | 100.00 | 100.00 | 100.00 | 100.00 | 14.34 | 100.00 | 100.00 | 100.00 | 50.00 | 10.00 |
| 22 | Base-rich fens | Raised Bog, Mire, Fen | 0.00 | 100.00 | 100.00 | 0.00 | 4.83 | 66.66 | 57.14 | 100.00 | 100.00 | 10.00 |
| 23 | Alder woodland on floodplains | Forests | 100.00 | 100.00 | 100.00 | 0.00 | 53.62 | 83.33 | 54.55 | 50.00 | 100.00 | 4.55 |
| 24 | Alpine and sub-alpine heaths | Temperate Heath / Scrub | 0.00 | 0.00 | 100.00 | 100.00 | 0.13 | 83.33 | 100.00 | 50.00 | 50.00 | 47.50 |
| 25 | Alpine and subalpine calcareous grasslands | Natural / Semi-Natural Grassland | 0.00 | 0.00 | 100.00 | 0.00 | 0.27 | 83.33 | 0.00 | 50.00 | 100.00 | 100.00 |
| 26 | High-altitude plant communities associated with areas of water seepage | Raised Bog, Mire, Fen | 100.00 | 100.00 | 100.00 | 0.00 | 5.09 | 66.66 | 0.00 | 50.00 | 100.00 | 100.00 |
| 27 | Annual vegetation of drift lines | Marine, Coastal, Halophytic | 0.00 | 0.00 | 100.00 | 0.00 | 10.86 | 83.33 | 0.00 | 50.00 | 100.00 | 100.00 |

## Pwysoli

Ar ôl sefydlu'r meini prawf a'r sgorio, rhoddwyd pwysau i bob maen prawf. I wneud hyn defnyddiwyd methodoleg "swing", sy'n ei gwneud yn ofynnol i benderfynwyr ystyried ystyr perthynol newid gwerth rhwng y sgoriau lleiaf a mwyaf posibl i bob maen prawf.

Gwnaed cymariaethau "swing" yn gyntaf ar lefel maen prawf ac yna rhwng clystyrau o feini prawf tebyg. Gwnaed hyn drwy wneud cymariaethau fesul parau i'r maen prawf lle mae'r "swing" yn cael ei ystyried yn fwyaf a nodi'r gwahaniaeth cymharol fel canran. Yna, cael pwysau drwy gymhwyso'r canrannau ar draws pob maen prawf ac o fewn pob clwstwr ar sail yr un gyfradd.

This section allows users to input their own swing weight scores. You MUST use the "Clear Input" button to clear the scores before starting again!
Edit white cells only. DO NOT change the location of this area (D1:S14) otherwise the cluster/node recognition will fail.

| Swing Weighting | Criteria | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Legal/Policy | | | Coverage | | Conservation Status | | Sensitivity | Value | Rarity |
| Clear Input | Habitats Directive Priority Feature | S.42 Habitats | WFD Feature Interest | UK special responsibility | Wales special responsibility | Article 17 Reporting | Current Condition of N2K sites in Wales | Climate change vulnerability index | Extent of Ecosystem Service Provision (ex-CS) | Frequency on N2K sites |
| Round 1 Score | 100 | 80 | 20 | 80 | 100 | 80 | 100 | 100 | 100 | 100 |
| Round 1 Winner | 100 | | | | 100 | | 100 | 100 | 100 | 100 |
| Round 2 Score | 70 | | | | 70 | | 100 | 70 | 10 | 35 |
| Final Swing Score | 70 | 56 | 14 | 56 | 70 | 80 | 100 | 70 | 10 | 35 |
| **Final Weights** | 0.125 | 0.100 | 0.025 | 0.100 | 0.125 | 0.143 | 0.178 | 0.125 | 0.018 | 0.062 |

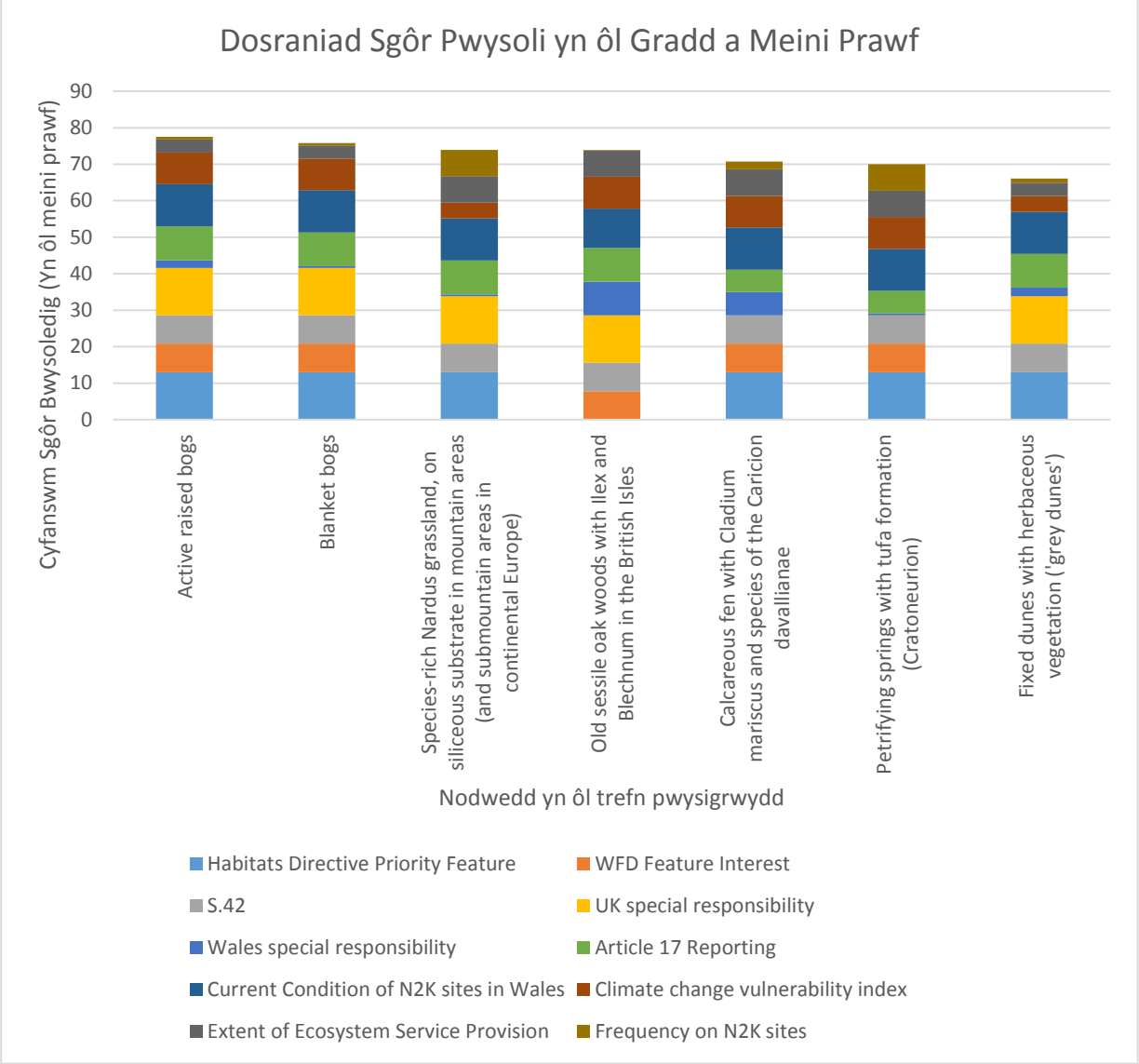
Ffigur 1: Sgrin ar gyfer cipio pwysoliad meini prawf.

## Cyfrifo

Cafodd sgôr pob nodwedd ei lluosogi gyda phwysau'r maen prawf, ac yna cafodd y sgoriau pwysoledig eu hadio ar gyfer pob nodwedd er mwyn cael un rhif cyffredinol. Arweiniodd hyn at roi'r nodwedd â'r sgôr uchaf ar y brig, ac yn y blaen hyd at y sgôr isaf.

## Dadansoddi

Dadansoddwyd y canlyniadau drwy asesu'r allbynnau yn y tablau a'r siartiau ac yna dethol y meini prawf eto, sgorio, a phwysoli os oedd y canlyniadau'n ymddangos yn anghyson neu'n afreolaidd. Gwnaed hyn mewn grwpiau ffocws bychain gyda staff mewnol CNC sydd â diddordeb penodol yn y grŵp nodweddion. Dadansoddwyd sensitifrwydd lle'r oedd angen priodoli a hefyd lle'r argymhellid hynny fel rhan o'r broses o ddethol y meini prawf.




Ffigur 2: Enghraifft o allbwn siart ar gyfer y canlyniad

## Canlyniadau

### Pwysoli

Drwy ddadansoddi'r pwysoliad gwelwyd mai statws cadwraeth sy'n cael ei ystyried fel y maen prawf pwysicaf ymhob un o'r tri MCDA. Dyma ganran y safleoedd sydd mewn cyflwr anffafriol i nodweddion cynefinoedd a rhywogaethau a'r rhestr Adar o Bryder Cadwraethol ar gyfer nodweddion adar. Ardal, sy'n cael ei fesur yn ôl canran yr adnoddau nodweddion yng Nghymru, oedd y ffactor pwysicaf nesaf. Roedd sbardunau cyfreithiol a pholisi hefyd yn bwysig ar gyfer nodweddion cynefinoedd ac adar, lle'r oedd nodweddion nad ydynt yn adar yn rhoi pwysoliad mawr i'r mynegai'n ymwneud â bod yn agored i newid yn yr hinsawdd. Nifer y safleoedd N2K a ddynodwyd ar gyfer gwasanaethau nodweddion ac ecosystem oedd y meini prawf a oedd yn gyson â'r pwysoliad isaf.

### Allbynnau

Roedd tri MCDA gwahanol yn nodi 32 o nodweddion anghenion uchel o blith 123 o rai posibl. Nodwyd nodweddion blaenoriaeth uchel gan doriadau naturiol mewn plot gwasgariad o sgoriau pwysoledig.

Roedd yr MCDA Cynefinoedd yn nodi 11 o nodweddion a oedd ag anghenion a sbardunau cadwraeth cymharol uwch o blith 54 o rai posibl. Dyma'r nodweddion y tynnwyd sylw atynt:

| Enw Ffurfiol y Nodwedd | Enw Anffurfiol y Nodwedd |
|---|---|
| Cyforgors weithredol | Cyforgors weithredol |
| Gorgorsydd | Gorgorsydd |
| Hen goed derw digoes gyda choed derw bytholwyrdd a *Blechnum* yn Ynysoedd Prydain | Coetir derw asidig Gorllewinol |
| Glaswelltir *Nardus* toreithiog o rywogaethau, ar swbstrad silicaidd mewn ardaloedd mynyddig | Glaswelltir toreithiog o rywogaethau gyda chawn du ar ucheldir |
| Cors galchog gyda *Cladium mariscus* a rhywogaethau o'r *Caricion davallianae* | Cors galchog â chorsfrwyn yn oruchaf |
| Twyni sefydlog gyda llystyfiant llysieuol ('twyni llwyd') | Glaswelltir twyni |
| Ffynhonnau petraidd gyda ffurfiad twffa (*Cratoneurion*) | Ffynhonnau dwr caled sy'n dyddodi calch |
| Coedwigoedd *Tilio-Acerion* llethrau, marian llethrau a dyfnentydd | Coetir cymysg ar briddoedd toreithiog o fas yn gysylltiedig â llethrau creigiog |
| Coedwigoedd llifwaddod gydag *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) | Gwernydd gorlifdir |
| Coed *Taxus baccata* Ynysoedd Prydain | Coetir â'r ywen yn oruchaf |
| Llaciau twyni llaith | Llaciau twyni llaith |

Cafodd cynefinoedd yr MCDA eu hidlo i ganfod 4 o nodweddion blaenoriaethol morol. Gwnaed hyn oherwydd cydnabuwyd bod gan nodweddion morol, mewn ambell achos, raglenni gwaith gwahanol a ffynonellau cyllid pwrpasol ac unigryw.

| Enw Ffurfiol y Nodwedd | Enw Anffurfiol y Nodwedd |
|---|---|
| Llystyfiant lluosflwydd glannau caregog | Llystyfiant marian arfordirol y tu hwnt i gyrraedd tonnau |
| Morfa arfor yr Iwerydd (*Glauco-Puccinellietalia maritimae*) | Morfa arfor yr Iwerydd |
| Aberoedd | Aberoedd |
| Lagwnau arfordirol | Lagwnau |

Roedd yr MCDA Rhywogaethau yn nodi pum nodwedd ag anghenion a sbardunau cadwraeth cymharol uchel o blith 28 o rai posibl. Roedd hyn yn cynnwys nifer o nodweddion anifeiliaid di-asgwrn-cefn afon a phlanhigion fasgwlaidd sensitif. Dyma'r nodweddion y tynnwyd sylw atynt:

| Enw Ffurfiol y Nodwedd | Enw Anffurfiol y Nodwedd |
|---|---|
| *Margaritifera margaritifera* | Misglen berlog |
| *Gentianella anglica* | Crwynllys cynnar |
| *Liparis loeselii* | Tegeirian y fign galchog |
| *Petalophyllum ralfsii* | Llysiau'r afu petalog |
| *Austropotamobius pallipes* | Cimwch afon crafanc wen |

Roedd yr MCDA adar yn nodi 13 o nodweddion blaenoriaethau ag anghenion a sbardunau cadwraeth cymharol uchel o blith 41 o nodweddion Ardal Warchodaeth Arbennig. Dyma'r nodweddion y tynnwyd sylw atynt:

| Enw Ffurfiol y Nodwedd | Enw Anffurfiol y Nodwedd | tymor |
|---|---|---|
| *Sterna dougallii* – bridio | Môr-wennol wridog | Magu |
| *Cygnus columbianus bewickii* (Gorllewin Siberia/Gogledd-ddwyrain a Gogledd-orllewin Ewrop) | Alarch Bewick | Gaeafu |
| *Anser albifrons albifrons* | Gŵydd Dalcenwen | Gaeafu |
| *Larus fuscus* | Gwylan Gefnddu Fechan | Magu |
| *Anser albifrons flavirostris* | Gŵydd Dalcenwen yr Ynys Las | Gaeafu |
| *Calidris alpina* | Pibydd mawn | Gaeafu |
| *Limosa lapponica* | Rhostog Gynffonfraith | Gaeafu |
| *Sterna paradisaea* | Môr-wennol y Gogledd | Magu |
| *Sterna hirundo* | Môr-wennol gyffredin | Magu |
| *Numenius arquata* | Gylfinir Ewrasiaidd | Gaeafu |
| *Arenaria interpres* | Cwtiad traeth | Gaeafu |
| *Pluvialis squatarola* | Cwtiad Llwyd | Gaeafu |
| *Sternula albifrons* | Môr-wennol fechan | Magu |

## Cyfyngiadau ac Argymhellion

Roedd yr erfyn hwn yn caniatáu ystyried amrywiaeth o ffactorau cadwraeth, a hynny ar y cyd gan gyfres o arbenigwyr rhywogaethau a chynefinoedd er mwyn datblygu'r allbwn.

Yn gyffredinol, roedd yr MCDA yn darparu asesiad rhesymol o anghenion a sbardunau cadwraeth. Ond roedd ambell anghysonder nad oedd cyfrif amdanynt yn yr MCDA. Er enghraifft, nodwyd bod y Fôr-wennol wridog yn nodwedd sydd ag anghenion a sbardunau cadwraeth uchel. Ond oherwydd natur ecoleg y nodwedd, mae'r dewisiad gofodol mewn perthynas â safleoedd yn gallu amrywio, ac erbyn hyn gwyddom fod y boblogaeth Gymreig yn byw yn Iwerddon. Nid oedd modd rhoi cyfrif am y ffactor hwn yn yr MCDA ac nid oes modd rheoli yn erbyn hyn felly penderfynwyd peidio ag ystyried hyn yn nodwedd anghenion uchel.

Roedd rhai problemau ymhlith arbenigwyr o ran bod yn hyderus yn y setiau data a ddefnyddiwyd, er eu bod yn cydnabod mai dyma'r setiau data mwyaf perthnasol a'u bod yn addas i'r diben. Oherwydd hyn, dyluniwyd yr MCDA i fod yn hyblyg fel bo modd diweddaru'r setiau data, neu ychwanegu setiau data fel bo modd ail-gynnal yr asesiad gan ddefnyddio'r wybodaeth a'r dystiolaeth orau sydd ar gael. Oherwydd lefel isel o hyder mewn rhai setiau data, yn enwedig ar gyfer nodweddion adar a morol, cydnabuwyd y dylid parhau i ganolbwyntio ar gael asesiad cyfoes ar gyflwr nodweddion N2K, sef meini prawf pwysig yn y broses benderfynu. Roedd y ffaith fod pwysoliad uchel i'r meini prawf hyn ymhob MCDA yn tynnu sylw at bwysigrwydd hyn. Hefyd, ystyrid bod rhai setiau data, megis y gwasanaeth ecosystem, yn ffactorau pwysig o bosibl ond eu bod yn cael pwysoliadau isel. Eto, roedd hyn yn adlewyrchu'r lefel isel o hyder yn y data gwaelodol a diffyg ffordd ystyrlon o'i fesur er mwyn cael cymhariaeth gywir o werth rhwng y nodweddion.

Roedd cyfyngiad arall ar yr MCDA oherwydd diffyg data yn ymwneud yn benodol â sensitifrwydd, brys a bod yn agored i ddirywiad. Er enghraifft, roedd nodweddion coetiroedd yn ymddangos yn uchel o fewn y dadansoddiad anghenion, ond oherwydd y lefel isel o frys ar gyfer ymyrraeth reolaethol, ystyrid bod y nodweddion wedi'u graddio'n gymharol uwch na'r disgwyl.

- Argymhellir gwneud gwaith i ddatblygu setiau data/mynegeion ar gyfer y meini prawf a ganlyn i'w cynnwys mewn fersiynau o'r MCDA yn y dyfodol er mwyn rhoi ystyriaeth fwy cyflawn i'r ffactorau. Set ddata i roi ystyriaeth fwy penodol i fod yn agored i ddirywiad.
- Agored i ddirywiad
- Prinder
- Gofyniad ar gyfer rheoli ac adfer (h.y. faint o waith sydd ei angen)
- Effaith darnio cynefinoedd

Er mwyn bod yn berthnasol i MCDA, dylai unrhyw setiau data newydd a ddatblygir gael eu creu'n gyson ymhob grŵp nodweddion er mwyn gallu cymharu'n rhwydd ac yn gywir.

Mae hefyd yn bwysig cydnabod bod ffactorau eraill heb gyfrif amdanynt yn yr MCDA. Er enghraifft, wrth weithredu'r camau blaenoriaeth mae nifer o ystyriaethau ymarferol i'w hystyried megis staffio, cyllid a logisteg. Felly bydd angen ystyried y ffactorau hyn wrth ystyried unrhyw allbynnau o'r erfyn. Mae gan randdeiliaid wahanol gylchoedd gwaith a sbardunau ar gyfer gwaith, ac nid oes ganddynt ddiddordeb yn yr holl nodweddion N2K. Dyna pam fod modd hidlo'r rhestr i ganolbwyntio ar wahanol grwpiau nodwedd a allai fod yn gymwys i wahanol gylchoedd gwaith a ffynonellau cyllid. Er enghraifft, cafodd y matrics cynefinoedd ei hidlo i ganfod nodweddion morol sydd ag anghenion a sbardunau cadwraeth uchel.

## Casgliad

Mae'r MCDA wedi galluogi amrywiaeth o ffactorau i gael eu hystyried, ar y cyd, gan ystod o arbenigwyr rhywogaethau a chynefinoedd i ddatblygu'r allbwn, ac mae hyn wedi arwain at asesiad rhesymol o anghenion a sbardunau cadwraeth ar gyfer nodweddion N2K yng Nghymru. Dangoswyd ei werth fel erfyn sy'n gallu cael ei ddefnyddio ar gyfer sefyllfa gadwraeth gymhleth yng Nghymru er mwyn meddwl yn fwy clir a bod yn gymorth i wneud penderfyniadau strategol.

Bu cyfyngiadau o ran data rhai meini prawf, ond ni fwriadwyd i'r MCDA gael ei ddefnyddio ar ei ben ei hun nac i fod yn rhestr swyddogol o flaenoriaethau cadwraeth. Mae hyblygrwydd yr erfyn a ddatblygwyd yn golygu bod modd ei ddiweddaru a'i ail-gynnal er mwyn adlewyrchu'r dystiolaeth orau a diweddaraf sydd ar gael.

Dyma brif lwyddiannau'r dull MCDA:

- Roedd yn caniatáu ystyried ystod o ffactorau ar y cyd er mwyn graddio nodweddion yn ôl eu hanghenion a'u sbardunau cadwraeth.
- Roedd yn caniatáu asesiad cyson ar sail tystiolaeth ar gyfer pob grŵp o nodweddion.
- Roedd yn caniatáu cydweithio ag amrywiaeth o arbenigwyr a oedd yn gallu dylanwadu ar yr allbynnau a'u dilysu.

# 2 Executive Summary

## Introduction

The LIFE Natura 2000 Programme is seeking to identify and agree strategic priorities for the Natura 2000 (N2K) series in Wales. This includes carrying out a conservation needs analysis for N2K species and habitat features, meaning Habitats Directive Annex I habitats and Annex II species as well as Birds Directive Annex I birds and regularly occurring migratory species designated on Special Areas of Conservation and Special Protection Areas in Wales. The Programme is managed by Natural Resources Wales (NRW) and co-funded by EU LIFE+ Nature and is due to complete in September 2015.

NRW has instructed ADAS UK Ltd (ADAS) to carry out a Multi-Criteria Decision Analysis (MCDA) of N2K features in Wales. MCDA is a systematic approach to discover and quantify evidence and stakeholder considerations about various factors in order to compare and rank alternative courses of action. Its purpose in this case is to establish, in the most objective and scientific way possible, which features have the greatest needs and drivers for management and restoration. This will act as a valuable tool for practitioners and decision-makers to help identify where limited resources can be directed to best effect, and which areas of work to should be addressed first.

The MCDA process is based on a matrix (in MS Excel) where N2K habitat and species features are ranked against criteria based on conservation needs and drivers, and which incorporates a weighting factor. A series of three MCDA matrices were developed for Annex I habitats, Annex II species, and Annex I birds respectively.

The MCDA is one of a number of tools developed by the LIFE Natura 2000 Programme, to aid the process of identifying strategic priorities. The MCDA is not intended to be used in isolation, or as a definitive list of conservation priorities, but used within the broader context of available tools. The overall approach is detailed in LIFE Natura 2000 Programme Approach to Prioritisation[3].

## Methodology summary

The methodology is summarised below. Full details can be found in Section 4.

The MCDA follows a method where raw data on features for a number of criteria is gathered and converted into a score based on a common metric, where higher scores denote a greater need for management intervention. The criteria are then weighted by specialists and the scores for each feature are summed to produce an overall score which forms the basis for the ranking. The overall approach is consistent with UK Government guidance on MCDA[4].

## Features assessed

The features of N2K sites, assessed in the MCDA, represent l species and habitats that are designated on at least one N2K site within Wales.

[3] LIFE Natura 2000 Programme Approach to Prioritisation (2015). Accessed at https://naturalresources.wales/about-us/our-projects/life-n2k-wales/life-n2k-reports/?lang=en

[4] Department of Communities and Local Government (2009). *Multi-criteria analysis: a manual.* London, Crown Copyright.

## Criteria

Criteria selection was initially carried out by the LIFE N2K Programme team/NRW staff. This was then assessed by ADAS against a series of requirements (completeness, size, operationality, redundancy, and double-counting) and the set was refined. The criteria was then vetted by NRW technical specialists at a workshop convened by ADAS in March 2015. During this process the criteria were also grouped into "clusters" of similar thematic relevance (Tables 1, 2 and 3). This was done to assist the rest of the criteria assessment process and also make the weighting process more manageable.

**Table 1: Criteria used within the habitats matrix**

| Cluster | Criteria |
|---|---|
| Legal/Policy | Habitats Directive Priority Feature |
| Legal/Policy | Section 42 Habitats of principal importance for conservation |
| Legal/Policy | Water Framework Directive feature interest |
| Coverage | UK special responsibility |
| Coverage | Percentage of UK resource in Wales |
| Conservation Status | Habitats Directive Article 17 reporting status |
| Conservation Status | Condition of N2K features on sites in Wales |
| Sensitivity | Climate change vulnerability index |
| Value | Range of ecosystem service provision |
| Rarity | Number of sites designated for feature |

**Table 2: Criteria used within the species matrix**

| Cluster | Criteria |
|---|---|
| Legal/Policy | Section 42 species of principal importance for conservation |
| Legal/Policy | Water Framework Directive feature interest |
| Coverage | UK special responsibility |
| Coverage | Wales special responsibility |
| Conservation Status | Habitats Directive Article 17 reporting status |
| Conservation Status | Condition of N2K features on sites in Wales |
| Conservation Status | International conservation status |
| Sensitivity | Climate change vulnerability index |
| Value | Range of ecosystem service provision |
| Rarity | Frequency on N2K sites |

Table 3: Criteria used within the birds matrix

| Cluster | Criteria |
|---|---|
| Legal/Policy | Section 42 species of principal importance for conservation |
| Legal/Policy | Water Framework Directive feature interest |
| Coverage | Wales special responsibility (% of UK population in Wales) |
| Conservation Status | Birds Of Conservation Concern (BOCC) List |
| Conservation Status | Condition on N2K Sites in Wales |
| Conservation Status | International conservation status |
| Sensitivity | Climate change vulnerability index |
| Rarity | Frequency on N2K sites |
| Population Trend | UK population trend (Long term) |
| Population Trend | UK population trend (Short term) |

## Scoring

All criteria were objectively scored against a underlying dataset. The scoring process was used to convert the transformed raw data to a 0 – 100 scale, where a score of 0 for a feature on a given criterion corresponds to the lowest raw data score and 100 to the highest. The process used for this is intended to be transparent and methodological. It also indicates whether the lowest and highest scores reflect the actual range of data presented or the theoretical range. Where datasets were incomplete, the approach was taken to input substitute values based on missing data guidance[5].

[5] See Carpenter, J. & Kenward, M. (n.d.). *Guidelines for handling missing data in Social Science Research*. Available at www.missingdata.org.uk

| | | Legal and Policy Drivers | | | Coverage | | Con Stat | | Sensitivity | Value | Rarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Feature Type | Habitats Directive Priority Feature | WFD Feature Interest | S.42 | UK special responsibility | Wales special responsibility | Article 17 Reporting | Current Condition of N2K sites in Wales | Climate change vulnerability index | Extent of Ecosystem Service Provision | Frequency on N2K sites |
| Active raised bogs | Raised Bog, Mire, Fen | y | y | y | y | 10.7 | BD | 0 | High | Medium | 7 |
| Base-rich fens | Raised Bog, Mire, Fen | n | y | y | n | 3.6 | BI | 42.86 | High | High | 7 |
| Alder woodland on floodplains | Forests | y | y | y | n | 40 | BS | 45.45 | Medium | High | 11 |
| Alpine and sub-alpine heaths | Temperate Heath / Scrub | n | n | y | y | 0.1 | BS | 0 | Medium | Medium | 2 |
| Alpine and subalpine calcareous grasslands | Natural / Semi-Natural Grassland | n | n | y | n | 0.2 | BS | 100 | Medium | High | 1 |
| High-altitude plant communities associated with areas of water seepage | Raised Bog, Mire, Fen | y | y | y | n | 3.8 | BI | 100 | Medium | High | 1 |
| Annual vegetation of drift lines | Marine, Coastal, Halophytic | n | n | y | n | 8.1 | BS | 100 | Medium | High | 1 |

Raw data converted into a score

| | | Legal and Policy Drivers | | | Coverage | | Con Stat | | Sensitivity | Value | Rarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Feature Type | Habitats Directive Priority Feature | WFD Feature Interest | S.42 | UK special responsibility | Wales special responsibility | Article 17 Reporting | Current Condition of N2K sites in Wales | Climate change vulnerability index | Extent of Ecosystem Service Provision | Frequency on N2K sites |
| Active raised bogs | Raised Bog, Mire, Fen | 100.00 | 100.00 | 100.00 | 100.00 | 14.34 | 100.00 | 100.00 | 100.00 | 50.00 | 10.00 |
| Base-rich fens | Raised Bog, Mire, Fen | 0.00 | 100.00 | 100.00 | 0.00 | 4.83 | 66.66 | 57.14 | 100.00 | 100.00 | 10.00 |
| Alder woodland on floodplains | Forests | 100.00 | 100.00 | 100.00 | 0.00 | 53.62 | 83.33 | 54.55 | 50.00 | 100.00 | 4.55 |
| Alpine and sub-alpine heaths | Temperate Heath / Scrub | 0.00 | 0.00 | 100.00 | 100.00 | 0.13 | 83.33 | 100.00 | 50.00 | 50.00 | 47.50 |
| Alpine and subalpine calcareous grasslands | Natural / Semi-Natural Grassland | 0.00 | 0.00 | 100.00 | 0.00 | 0.27 | 83.33 | 0.00 | 50.00 | 100.00 | 100.00 |
| High-altitude plant communities associated with areas of water seepage | Raised Bog, Mire, Fen | 100.00 | 100.00 | 100.00 | 0.00 | 5.09 | 66.66 | 0.00 | 50.00 | 100.00 | 100.00 |
| Annual vegetation of drift lines | Marine, Coastal, Halophytic | 0.00 | 0.00 | 100.00 | 0.00 | 10.86 | 83.33 | 0.00 | 50.00 | 100.00 | 100.00 |

Figure 1: Screen indicating raw data and score conversion.

## Weighting

After the criteria and scoring were established weights were assign to each of the criteria. To do this a "swing" methodology was used, which required decision-makers to consider the relative meaning of a change in value between the minimum and maximum scores possible on each criterion.

Swing comparisons were made first at criteria level and then between clusters of similar criteria. This was done by making pairwise comparisons to the criterion where the swing is perceived to be the greatest and noting the relative difference as a percentage. Weights are then elicited by applying the percentages across each criteria and within each cluster on a pro-rata basis.

This section allows users to input their own swing weight scores. You MUST use the "Clear Input" button to clear the scores before starting again!
Edit white cells only. DO NOT change the location of this area (D1:S14) otherwise the cluster/node recognition will fail.

| Swing Weighting | Criteria | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Legal/Policy | | | Coverage | | Conservation Status | | Sensitivity | Value | Rarity |
| Clear Input | Habitats Directive Priority Feature | S.42 Habitats | WFD Feature Interest | UK special responsibility | Wales special responsibility | Article 17 Reporting | Current Condition of N2K sites in Wales | Climate change vulnerability index | Extent of Ecosystem Service Provision (ex-CS) | Frequency on N2K sites |
| Round 1 Score | 100 | 80 | 20 | 80 | 100 | 80 | 100 | 100 | 100 | 100 |
| Round 1 Winner | 100 | | | | 100 | | 100 | 100 | 100 | 100 |
| Round 2 Score | 70 | | | | 70 | | 100 | 70 | 10 | 35 |
| Final Swing Score | 70 | 56 | 14 | 56 | 70 | 80 | 100 | 70 | 10 | 35 |
| **Final Weights** | 0.125 | 0.100 | 0.025 | 0.100 | 0.125 | 0.143 | 0.178 | 0.125 | 0.018 | 0.062 |

Figure 2: Screen for capturing the weighting of criteria.

## Calculation

The score for each feature against each criterion was multiplied by the criterion weight, and then the weighted scores added for each feature, to give an overall number. This resulted in the feature with the highest score being top ranked and so on down to the lowest score.

## Analysis

Analysis of the results was done by assessing tabular and chart outputs and then repeating the criteria selection, scoring, and weighting exercise if results appear inconsistent or irregular. This was done in small focus groups with internal NRW staff who have an expertise in a feature group.

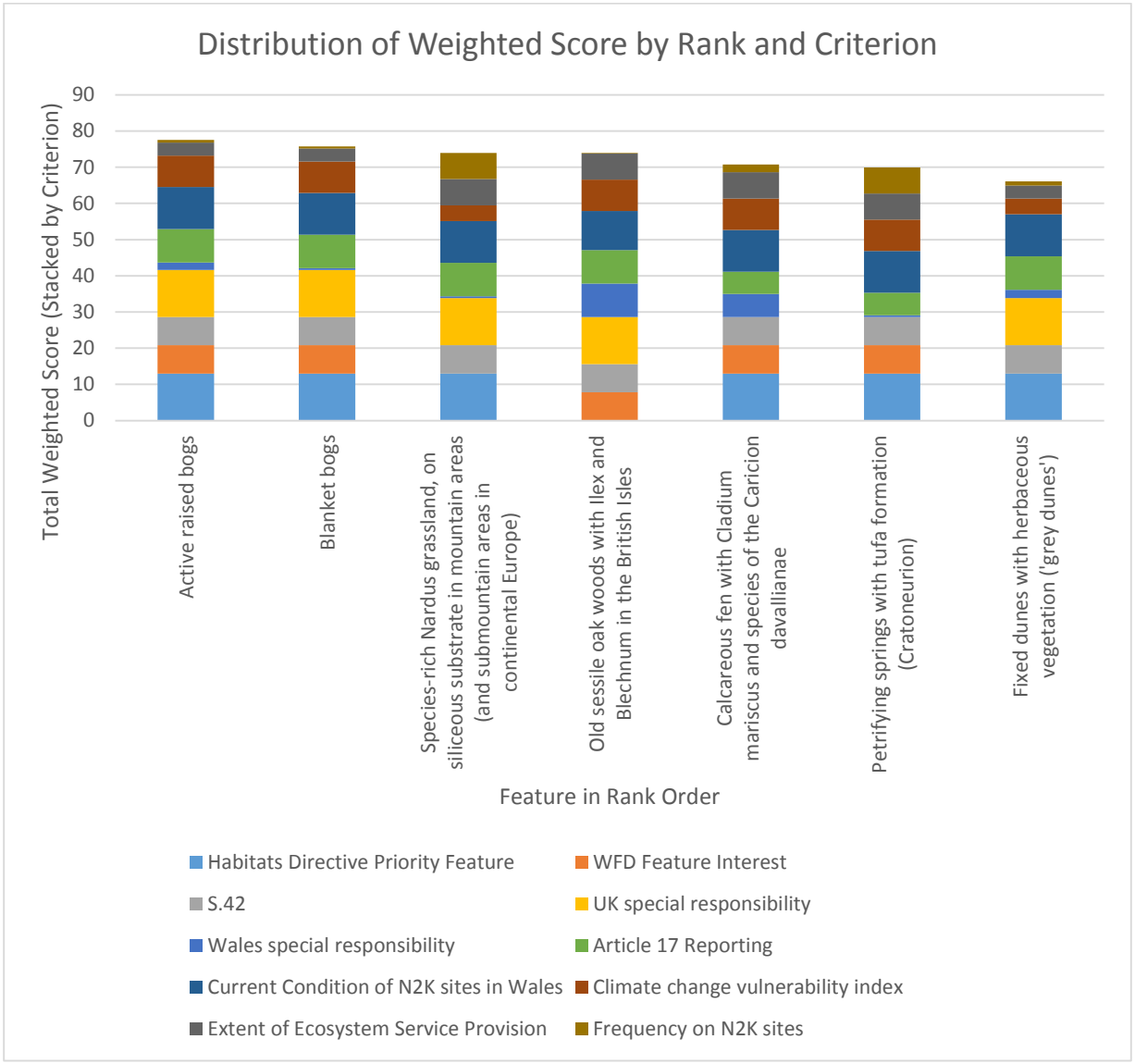



Figure 3: Example of chart output for the results

## Results

### Weighting

Analysis of the weighting showed that conservation status was considered the as most important criteria across all three MCDAs. This represents the percentage of sites where habitats and species features and the Birds of Conservation Concern (BOCC) list for bird features are in unfavourable condition. Coverage, measured by the percentage of the feature resources in Wales, was the next most important factor. Legal and policy drivers were also important for habitats and bird features, however, non-bird features gave a great weighting to climate change vulnerability index. Feature frequency on sites and ecosystem services were consistently awarded the lowest weighting.

### Outputs

The three separate MCDAs identified 32 features with 'high conservation needs', from a possible 123. Features deemed to have high conservation needs were identified from a scatter plot of weighted scores, using natural breaks in the plot to separate high need features from the rest.

The Habitat MCDA identified 11 features with relatively higher conservation needs and drivers from a possible 54. The features highlighted were:

| Feature Formal Name | Feature Informal Name |
|---|---|
| Active raised bogs | Active raised bogs |
| Blanket bogs | Blanket bog |
| Old sessile oak woods with Ilex and *Blechnum* in the British Isles | Western acidic oak woodland |
| Species-rich *Nardus* grassland, on siliceous substrate in mountain areas | Species-rich grassland with mat-grass in upland areas |
| Calcareous fen with *Cladium mariscus* and species of the *Caricion davallianae* | Calcium-rich fen dominated by great fen sedge (saw sedge) |
| Fixed dunes with herbaceous vegetation ('grey dunes') | Dune grassland |
| Petrifying springs with tufa formation (*Cratoneurion*) | Hard-water springs depositing lime |
| *Tilio-Acerion* forests of slopes, screes and ravines | Mixed woodland on base-rich soils associated with rocky slopes |
| Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) | Alder woodland on floodplains |
| *Taxus baccata* woods of the British Isles | Yew-dominated woodland |
| Humid dune slacks | Humid dune slacks |

The habitats MCDA was filtered to identify 4 marine priority features. This was done as it was acknowledged that marine features had, in some cases, separate programmes of work and unique dedicated funding sources. These are shown below:

| Feature Formal Name | Feature Informal Name |
|---|---|
| Perennial vegetation of stony banks | Coastal shingle vegetation outside the reach of waves |
| Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) | Atlantic salt meadows |
| Estuaries | Estuaries |
| Coastal lagoons | Lagoons |

The species MCDA identified five feature with relatively higher conservation needs and drivers from a potential 28. This included a number of sensitive river invertebrates and vascular plant features. The features highlighted were:

| Feature Formal Name | Feature Informal Name |
|---|---|
| *Margaritifera margaritifera* | Freshwater pearl mussel |
| *Gentianella anglica* | Early gentian |
| *Liparis loeselii* | Fen orchid |
| *Petalophyllum ralfsii* | Petalwort |
| *Austropotamobius pallipes* | White-clawed crayfish |

The bird MCDA identified 13 priority features with relatively higher conservation needs and drivers from 41 SPA features. The features highlighted were:

| Feature Formal Names | Feature Informal Name | Season |
|---|---|---|
| *Sterna dougallii* - breeding | Roseate Tern | Breeding |
| *Cygnus columbianus bewickii* (Western Siberia/North-eastern & North-western Europe) | Bewick`s Swan | Wintering |
| *Anser albifrons albifrons* | Greater white-fronted Goose | Wintering |
| *Larus fuscus* | Lesser Black-backed Gull | Breeding |
| *Anser albifrons flavirostris* | Greenland white-fronted Goose | Wintering |
| *Calidris alpina* | Dunlin | Wintering |
| *Limosa lapponica* | Bar-tailed Godwit | Wintering |
| *Sterna paradisaea* | Arctic Tern | Breeding |
| *Sterna hirundo* | Common Tern | Breeding |
| *Numenius arquata* | Eurasian Curlew | Wintering |
| *Arenaria interpres* | Turnstone | Wintering |
| *Pluvialis squatarola* | Grey Plover | Wintering |
| *Sternula albifrons* | Little Tern | breeding |

## Limitations and Recommendations

Overall the MCDA provided a reasonable assessment of conservation needs and drivers. However there were some anomalies that were not accounted for in the MCDA. For example the Roseate tern was identified as a feature with high conservation needs and drivers. However due to the nature of the feature's ecology, the spatial preference of breeding sites can vary, and the Welsh population is now know to reside in Ireland. This factor could not be accounted for in the MCDA and there is no possibility to manage against this, so a decision was made not consider this as a high needs feature.

Some NRW specialists expressed concerns about confidence in some of the datasets used, although it was acknowledged that they represent the most applicable datasets and were deemed fit-for-purpose. To account for this, the MCDA was designed with flexibility so the datasets can be updated, or new datasets added, so the assessment can be re-run using the best available knowledge and evidence. Due to the lower confidence in condition assessments for bird and marine N2K features and their high weighting in the MCDA process, there was an acknowledgement that there should remain a focus on obtaining up-to-date condition assessment for these features. The ecosystem service criteria was seen as a potentially important factor but was generally given low weightings, due to a lower level of confidence in the underlying data and the lack of a meaningful way to quantify it to allow an accurate comparison of value across features.

Another limitation of the MCDA was due to the lack of data explicitly dealing with sensitivity, urgency and vulnerability to decline. For example, woodland features appeared high within the needs analysis, but due to the low urgency for management intervention, the features were consider to be ranked relatively higher than expected. Therefore, it is recommended that work is undertaken to develop datasets/indices for the following criteria to include in future versions of the MCDAs to allow a more complete consideration of factors:

- Vulnerability to decline
- Rarity
- Requirement for management and restoration (i.e. amount of work needed)
- Impact of habitat fragmentation

Any new datasets developed should be created with consistency across all feature groups to enable comparisons to be made.

It is also important to recognise that there are other factors not accounted for within the MCDA. For example, when implementing priority actions, there are also many practical considerations to take into account such as staffing, funding and logistics. These factors will therefore need to be considered when considering any outputs from the tool. Stakeholders have different remits and drivers for work, and do not have an interest in all N2K features. For this reason the list can filtered to focus on different feature groups which may be applicable to different work remits and sources of funding. For example, the habitats matrix was filtered to identify marine features with higher conservation needs and drivers.

## Conclusion

The MCDA tool allows a range of conservation criteria to be considered together, alongside input from species and habitat specialists, to produce a comprehensive guide to aid strategic decision-making. It allows the needs and drivers affecting different features to be compared against each other to bring clarity to a complex raft of information.

There are data limitations for some criteria, however, the MCDA was not intended to be used in isolation or to derive a definitive list of conservation priorities. The flexibility of the tool means that it can be updated and re-run to reflect the latest and best available evidence.

In summary, the key achievements of the MCDA approach are:

- It allows a range of factors to be considered concurrently to rank features according to their conservation needs and drivers.
- It allows a consistent evidence-based assessment to be made across each feature group.
- It allowed for collaboration with a range of specialists who were able to influence and validate the outputs.

# 3 Introduction

The Natura 2000 (N2K) network of European protected wildlife sites is a cornerstone of nature conservation in Wales and across Europe. Natura 2000 in Wales comprises of 92 Special Areas of Conservation (SACs) and 20 Special Protection Areas (SPAs) as designated under the Habitats and Birds Directives. These sites are designated for the conservation and protection of 123 different species and habitats features.

The LIFE Natura 2000 Programme is seeking to identify and agree strategic priorities for the Natura 2000 (N2K) series in Wales. This includes carrying out a conservation needs analysis for N2K species and habitat features, meaning Habitats Directive Annex I habitats and Annex II species as well as Birds Directive Annex I birds and regularly occurring migratory species designated on Special Areas of Conservation and Special Protection Areas in Wales. The Programme is managed by Natural Resources Wales (NRW) and co-funded by EU LIFE+ Nature and is due to complete in September 2015.

NRW has instructed ADAS UK Ltd (ADAS) to carry out a Multi-Criteria Decision Analysis (MCDA) of N2K features in Wales. MCDA is a systematic approach to discover and quantify evidence and stakeholder considerations about various factors in order to compare and rank alternative courses of action. MCDAs are commonly used in environmental decision making where the factors affecting decision-making are heterogeneous and uncertain in nature, and do not lend themselves to monetary valuation.

Its purpose in this case is to establish, in the most objective and scientific way possible, which features have the greatest needs and drivers for management and restoration. This will act as a valuable tool for practitioners and decision-makers to help identify where limited resources can be directed to best effect, and which areas of work to should be addressed first.

The MCDA process is based on a matrix (in MS Excel) where N2K features are ranked against criteria based on conservation needs and drivers, and which incorporates a weighting preference of NRW species and habitat specialists. A series of three MCDA matrices were developed by ADAS, for Annex I habitats, Annex II species, and Annex I birds respectively.

The MCDA is one of a number of tools developed by the LIFE Natura 2000 Programme, to aid the process of identifying strategic priorities. The MCDA is not intended to be used in isolation, or as a definitive list of conservation priorities, but used within the broader context of available tools. The overall approach is detailed in LIFE Natura 2000 Programme Approach to Prioritisation[6].

[6] LIFE Natura 2000 Programme Approach to Prioritisation (2015). Accessed at https://naturalresources.wales/about-us/our-projects/life-n2k-wales/life-n2k-reports/?lang=en

# 4 Methodology

## Overall Approach

The MCDA was based on a simple linear weighted model, with weights elicited using a 'swing' method. The overall approach was in line with UK Government guidance as set out in "*Multi-criteria analysis: a manual*"[7] ("The Manual"). This sets out a systematic method to conduct an MCDA and is considered best practice within the UK.

The Manual is worded to fit situations where a decision needs to be taken in favour of one course of action out of several options that might be available to achieve a desired outcome. In this case the primarily interest is to rank N2K features based on their needs and drivers for management intervention. The process involves eight distinct stages as summarised below.

| STAGE | PROCESS |
|---|---|
| 1. | **Establish the Decision Context**<br>- Establish aims of the MCDA, and identify decision makers and other key players.<br>- Design the socio-technical system for conducting the MCDA. |
| 2. | **Identify the Features to be Appraised** |
| 3. | **Identify Criteria**<br>- Identify criteria for assessing the worthiness of each feature.<br>- Organise the criteria by clustering them under high-level and low-level objectives in a hierarchy.<br>- High level assessment of requirements for suitable criteria (completeness, redundancy, operationality, double-counting, size). |
| 4. | **Scoring**<br>- Establish methodology to score the features against the criteria.<br>- Check the scores on each criterion for consistency and potential unsuitability. |
| 5. | **Weighting**<br>- Assign weights for each of the criteria to reflect their relative importance to the decision. |
| 6. | **Calculation**<br>- Combine the weights and scores for each feature to derive an overall value. |
| 7. | **Examine the Results** |
| 8. | **Sensitivity Analysis**<br>- Conduct a sensitivity analysis.<br>- Do the weights associated with certain preference groups affect overall ordering of the features and their categorisation? |

**Eight stage process for conducting MCDA.** Modified from DCLG (2009).

[7] Department of Communities and Local Government (2009). *Multi-criteria analysis: a manual.* London, Crown Copyright.

## Planning and Consultation

An inception meeting and a series of conference calls took place in February 2015 between NRW and ADAS to agree the initial approach to the MCDA. A workshop facilitated by ADAS took place in March 2015 and was attended by 20 NRW staff. The purpose of the workshop was to have a discussion/debate on the criteria and scoring process as well as carrying out the weighting process and producing a ranking and categorisation. A number of revisions to the initial methodology were made as a result of this work shop which are detailed in appendix 4. The final weighting exercise was undertaken within NRW by small focus groups.

## The Decision Context

### Aims

The LIFE N2K Programme aims to identify and prioritise a set of actions which will significantly improve the condition of N2K sites and features in Wales. Prioritisation of issues and risks, into high, medium, and low categories, had already taken place at a site level. Thematic Action Plans for dominant issues across the network have also been created. This MCDA aims to build on this by assessing the needs and drivers for conservation management and restoration of N2K features at a national level. The outputs of this project will be used as a tool to help practitioners and decision-makers to identify where limited resources can be directed to best effect, and which areas of work to should be addressed first.

### Stakeholders

As a Welsh Government Sponsored Body whose purpose is to ensure that the natural resources of Wales are sustainably maintained, enhanced and used, now and in the future, NRW has both an advisory and regulatory function in the context of the N2K network within Wales. NRW is thus a key stakeholder in the decision-making but there are other key stakeholders including the Welsh Government, NGOs and other groups with an interest in biodiversity in Wales.

### Socio-Technical System

There are many different approaches possible to conducting an MCDA. The process can be carried out by individuals working in isolation, or else people can come together and make collective decisions in a group context. MCDA can also be conducted within a single organisation, or can be used to collect the preferences of multiple organisations. Finally, the outputs of an MCDA can be applied directly to the decision-making in a democratic process, or else higher level executives can consider the results supplied within the context of their overall decision-making.

NRW's decision-making would ultimately be made at the executive level. However, NRW wished to explore and understand the preferences of different stakeholders within NRW. These included specialist ecologists with interests in certain species or habitat types, as well as more generalist ecologists with broader remits. In particular, NRW wanted to understand how and where these different groups might reach consensus on prioritisation.

### Features

The features assessed in the MCDA represent 123 different species and habitats that are designated on at least one N2K site within Wales. A preliminary trial was conducted to score and rank all N2K features within the same MCDA framework, as the requirement was to allocate resources as effectively as possible across the N2K network as a whole. However, due to challenges when comparing inherently different feature groups, feedback from the workshop, and the inapplicability of applying data consistently across all N2K feature groups, the MCDA process was ultimately conducted separately for N2K habitats features (appendix 1), non-bird species features (appendix 2) and bird species features (appendix 3).

## Criteria

Criteria selection was initially carried out by the LIFE N2K Programme team. This was then assessed by ADAS against a series of requirements (completeness, size, operationality, redundancy, and double-counting). The criteria was then vetted by NRW technical specialists at a workshop convened by ADAS in March 2015. These criteria were considered and some minor adjustments were made to the way they were formulated and named to produce the set in the table below.

**Criteria Set for Inclusion in Pilot Matrices**

| Criterion | Rationale |
|---|---|
| Habitats Directive Priority Feature | Under the Habitats Directive there are certain features for which conservation action has been prioritised as they are considered to be particularly vulnerable, in rapid decline and mainly, or exclusively, found within the EU. |
| Section 42 habitats and species | This list is the definitive list of habitats and species that are deemed to be of principle importance for conservation in Wales. As required under the NERC Act 2006 the list should be used by decision-makers when exercising their statutory duties. |
| UK special responsibility | Under the Habitats Directive, for certain Annex I habitats and Annex II species, the UK has a special responsibility. This is because we hold a disproportionately large proportion of the European resource or because the habitats/species in question are endemic or near endemic to the UK. Consequently, the UK has a special responsibility to protect them and to ensure that there is a sufficient quantity designated to maintain them at, or bring them into, favourable conservation status. Features for which the UK has a special responsibility are proposed for designation not only because of the population size or the area they cover, but also because they are of a "high quality" when judged against other criteria. As such, features may or may not also be regarded as being "priority". |
| Percentage of UK resources in Wales | Knowledge of the proportion of area of habitats, and populations of species occurring in Wales, comparative to the UK total, provides a measure of the degree to which Wales has a special responsibility to individual features. For habitats, this is measured as the percentage of the UK area in Wales. For species this is measured as the percentage of the UK population in Wales. |
| International conservation status | The IUCN Red List of threatened species provides an assessment of the International conservation status of species, which is based on the globally recognised IUCN Red List Categories and Criteria. |
| National conservation status | The national conservation status of a species provides an assessment of its status at the national scale. However, there is no individual, all taxa- recognised measure of national conservation status. |
| Birds of Conservation Concern | Birds have been assessed on the Wales Red, Amber, Green classification system indicating an increasing level of conservation concern. |
| Condition of feature on N2K sites in Wales | Of all the sites where the feature is found, this measure considers on what proportion of those sites the *feature* is favourable condition. |

**Criteria Set for Inclusion in Pilot Matrices**

| Criterion | Rationale |
|---|---|
| Climate change vulnerability index | The Climate Change Strategy for Wales has clearly identified the need for a greater understanding of the vulnerability of the protected sites network in order to inform adaptation delivery.<br>See: http://wales.gov.uk/docs/desh/publications/101006ccstratfinalen.pdf |
| Water Framework Directive feature interest | The UK Technical Advisory Group on the Water Framework Directive[8] describes the principles to be adopted by agencies responsible for implementing the Water Framework Directive in the UK. This document details N2K features that are deemed to be "water dependent". Subsequently, NRW have carried out an internal review to identify "Highly water dependent (aquatic) features". An understanding of the "water dependence" of a feature is likely to inform targeted resource allocation. |
| Number of ecosystem services provided | The UK National Ecosystem Assessment[9] details the UK's natural environment in terms of the benefits that it provides. Defra (2015)[10] describes the costs and risks that will accrue if we fail to take the value of ecosystem services into account in decision making, and how this approach is now central to the Government's aim. Consequently, an understanding of the ecosystem services provided by features will meet these obligations. |
| Number of sites designated for feature | The number of N2K sites in Wales where the feature occurs. An understanding of the comparative frequency with which a feature occurs on N2K sites is likely to provide an informative measure of targeted resource allocation. |
| Short term population trend | Population trend will give an indication of the short term and long term health of the features. |
| Long term population trend | |

## Criteria Data Sources and Types

The underlying values for the criteria were derived from the following sources as listed in the table below. Where more than one source is listed for the same criterion this is because different datasets were required for different taxa and habitats, or because a reference to an additional source was necessary to validate or complete the dataset for certain features.

[8] See: http://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Determining%20whether%20Natura%202000%20protected%20areas%20are%20meeting%20article%204_Final_010311.pdf)

[9] See: http://uknea.unep-wcmc.org/EcosystemAssessmentConcepts/tabid/98/Default.aspx

[10] Defra (2015) *What nature can do for you - A practical introduction to making the most of natural services, assets and resources in policy and decision making*.

**Data Sources**

| Criteria | Data Source / Data Type |
|---|---|
| Habitats Directive Priority Feature | JNCC web page http://jncc.defra.gov.uk/page-1523<br>No dataset for Birds Directive features. |
| | **Binary:** Features are either "Yes" or "No". |
| Section 42 | Wales biodiversity Partnership http://www.biodiversitywales.org.uk/49/en-GB/Section-42-Lists<br>Conservation Designations Spreadsheet JNCC web page http://jncc.defra.gov.uk/page-3408<br>Jones, P.S., Stevens, T.H., Blackstock, C.R., Burrows, C.R. & Howe, E.A. (2003) *Priority Habitats of Wales - a technical guide.* |
| | **Binary:** Features are either "Yes" or "No". |
| UK special responsibility | JNCC web page http://jncc.defra.gov.uk/page-1523<br>No dataset for Birds Directive features. |
| | **Binary:** Features are either "Yes" or "No". |
| Percentage of UK resources in Wales | **SAC Features:** Ranking of species and habitats to identify Welsh priorities.xls (Provided by NRW).<br>The "Ranking…" spreadsheet provides data on geographical area (for habitats) and population (for species) in Wales vs. UK as a whole. For most cases this considers the entire resource (and not just the SAC series) and is taken from 2013 Article 17 reports. For some features this is based on the SAC data alone (Depressions on Peat Substrates, Oligotrophic to Mesotrophic Standing Waters, Petrifying Springs, Transition Mires). For Hard Oligo-mesotrophic Waters this is based on 2007 data.<br><br>**SPA Features:** UK_SPA_DATA_20140901.xls (http://jncc.defra.gov.uk/page-1409)<br>Summary data for all classified SPAs in the UK. The list of species for each site includes only those listed on the Natura 2000 Data Form submitted to the European Commission. It does not yet take account of the amendments published in the SPA Review.<br><br>The "UK_SPA_DATA…" spreadsheet provides data on populations observed on SPA's in Wales vs. SPA's in UK as a whole. Some of the data is old, dating from ca. 1990. Population counts do not necessarily distinguish breeding vs. non-breeding. |
| | **Ratio:** Features are valued as proportion of UK SPA resource found in Wales. |
| International Conservation Status | **Annex II Species:**<br>Conservation Designations Spreadsheet JNCC web page http://jncc.defra.gov.uk/page-3408<br>**Birds:**<br>IUCN web page http://www.iucnredlist.org/<br>No dataset for Annex I Habitats. |

**Data Sources**

| Criteria | Data Source / Data Type |
|---|---|
| | **Ordinal:** Classified according to IUCN criteria: Critically Endangered, Endangered, Vulnerable, Near-threatened, Least Concern. |
| National conservation status | **SAC Features:**<br>JNCC web page http://jncc.defra.gov.uk/page-4239<br>Conservation Designations Spreadsheet JNCC web page http://jncc.defra.gov.uk/page-3408<br>Christine M. Cheffings and Lynne Farrell (Eds) (2005) Species Status No. 7 The Vascular Plant Red Data List for Great Britain website at http://www.jncc.gov.uk/<br>Arkive website at http://www.arkive.org<br>Bosanquet, S. (2011) *A Bryophyte Red Data List for Wales*<br>Daguet, C., French, G., Taylor, P., (eds) (2008) *The Odonata Red Data List for Great Britain.*<br>Fox, R., Warren, M. S. & Brereton, T. (2010) *The Butterfly Red List for Great Britain*.<br>Updates the National Review of non-marine Molluscs (1983), using the old IUCN categories and criteria (pre 1994) Ed. Bratton, J. H. Published by JNCC, 1991.<br>Harris, S., Morris, P., Wray S., & Yalden, D. (1995) *A review of British mammals: population estimates and conservation status of British mammals other than cetaceans.*<br><br>**SPA Features:**<br>Birds of Conservation Concern http://www.bto.org/sites/default/files/u12/bocc3.pdf<br>The State of Birds in Wales 2012 http://www.birdsinwales.org.uk/downloads/SOBIW2012eng.pdf<br>The Population Status of Birds in Wales http://www.rspb.org.uk/Images/Population%20Status%20of%20Birds%20in%20Wales%202_tcm9-269034.pdf<br>Eaton MA, Brown AF, Noble DG, Musgrove AJ, Hearn R, Aebischer NJ, Gibbons DW, Evans A and Gregory RD (2009) Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. *British Birds* 102, pp296-341. PDF |
| | **Ordinal:** As follows:<br><br>***SAC Features*:** The 2013 UK Article 17 reports classify into one of 8 categories (Bad Declining, Bad Stable, Bad Improving, Inadequate Declining, Inadequate Stable, Inadequate Improving, Favourable, and Unknown). Where 2013 information is unavailable, the 2007 data has been used (*Triturus cristatus, Petromyzon marinus*).<br><br>***SPA Features*:** Classified as Wales Red, Wales Amber, or Wales Green based on a broad set of criteria encompassing condition, coverage, and trend. |
| Current condition of feature on N2K sites in wales | Derived from NRW SAC and SPA monitoring programmes and recorded in:<br>- SAC Monitoring Programme SAC monitoring results 2013 - 2018.xls<br>- LIFE N2K SAC and SPA Sites and Features Master (July 2014).xls<br>(Provided by NRW; both contain SPA data) |

**Data Sources**

| Criteria | Data Source / Data Type |
|---|---|
| | **Ratio:**<br>Numerator: Number of sites assessed where feature is in favourable condition.<br>Denominator: Total number of sites where feature has been assessed. |
| Climate change vulnerability index | Data supplied by NRW - LIFE N2K SAC and SPA sites and features master xls.<br>Wilson, L., McCall, R., Astbury, S., Bhogal, A., & Walmsley, C., (2013) *Climate Vulnerability Assessment of Designated Sites in Wales.* CCW Contract Science Report No. 1017. |
| | **Ordinal:** The Climate Vulnerability report categorised sites as being Low, Medium, or High in terms of vulnerability to climate change, as assessed against a range of criteria. |
| Water Framework Directive feature interest | Data supplied by NRW - LIFE N2K Highly Water-dependent SAC and SPA Features xls.<br>This was an internal review carried out by NRW to identify "Highly water dependent features". |
| | **Binary:** Features are either "Yes" or "No". |
| Number of ecosystem services provided | Data supplied by NRW - LIFE N2K_Inventory_2014_02_06 xlsx.<br>NRW's N2K Ecosystem Inventory is a repository of information identifying the ecosystem service provision of each N2K feature. |
| | **Discrete:** The data is thus a simple count of the number of ecosystem services provided by each N2K feature. |
| Number of sites designated for feature | Data supplied by NRW - LIFE N2K SAC and SPA sites and features master xls. |
| | **Discrete:** The data is the count of sites in Wales where the feature is known to occur. |
| Population trend | Bird population trend data which has been sourced at a UK level only and was part of the submission for the Article 12 reporting |
| | The source of this data is http://jncc.defra.gov.uk/default.aspx?page=6526 |

## Assessing Criteria

In order to justify inclusion in the MCDA framework, the criteria were themselves considered against various requirements to judge their fitness for purpose. Requirements relevant to this exercise included completeness, size, operationality, redundancy, and double-counting. The latter two could only be fully assessed when the criteria were either scored or weighted. However, a consideration of the causal links between criteria and the overall objective and potential causal links between individual criteria themselves helped identify areas of concern and thus allowed the sensitivity analysis to be more focussed.

### *Completeness*

Completeness considers whether there are any missing general themes, or any missing criteria within these themes that would be essential to facilitate decision making. This was also vetted in detail during the facilitated workshop with NRW specialists.

### *Size*

An overly large criteria set can be unmanageable when used in facilitated workshops as it increases the complexity of the exercise. Initially there were 11 potential criteria which was larger than ideal. The redundancy and double-counting analysis (see below) was used to reduce the criteria down to a more condensed and manageable set.

### *Operationality*

This indicates the extent to which it is possible to accurately score features against a criterion. NRW's preference was that all criteria should be able to be objectively scored against a transparent underlying dataset, available in the public domain. If this was not possible because no underlying dataset existed for that criterion, or that dataset was mostly incomplete then it would be removed.

### *Missing data treatment*

Where datasets were mostly complete, a method was established to impute the missing data.

Professional guidance[11] recommends that missing data should be imputed by means of a theoretical or empirical statistical model. Both approaches would have required considerable analysis beyond the scope of this project. This left the following range of possible simpler approaches:

i) Assign an ad hoc value – e.g. zero, the mean, the mode.
ii) Professional judgement.
iii) Remove the criterion altogether.

Assigning *ad hoc* values such as the mean, mode, or zero is a more transparent approach, but does not reflect that data tend to follow a distribution and so can be problematic, especially if there are a number of missing data points for a criterion. Equally, it could also lead to individual data values that are evidently nonsensical. Using professional judgement allows some common sense to be applied but removes the transparency. Removing the criterion altogether avoids these issues but potentially excludes an important differentiator for features where data does exist.

After some consideration of the relative merits and pitfalls of each method the following approach was taken:

- If there were more missing than validated data points, then the criterion should be removed.
- If missing data was in the minority, then professional judgement would be used where possible to elicit the value, and where this had occurred it would be clearly marked.
- If professional judgement was not possible then *ad hoc* values would be used. Again where this had occurred it would be clearly marked.
- When final scoring and weighting was known, a sensitivity analysis would be applied to establish how sensitive the final rankings would be to variation in the missing data.

There was sufficient data on all of the criteria to warrant their continued inclusion in the MCDA. However, some professional judgment and *ad hoc* data entry was used for "Wales Special Responsibility", "National Conservation Status", "Current Condition", and "Climate Change Vulnerability Index". These are shown in the table below.

[11] See Carpenter, J. & Kenward, M. (n.d.). *Guidelines for handling missing data in Social Science Research*. Available at www.missingdata.org.uk

**Missing Data Treatment**

| Criterion | Feature / Issue | Decision |
|---|---|---|
| Wales Special Responsibility | Data is missing for: Caves not open to the public, Submerged or partially submerged sea-caves, *Alosa alosa, Tursiops truncatus, Halichoerus grypus, Mergus serrator, Arenaria interpres*. | Mean values for the corresponding feature class (Habitat, Species, Bird) have been substituted accordingly (12.5%, 23.89%, 18.91%) |
| Article 17 Reporting | Data is missing or Unknown for: Caves not open to the public, Submerged or partially submerged sea-caves, *Barbestalla barbastellus, Cottus gobio.* | Mode values for the habitat series have been substituted. Professional judgement has been used for the missing species with respect to other data sources. |
| International Conservation Status | Data is missing for: *Petalophyllum ralfsii, Hamatocaulis vernicosus* | Mode values have been substituted for *Petalophyllum* (Least Concern). Professional judgement used for *Hamatocaulis*. |
| Current Condition of Feature on N2K Sites in Wales | No sites have been assessed for: *Trichomanes speciosum, Mergus serrator, Gavia stellata, Arenaria interpres* and the Seabird Assemblage.<br><br>Some features are partially missing assessments. This does not affect the score now, but could change if this information becomes available at a later stage (Atlantic salt meadows, Coastal lagoons, Estuaries, Mudflats and sandflats, Reefs, Sandbanks, Vegetated seacliffs, *Alosa alosa, Luronium natans, Lampetra fluviatilis, Petromyzon marinus, Alosa fallax, Limosa limosa, Tadorna tadorna Sternula albifrons, Puffinus puffinus, Falco columbarius, Pyrrochorax pyrrochorax, Sterna sandvicensis.* Waterfowl assemblage). | Missing values for the Species and Birds series which are entirely unassessed have been substituted with the mean value (Species - 34.33%, Birds - 77.78%). |

## Clustering Criteria

The criteria was grouped into "clusters" of similar thematic relevance. This was done to assist the rest of the criteria assessment process and also make the weighting process more manageable. The following groups were used to cluster the data.

| Cluster | Description |
|---|---|
| Legal and Policy | Duty represents what is legally required of NRW / Welsh Government towards that feature. It is broken down into two subcomponents which cover what is required under EU law (Habitats Directive, Water Framework Directive) and UK Law (Section 42). |
| Coverage | Coverage means how extensive is the feature prevalent as a proportion of the EU or national average, and thus why it may be of greater importance for Wales to manage it. |
| Conservation Status | Conservation Status means the current status of the feature. For habitats it is only possible to consider the condition on sites, but for species this can also take into account the international and national status. |
| Sensitivity | Sensitivity means how sensitive the feature is to environmental change and conditions. The key variables being assessed here are climate change and water. |
| Value | Value means value of the feature to society. This is currently considered in terms of ecosystem services provided, but could potentially be measured in monetary or other terms. |
| Rarity | Rarity means how frequently the feature is designated on N2K sites. This is a different measure from coverage, status, and vulnerability. Species can be uncommon but not necessarily under threat or vulnerable to environmental change. |
| Population Trend | Population Trend refers to the direction in which the population of a species is moving in time. This cluster was only applied to the Birds feature group. |

The Criteria was grouped into clusters, for the three separate MCDAs as detailed below.

Criteria used within the habitats matrices

| Cluster | Criteria |
|---|---|
| Legal/Policy | Habitats Directive Priority Feature |
| Legal/Policy | Section 42 Habitats of principal importance for conservation |
| Legal/Policy | Water Framework Directive feature interest |
| Coverage | UK special responsibility |
| Coverage | Percentage of UK resource in Wales |
| Conservation Status | Habitats Directive Article 17 reporting status |
| Conservation Status | Condition of N2K features on sites in Wales |
| Sensitivity | Climate change vulnerability index |
| Value | Range of ecosystem service provision |
| Rarity | Number of sites designated for feature |

Criteria used within the species matrices

| Cluster | Criteria |
|---|---|
| Legal/Policy | Section 42 species of principal importance for conservation |
| Legal/Policy | Water Framework Directive feature interest |
| Coverage | UK special responsibility |
| Coverage | Wales special responsibility |
| Conservation Status | Habitats Directive Article 17 reporting status |
| Conservation Status | Condition of N2K features on sites in Wales |
| Conservation Status | International conservation status |
| Sensitivity | Climate change vulnerability index |
| Value | Range of ecosystem service provision |
| Rarity | Number of sites designated for feature |

Criteria used within the birds matrices

| Cluster | Criteria |
|---|---|
| Legal/Policy | Section 42 species of principal importance for conservation |
| Legal/Policy | Water Framework Directive feature interest |
| Coverage | Wales special responsibility (% of UK population in Wales) |
| Conservation Status | Birds Of Conservation Concern (BOCC) List |
| Conservation Status | Condition on N2K Sites in Wales |
| Conservation Status | International conservation status |
| Sensitivity | Climate change vulnerability index |
| Rarity | Number of sites designated for feature |
| Population Trend | UK population trend (Long term) |
| Population Trend | UK population trend (Short term) |

## Scoring

A rule-based approach to scoring was devised to assign values to the diverse datasets on a common, 0-100 scale, as follows.

A scoring method produced by NRW in advance of the project adopted a categorical approach where features were assigned values of 0, 1, 2, or 3, irrespective of whether the underlying data were quantitative or qualitative. The scoring approach was changed to the one recommended in The Manual which uses a 0 to 100 scale where 0 represents the lowest performance possible on that criterion and 100 represents the highest performance possible on that criterion. Lower values would reflect a lesser need to prioritise the feature, whilst higher values would indicate a greater need. This approach was favoured because it could be assigned to any possible underlying dataset, regardless of whether the data is qualitative or quantitative in nature. It also linked in more intuitively with the 'swing' weighting approach described below.

The original scoring was transformed to a 0 to 100 scale, and where reasonable the quantitative nature of the underlying data was retained, rather than categorising it into ordinal values. However, in some cases an ordinal approach was required where there was clear non-linearity in the meaning of the numerical data.

It is important to define the meaning of the 0 and 100 values in an MCDA. Some approaches will consider the 0 and 100 to be defined by the minimum and maximum value scored in the options under consideration only ("local range"). Other approaches require the 0 and 100 to represent the minimum and maximum values which could be reasonably scored whatever the options considered ("global range"). Local ranges are easier to implement but require re-setting if the options change or if the underlying data is refined and the minimum or maximum values change. Global ranges are harder to conceptualise in some cases, but can be reused if there are these changes.

Although NRW intends to re-use the MCDA spreadsheet, it was felt that changes in feature composition and underlying criteria data values were unlikely over a realistic time frame. As such, local ranges were used. This was immaterial where criteria are binary in nature (yes/no), but did matter where qualitative criteria are ordinal (low/medium/high) and where criteria were quantitative.

The generic process for scoring is set out below:

### *Qualitative Data*

For this MCDA the qualitative data was either binary or ordinal.

- For the binary datasets scores are either 0 or 100.
- For the ordinal datasets the lowest possible category should be scored as 0 and the highest possible category at 100. Between these, other categories would be fitted according to some judgement about their relative performance.

### *Quantitative Data*

For this MCDA the quantitative data was either discrete (i.e. integer count values) or ratio (e.g. percentages).

- For discrete datasets 0 and 100 represent the lowest and highest meaningful performance on that criterion.
- For ratio datasets 0 and 100 represent the lowest and highest meaningful performance on that criterion.

Where quantitative data have been transformed into qualitative data, the rules above were applied.

The table below shows the new scoring for each criterion by feature class.

**Scoring Approach**

| Criterion | Data Type | Min (Score = 0) | Max (Score = 100) |
|---|---|---|---|
| Habitats Directive Priority Feature | Binary | No | Yes |
| | Criterion is a binary dataset so min and max are automatically defined. All birds are regarded as "No" and scored at 0. | | |
| Section 42 | Binary | No | Yes |
| | Criterion is a binary dataset so min and max are automatically defined. | | |
| UK special responsibility | Binary | No | Yes |
| | Criterion is a binary dataset so min and max are automatically defined. All birds are regarded as "No" and scored at 0. | | |
| Wales special responsibility | Ratio | 0 | SAC Feature: 74.6%<br>SPA Feature: 100% |
| | Underlying percentages have been transformed separately for the SAC and SPA datasets due to the non-equivalence of the data.<br>For SAC features the maximum score (74.6%) is assigned a value of 100 and the actual percentages are pro-rata'd accordingly.<br>The same is done for SPA features though this is simply the percentage as the maximum value is 100%. | | |
| Article 17 Reporting | Ordinal | Favourable | Bad Declining |
| | The ordinal categories are assigned a score between 0 and 100 based on the number of category steps.<br>Favourable = 0, Inadequate Improving = 16.67, Inadequate Stable = 33.33, Inadequate Declining = 50.00, Bad Improving = 66.67, Bad Stable = 83.33, Bad Declining = 100. | | |
| Birds of Conservation Concern (BOCC) List | Ordinal | Wales Green | Wales Red |
| | The ordinal categories are assigned a score between 0 and 100 based on the number of category steps.<br>Wales Green = 0, Wales Amber = 50, Wales Red = 100. | | |
| Current condition of feature on N2K sites in Wales | Ratio | 100 | 0 |
| | Underlying dataset is the percentage of sites where features found that are in favourable condition. The score is 100 minus the actual percentage as the higher priority should go to those features where there are proportionately fewer sites in favourable condition. | | |
| Climate change vulnerability index | Ordinal | Low | High |
| | Low, Medium, and High is the possible range of categories available here. Medium will be scored at 50. | | |
| WFD Feature Interest | Binary | No | Yes |
| | Criterion is a binary dataset so min and max are automatically defined. | | |
| Extent of ecosystem service provision | Ordinal | Low | High |
| | The actual number of ecosystem services is converted to a high, low, or medium rating. The ranges were set based on the highest and lowest count | | |

**Scoring Approach**

| Criterion | Data Type | Min (Score = 0) | Max (Score = 100) |
|---|---|---|---|
| | within each feature class and divided that range into equal thirds. Counts of ecosystem service provision within the top third were assigned "High", the middle third "Medium", and the bottom third "Low".<br>Low = 0, Medium = 50, High = 100. | | |
| Number of sites designated for feature | Discrete | 21 | 1 |
| | Frequency is being used as an indicator of rarity. The rarer, the higher priority the feature. As an indicator it is the inverse of frequency, so score = 1 / Frequency. This is then rescaled so that the highest frequency item (21 counts which translates to 4.76) is readjusted to zero and values are pro-rata'd accordingly.<br>Although the bottom end of the scale is low, the pro-rata has been done to preserve consistency with other criteria. | | |
| UK population trend (Long term) | Ordinal | Increase | Decrease |
| | Data can be: Decrease, Fluctuating, Stable, or Increase. The ordinal categories are assigned a score between 0 and 100 based on the number of category steps. This means:<br>Decrease = 100; Stable = 66.67, Fluctuating = 33.33, Increase = 0 | | |
| UK population trend (Short Term) | Ordinal | Increase | Decrease |
| | Data can be: Decrease, Fluctuating, Stable, or Increase. The ordinal categories are assigned a score between 0 and 100 based on the number of category steps. This means:<br>Decrease = 100; Stable = 66.67, Fluctuating = 33.33, Increase = 0 | | |

## Weighting

The next step after criteria and scoring have been established was to assign weights to each of the criteria. This was done by applying a simple version of 'swing' methodology. Swing is an approach to setting weights where decision-makers must take into consideration the relative value of a swing in value between the minimum and maximum scores possible on each criterion. The reason for doing this is that this swing in value is an essential component in decision-making. Weights were established by NRW using focus groups with key stakeholders and experts for each feature class.

A swing weight process works as follows:

i) Starting at the lowest tier of the criteria hierarchy, and within each thematic cluster, pairwise comparisons are made between criteria. Starting with any two criteria, the decision-maker considers what is the meaning of moving from a 0 score to a 100 score and whether they care more about the swing on one criteria than on the other. They then compare the one they prefer with the other criteria. If at any point, the preference changes, the decision-maker switches to the new preferred criterion and assesses that until they have considered all of the criteria within that node. The criterion which is still preferred at the end is the top ranked criterion (within the cluster).

ii) Remaining within the cluster, the decision-maker sets out the top ranking criterion as the benchmark and assigns it an arbitrary value of 100 points. They then compare the lower ranked criteria against this to work out their score relative to this benchmark. Again the assessment concerns the importance of the swing, so if a criterion whose value swing was only judged to be 40% as important as the benchmark, then it would be assigned 40 points. Once comparisons are made of all the criteria to the benchmark, they are lined up in rank order with their point allocation. If the ranking appears to be unexpected the process is repeated until the decision-maker is satisfied.

iii) Carry out i) and ii) at each cluster until all have been assigned benchmark and relative values.

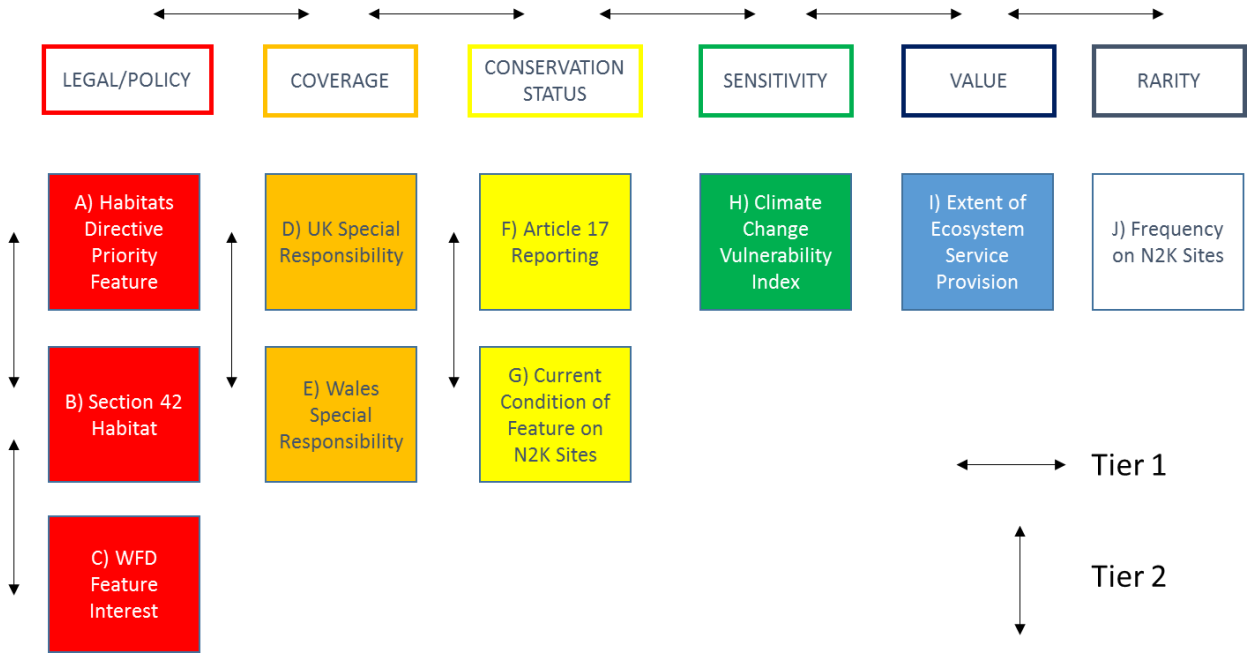
iv) Carry out the process of i) and ii) but this time only considering the top ranked criteria for each cluster, which are compared with each other.

v) Adjust the values of the top ranked criteria according to the value assigned in step iv) and pro-rata the other criteria according to the relative score within the cluster. Only the criterion which remains top and its associated within-cluster criteria retains their stage iii) values.

vi) If there are further tiers of a cluster hierarchy, then iv) and v) are repeated again until all the winners have been assessed against each other and the scores down the hierarchy adjusted accordingly.

vii) Weights are then established for each criterion by dividing the criterion value against the sum of all of the criteria scores.

This process is illustrated in the figure below, as applied to the Habitats feature group.

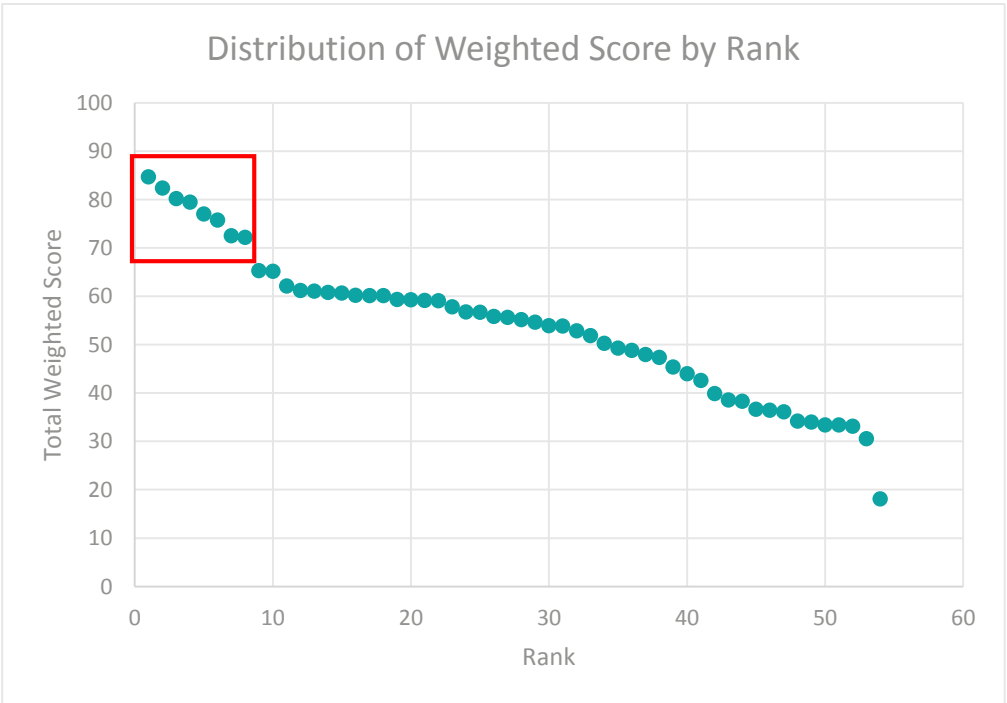



**Comparisons needed to elicit swing weights.** In this case Tier 2 is the lowest level of the cluster hierarchy and Tier 1 is the highest.

## Calculation

The score for each feature against each criterion will be multiplied by the criterion weight, and then the weighted scores added for each feature, to give an overall number. The feature with the highest score will be the top ranked and so on down to the lowest score.

To identify the features with the highest needs and drivers, the total weighted scores were plotted in order of rank to identify natural breaks in the output. From this the features identified by the first break were used.



## Sensitivity Analysis

Sensitivity analysis is an important part of the MCDA process. The outputs would need to be checked for the following issues:

i) Criterion redundancy due to score similarity.
ii) Identification of potential double-counting between criteria.
iii) Criterion redundancy due to very low weighting.
iv) Sensitivity to missing data. Does ranking / categorisation change materially if missing data inferred by professional judgement or ad hoc processes is modified?
v) Sensitivity to group processes.

Some of these could only be assessed once the workshops had taken place and weights had been assigned (iii) and (v). Others had already been performed as part of the criteria assessment process outlined above (i) and (ii). The missing data assessment could have been performed at this stage. However, as one of the objectives of the workshop was to elicit alternative data sources, this assessment was delayed until the data sources were clarified.

# 5 Results

## Weighting

The weightings derived for the individual matrices were produced during NRW focus groups. Analysis of the weighting showed that conservation status was considered as the most important criteria across all three MCDAs. This was the percentage of sites in unfavourable condition for habitats and species features and the Birds of Conservation Concern (BOCC) list for bird features. Coverage, measured by the percentage of the feature resources in Wales, was the next most important factor. Legal and policy drivers were also important for habitats and bird features, where non-bird features gave a great weighting to climate change vulnerability index. Rarity and ecosystem services were consistently the lowest weighted criteria.

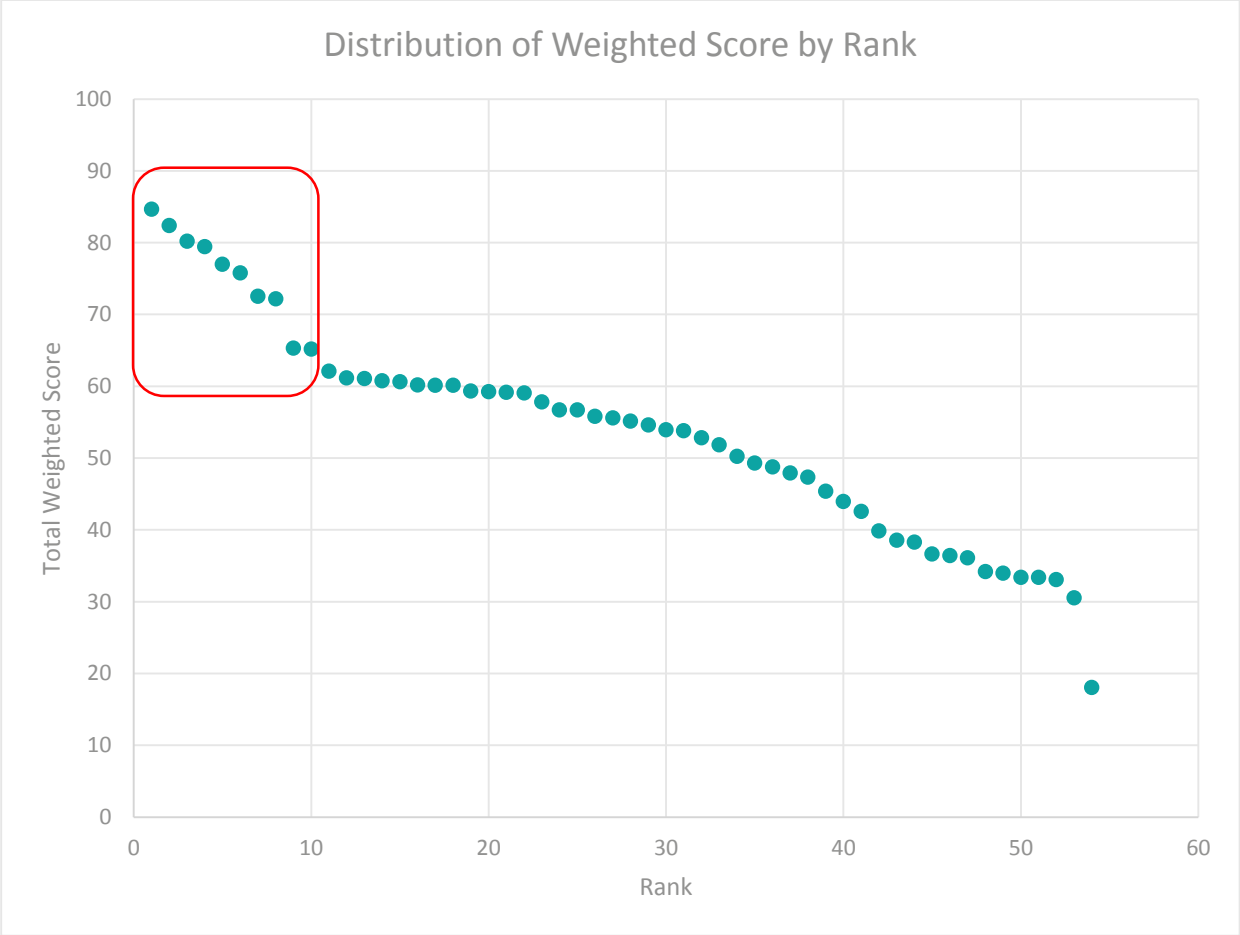
**Analysis of Weights**

| Cluster | Criterion | Focus Group (Habitats) | Focus Group (Species) | Focus Group (Birds) |
|---|---|---|---|---|
| Legal and policy | Habitats Directive Priority Feature | 0.13 | | |
| | Section 42 | 0.10 | 0.12 | 0.12 |
| | WFD feature interest | 0.03 | 0.03 | 0.02 |
| Coverage | UK special responsibility | 0.10 | 0.10 | |
| | Wales special responsibility | 0.125 | 0.13 | 0.13 |
| Conservation status | International conservation status | | 0.11 | 0.13 |
| | Article 17 / BOCC List | 0.14 | 0.14 | 0.18 |
| | Current Condition on N2K Sites | 0.18 | 0.18 | 0.14 |
| Sensitivity | Climate change vulnerability index | 0.13 | 0.13 | 0.08 |
| Value | Extent of ecosystem services | 0.02 | 0.02 | |
| Rarity | Number of sites designated for feature | 0.07 | | 0.06 |
| Trend | Long term population trend | | | 0.07 |
| | Short term population trend | | | 0.07 |

## Outputs

The three separate MCDA identified 32 high needs features from a possible 123.

The Habitat MCDA identified 11 features with relatively higher conservation needs and drivers from a possible 54.




The features highlighted were:

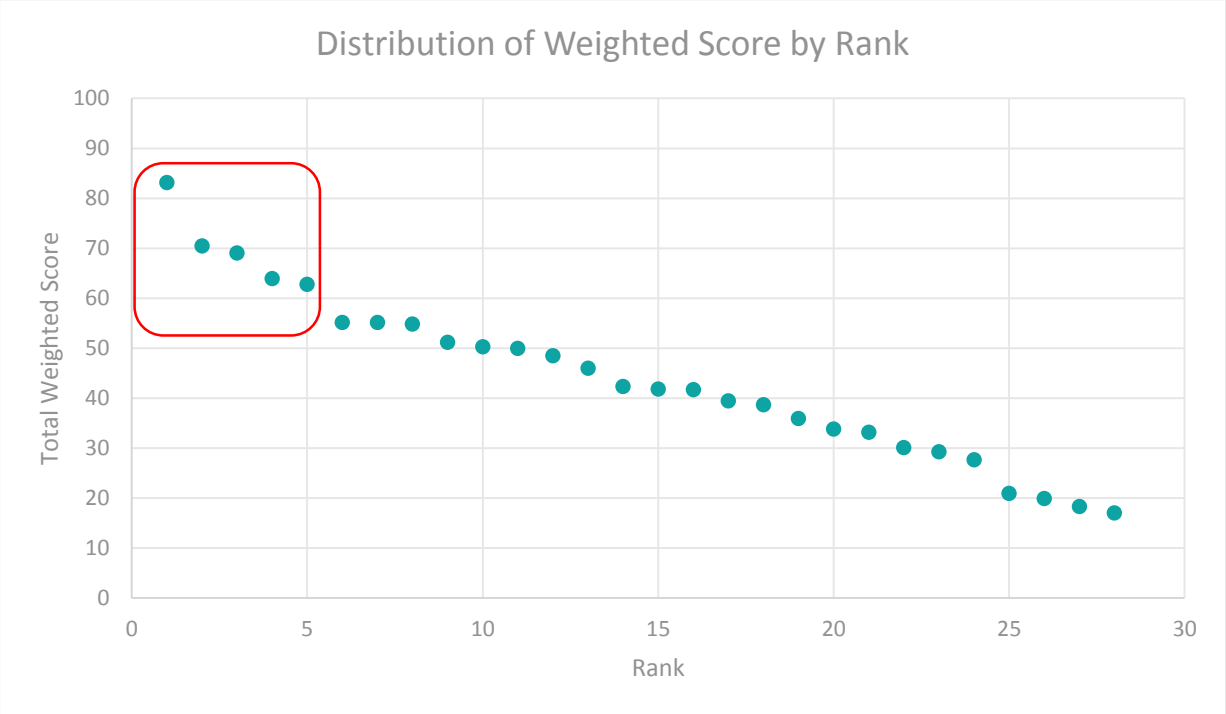
| Feature Formal Name | Feature Informal Name |
|---|---|
| Active raised bogs | Active raised bogs |
| Blanket bogs | Blanket bog |
| Old sessile oak woods with Ilex and Blechnum in the British Isles | Western acidic oak woodland |
| Species-rich *Nardus* grassland, on siliceous substrate in mountain areas (and submountain areas in continental Europe) | Species-rich grassland with mat-grass in upland areas |
| Calcareous fen with *Cladium mariscus* and species of the *Caricion davallianae* | Calcium-rich fen dominated by great fen sedge (saw sedge) |
| Fixed dunes with herbaceous vegetation ('grey dunes') | Dune grassland |
| Petrifying springs with tufa formation (*Cratoneurion*) | Hard-water springs depositing lime |
| *Tilio-Acerion* forests of slopes, screes and ravines | Mixed woodland on base-rich soils associated with rocky slopes |
| Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) | Alder woodland on floodplains |
| *Taxus baccata* woods of the British Isles | Yew-dominated woodland |

| | |
|---|---|
| Humid dune slacks | Humid dune slacks |

The habitats MCDA was filtered to identify four marine priority features. This was done as it was acknowledged that marine features had, in some cases, separate programmes of work and unique dedicated funding sources.

| Feature Formal Name | Feature Informal Name |
|---|---|
| Perennial vegetation of stony banks | Coastal shingle vegetation outside the reach of waves |
| Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) | Atlantic salt meadows |
| Estuaries | Estuaries |
| Coastal lagoons | Lagoons |

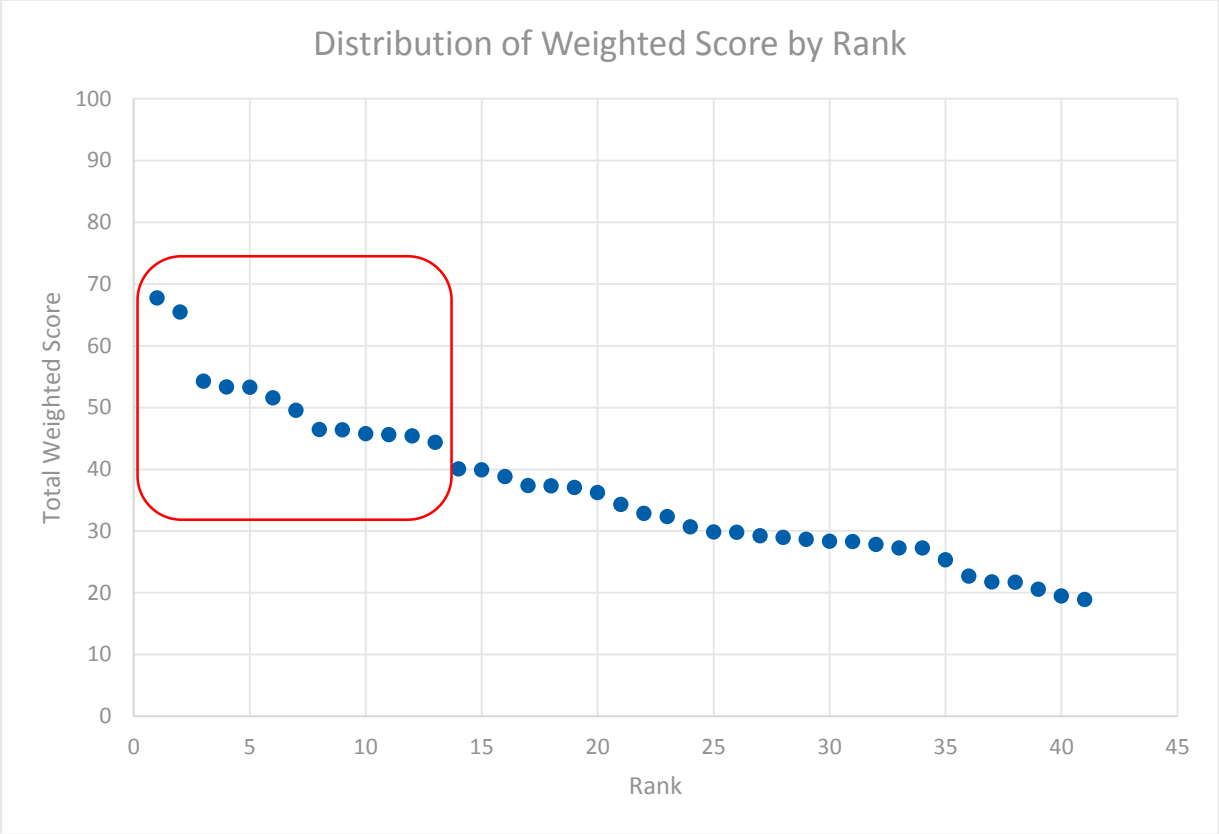
The Species MCDA identified five feature with relatively higher conservation needs and drivers from a potential 28. This included a number of sensitive river invertebrates and vascular plant features.




The features highlighted were:

| Feature Formal Name | Feature Informal Name |
|---|---|
| *Margaritifera margaritifera* | Freshwater pearl mussel |
| *Gentianella anglica* | Early gentian |
| *Liparis loeselii* | Fen orchid |
| *Petalophyllum ralfsii* | Petalwort |
| *Austropotamobius pallipes* | White-clawed crayfish |

The bird MCDA identified 13 priority features with relatively higher conservation needs and drivers from 41 SPA features.




The features highlighted were:

| Feature Formal Names | Feature Informal Name | season |
|---|---|---|
| *Sterna dougallii* - breeding | Roseate tern | Breeding |
| *Cygnus columbianus bewickii* (Western Siberia/North-eastern & North-western Europe) | Bewick`s swan | Wintering |
| *Anser albifrons albifrons* | Greater white-fronted goose | Wintering |
| *Larus fuscus* | Lesser black-backed gull | Breeding |
| *Anser albifrons flavirostris* | Greenland white-fronted goose | Wintering |
| *Calidris alpina* | Dunlin | Wintering |
| *Limosa lapponica* | Bar-tailed godwit | Wintering |
| *Sterna paradisaea* | Arctic tern | Breeding |
| *Sterna hirundo* | Common tern | Breeding |
| *Numenius arquata* | Eurasian curlew | Wintering |
| *Arenaria interpres* | Turnstone | Wintering |
| *Pluvialis squatarola* | Grey plover | Wintering |
| *Sternula albifrons* | Little tern | breeding |

## Sensitivity Analysis - Missing Data

Two solutions were found to overcome the issue of missing data. The first, where values are decided by professional judgement will not be evaluated. The second, replacing the value with the mean or mode is statistically contentious so it is important to understand the impact of choosing different values.

### *Habitats Features*

For Habitats features *ad hoc* values have been used for:

- Wales Special Responsibility and Article 17 Reporting (sea caves and caves not open to the public).

The following adjustments were made:

| Feature | Adjustment | Change in Overall Score (100) | Change in Rank (54) |
|---|---|---|---|
| Sea caves | Use highest value for Wales Special Responsibility (47.6) and Article 17 Reporting (BD) | 38.59 -> 50.20 | 43 -> 35 |
| Sea caves | Use lowest value for Wales Special Responsibility (0.1) and Article 17 Reporting (F) | 38.59 -> 23.46 | 43 -> 53 |
| Caves not open to the public | Use highest value for Wales Special Responsibility (47.6) and Article 17 Reporting (BD) | 18.10 -> 29.70 | 54 -> 54 |
| Caves not open to the public | Use lowest value for Wales Special Responsibility (0.1) and Article 17 Reporting (F) | 18.1 -> 2.96 | 54 -> 54 |

Both of these habitats rank in the bottom 12 on the overall priority list. The means and modes were replaced with the highest possible value. This raised the overall ranking of sea caves from 43 to 35 out of 54 features but caves not open to the public remained bottom. The missing data therefore does not have a material impact on the habitats ranking.

### *Species Features*

For Species features ad hoc values have been used for:

- Wales Special Responsibility (Allis shad, Bottle-nosed dolphin, Grey seal).
- International Conservation Status (Petalwort).
- Current Condition on N2K Sites in Wales (Killarney fern).
- Climate Change Vulnerability Index (Bottle-nosed dolphin, Grey seal).

The following adjustments were made:

| Feature | Adjustment | Change in Overall Score (100) | Change in Rank (28) |
|---|---|---|---|
| Allis shad (*Alosa alosa*) | Use highest value for Wales Special Responsibility (74.6) | 49.99 -> 58.67 | 11 -> 6 |
| Allis shad (*Alosa alosa*) | Use lowest value for Wales Special Responsibility (1.2) | 49.99 -> 46.10 | 11 -> 12 |
| Bottle-nosed dolphin (*Tursiops truncatus*) | Use highest value for Wales Special Responsibility (74.6) and Climate Change Vulnerability Index (High) | 20.93 -> 42.17 | 25 -> 15 |

| Feature | Adjustment | Change in Overall Score (100) | Change in Rank (28) |
|---|---|---|---|
| Bottle-nosed dolphin (*Tursiops truncatus*) | Use lowest value for Wales Special Responsibility (1.2) and Climate Change Vulnerability Index (Low) | 20.93 -> 17.05 | 25 -> 27 |
| Grey seal (*Halichoerus gypus*) | Use highest value for Wales Special Responsibility (74.6) and Climate Change Vulnerability Index (High) | 18.35 -> 39.58 | 27 -> 17 |
| Grey seal (*Halichoerus gypus*) | Use lowest value for Wales Special Responsibility (1.2) and Climate Change Vulnerability Index (Low) | 18.35 -> 14.46 | 27 -> 28 |
| Petalwort (*Petalophyllum ralfsii)* | Use highest value for International Conservation Status (Endangered) | 63.96 ->72.03 | 4 -> 2 |
| Killarney fern (*Trichomanes speciosum*) | Use highest value for Current Condition… (0%) | 29.30 -> 35.46 | 23 -> 20 |
| Killarney fern (*Trichomanes speciosum*) | Use lowest value for Current Condition… (100%) | 29.30 -> 17.52 | 23 -> 27 |

Material changes in score and rank are seen if the highest possible values for Wales Special Responsibility and Climate Change Vulnerability Index are applied instead of the means/modes. However, as the two species which are most affected by this are towards the lower end of the rankings, the impact is unlikely to change the overall prioritisation. The changes for Allis shad and Petalwort are less material in terms of score change, but they do move the species into more prominent positions (sixth and second respectively). However, the Petalwort was already selected in the output as a high needs species whilst the increase in the Allis shad's overall score does not quite put it into this category.

### *Birds Features*

For Birds features ad hoc values have been used for:

- Wales Special Responsibility (Red-breasted merganser, Turnstone).
- International Conservation Status (Seabird assemblage, Waterfowl assemblage).
- BOCC list (Seabird assemblage, Waterfowl assemblage).
- Current Condition of Feature on N2K Sites (Red-breasted merganser, Red-throated diver, Seabird assemblage, Turnstone).
- UK Long Term Population Trend (European storm petrel, Manx shearwater, Sandwich tern, Seabird assemblage, Waterfowl assemblage).
- UK Long Term Population Trend (Manx shearwater, Sandwich tern, Seabird assemblage, Waterfowl assemblage).

| Feature | Adjustment | Change in Overall Score (100) | Change in Rank (41) |
|---|---|---|---|
| Red-breasted merganser | Use highest value for Wales Special Responsibility (100%) and Current Condition… (0%) | 37.36 -> 57.75 | 18 -> 3 |

| Feature | Adjustment | Change in Overall Score (100) | Change in Rank (41) |
|---|---|---|---|
| (*Mergus serrator*) | | | |
| Red-breasted merganser (*Mergus serrator*) | Use lowest value for Wales Special Responsibility (0%) and Current Condition… (100%) | 37.36 -> 31.11 | 18 -> 24 |
| Turnstone (*Arenaria interpres*) | Use highest value for Wales Special Responsibility (100%) and Current Condition… (0%) | 45.63 -> 66.01 | 11 -> 2 |
| Turnstone (*Arenaria interpres*) | Use lowest value for Wales Special Responsibility (0%) and Current Condition… (100%) | 45.63 -> 39.38 | 11 -> 15 |
| Red-throated diver (*Gavia stellata*) | Use highest value for Current Condition…(0%) | 21.73 -> 31.69 | 38 -> 25 |
| Red-throated diver (*Gavia stellata*) | Use lowest value for Current Condition… (100%) | 21.73 -> 17.91 | 38 -> 41 |
| European storm petrel (*Hydrobates pelagicus*) | Use highest value for Long Term Population Trend (Decrease) | 39.93 -> 47.28 | 15 -> 9 |
| Manx shearwater (*Puffinus puffinus*) | Use highest value for Long Term Population Trend (Decrease) and Short Term Population Trend (Decrease) | 28.68 -> 36.03 | 30 -> 22 |
| Manx shearwater (*Puffinus puffinus*) | Use lowest value for Long Term Population Trend (Increase) and Short Term Population Trend (Increase) | 28.68 -> 21.40 | 30 -> 38 |
| Sandwich tern (*Sterna sandvicensis*) | Use highest value for Long Term Population Trend (Decrease) and Short Term Population Trend (Decrease) | 29.80 -> 37.15 | 27 -> 20 |
| Sandwich tern (*Sterna sandvicensis*) | Use lowest value for Long Term Population Trend (Increase) and Short Term Population Trend (Increase) | 29.80 -> 22.50 | 27 -> 36 |
| Seabird assemblage | Use highest value for International Conservation Status (Near threatened), BOCC list (Wales Red), Current Condition… (0%), Long Term Population Trend (Decrease), Short Term Population Trend (Decrease) | 32.35 -> 62.06 | 24 -> 3 |
| Seabird assemblage | Use lowest value for International Conservation Status (Least Concern), BOCC list (Wales Green), Current Condition… (100%), | 32.35 -> 12.08 | 24 -> 41 |

| Feature | Adjustment | Change in Overall Score (100) | Change in Rank (41) |
|---|---|---|---|
| | Long Term Population Trend (Increase), Short Term Population Trend (Increase) | | |
| Waterfowl assemblage | Use highest value for International Conservation Status (Near threatened), BOCC list (Wales Red), Long Term Population Trend (Decrease), Short Term Population Trend (Decrease) | 28.35 -> 48.10 | 31 -> 9 |
| Waterfowl assemblage | Use lowest value for International Conservation Status (Least Concern), BOCC list (Wales Green), Long Term Population Trend (Increase), Short Term Population Trend (Increase) | 28.35 -> 11.89 | 31 -> 41 |

Current Condition of Feature on N2K sites and Wales Special Responsibility were the second and third highest weighted criteria in the Birds MCDA. It is not surprising then that material changes in scoring and ranking occur when the missing data imputation is stress tested. At the individual species level this has pertinence for the Red-breasted merganser and Turnstone which could move into the top three if the most precautionary approach were used for the missing data (higher scores). The Turnstone was already included in the high needs category, however the Red-breasted merganser was not. It may therefore be prudent to re-evaluate the needs of this bird on an individual basis to establish whether it may require prioritisation.

The missing data for population trend did not make a major difference in the ranking for the individual bird species concerned, with only the European storm petrel moving into the top 10 in the most extreme scenario. However, as this would have then put this bird into the high needs category a closer examination of its situation may be warranted.

Uncertainty is highest for the Bird assemblages because data is missing for almost half of all criteria. The Seabird assemblage could theoretically score anywhere from 12.08 to 62.06 which is almost the entire range of scores, and thus could be ranked between 3 and 41. The Waterfowl assemblage also has a large possible range (11.89 – 48.10), so it could potentially rank as high as 9 or as low as 41. With such a large degree of uncertainty, it would be inadvisable to make a prioritisation decision for the assemblages on the basis of this data. In the short term professional judgement should be used on some of the criteria for these features to narrow the potential variation to more reasonable levels. In the longer term, there is a need to collect the actual data.

## Sensitivity Analysis – Correlations and Double Counting

Based on the scoring approach outlined above, the following correlation matrices have been established. A two-tailed test has been applied as negative correlations could be an indicator of under-counting if one of the criteria is expressed in an inverse manner.

| | *Habitats Directive Priority Feature* | *S.42 Habitats* | *WFD Feature Interest* | *UK special responsibility* | *Wales special responsibility* | *Article 17 Reporting* | *Current Condition on N2K sites in Wales* | *Climate change vulnerability index* | *Extent of Ecosystem Service Provision* | *Frequency on N2K sites* |
|---|---|---|---|---|---|---|---|---|---|---|
| Habitats Directive Priority Feature | 1.000 | | | | | | | | | |
| S.42 Habitats | -0.053 | 1.000 | | | | | | | | |
| WFD Feature Interest | 0.114 | 0.128 | 1.000 | | | | | | | |
| UK special responsibility | 0.106 | -0.149 | 0.012 | 1.000 | | | | | | |
| Wales special responsibility | 0.000 | 0.161 | 0.063 | -0.119 | 1.000 | | | | | |
| Article 17 Reporting | 0.074 | 0.083 | -0.103 | 0.262 | 0.363 | 1.000 | | | | |
| Current Condition on N2K sites in Wales | 0.057 | 0.115 | 0.188 | 0.359 | -0.048 | 0.054 | 1.000 | | | |
| Climate change vulnerability index | 0.385 | 0.037 | 0.278 | -0.168 | 0.008 | 0.086 | 0.203 | 1.000 | | |
| Extent of Ecosystem Service Provision | 0.219 | 0.024 | 0.255 | 0.254 | 0.013 | 0.294 | 0.424 | 0.225 | 1.000 | |
| Frequency on N2K sites | 0.149 | -0.166 | -0.330 | -0.133 | -0.340 | -0.169 | -0.365 | -0.116 | -0.265 | 1.000 |

**Habitat features – Correlation coefficients for criteria.** Highlighted cells show levels of r that exceed the 2-tailed test significance threshold at the 1% level (N = 54).

The Habitats feature class shows significant positive correlation between Current Condition and the Extent of Ecosystem Services provision, and between Climate Change Vulnerability Index and Habitats Directive Priority Feature. There is also a significant positive correlation between Wales Special Responsibility and Article 17 Reporting.

There is a no obvious explanation for the link between Ecosystem Service Provision and Current Condition, but this does not matter here as the ecosystem service criteria was also very low-weighted (0.02). Greater caution should perhaps be applied to the correlation between Climate Change Vulnerability Index and Habitats Directive Priority Feature which are higher weighted criteria (0.13). Nine of the eleven high needs features score the maximum on Habitats Directive Priority Feature and six of the eleven score the maximum on Climate Change Vulnerability. An examination of the method used to derive the underlying data for both criteria is recommended to ensure that the correlation is coincidental and not causal. Wales Special Responsibility and Article 17 Reporting are highly weighted criteria (0.13 and 0.14) but there is no obvious causal link. Furthermore, although most of the high needs features score very highly on Article 17 reporting, their scores are widely distributed for Wales Special Responsibility.

| | *S.42 Species* | *WFD Feature Interest* | *UK special responsibility* | *Wales special responsibility* | *Article 17 Reporting* | *Current Condition on N2K sites in Wales* | *International conservation status* | *Climate change vulnerability index* | *Extent of Ecosystem Service Provision* | *Frequency on N2K sites* |
|---|---|---|---|---|---|---|---|---|---|---|
| S.42 Species | 1.000 | | | | | | | | | |
| WFD Feature Interest | -0.190 | 1.000 | | | | | | | | |
| UK special responsibility | 0.153 | 0.091 | 1.000 | | | | | | | |
| Wales special responsibility | -0.165 | 0.030 | -0.356 | 1.000 | | | | | | |
| Article 17 Reporting | 0.454 | -0.044 | 0.113 | -0.341 | 1.000 | | | | | |
| Current Condition on N2K sites in Wales | 0.056 | 0.283 | 0.001 | -0.098 | 0.251 | 1.000 | | | | |
| International conservation status | 0.135 | -0.030 | 0.248 | -0.256 | 0.565 | 0.037 | 1.000 | | | |
| Climate change vulnerability index | 0.064 | 0.139 | 0.102 | -0.114 | 0.222 | 0.183 | 0.278 | 1.000 | | |
| Extent of Ecosystem Service Provision | -0.270 | 0.104 | -0.013 | 0.437 | -0.055 | 0.258 | 0.019 | 0.233 | 1.000 | |
| Frequency on N2K sites | 0.222 | -0.266 | 0.066 | -0.505 | 0.601 | -0.238 | 0.693 | 0.322 | -0.227 | 1.000 |

**Species Features – Correlation coefficients for criteria.** Highlighted cells show levels of r that exceed the 2-tailed test significance threshold at the 1% level (N = 28)

For Species there is significant positive correlation between International Conservation Status and Article 17 Reporting as well as rarity (frequencies on N2K sites). It is not hard to imagine a causal link between the three criteria. However, the weighting for rarity was relatively low (0.05) and the scores on the other two criteria in the high needs features were quite widely distributed suggesting that this might not be such a material effect in the selection process. Furthermore, Article 17 and International Conservation Status are both within the same cluster, so participants had could consider the meaning of each and make a pairwise comparison. Participants did not report any difficulty carrying out this task, and the weights elicited (0.14 vs 0.11) did not suggest any redundancy, so there is no reason to exclude either criterion.

| | S.42 Species | WFD Feature Interest | Wales special responsibility | BOCC List | Current Condition on N2K Sites in Wales | International conservation status | Climate change vulnerability index | Frequency on N2K sites | UK Population Trend (Long Term) | UK Population Trend (Short Term) |
|---|---|---|---|---|---|---|---|---|---|---|
| S.42 Species | 1.000 | | | | | | | | | |
| WFD Feature Interest | -0.114 | 1.000 | | | | | | | | |
| Wales special responsibility | 0.096 | -0.243 | 1.000 | | | | | | | |
| BOCC List | 0.352 | 0.122 | -0.438 | 1.000 | | | | | | |
| Current Condition on N2K Sites in Wales | 0.237 | -0.258 | 0.136 | -0.117 | 1.000 | | | | | |
| International conservation status | 0.077 | -0.149 | 0.243 | 0.079 | -0.095 | 1.000 | | | | |
| Climate change vulnerability index | -0.373 | 0.446 | -0.155 | 0.092 | -0.182 | -0.092 | 1.000 | | | |
| Frequency on N2K sites | -0.023 | 0.327 | -0.232 | 0.010 | 0.196 | -0.109 | 0.135 | 1.000 | | |
| UK Population Trend (Long Term) | -0.050 | 0.126 | 0.005 | 0.213 | 0.152 | -0.192 | 0.294 | 0.116 | 1.000 | |
| UK Population Trend (Short Term) | -0.132 | 0.250 | -0.057 | -0.053 | -0.066 | -0.137 | 0.133 | -0.171 | 0.378 | 1.000 |

**Birds Features – Correlation coefficients for criteria.** Highlighted cells show levels of r that exceed the 2-tailed test significance threshold at the 1% level (N = 38).

WFD feature interest correlated highly with Climate Change Vulnerability and rarity (frequency on N2K sites) for the Birds dataset but was again a very low weighted criterion (0.02), so the effect is probably not material. However, there was significant positive correlation (0.378) between the short term and long term population trend scores As they were in the same cluster, participants did have an opportunity to do a pair-wise comparison, which resulted in identical weights (0.07). No problems were reported in carrying out this comparison and the weights elicited suggest that participants believed a swing from "Increase" to "Decrease" on both criteria to be equally meaningful. As a result it is difficult to exclude either of them despite the high correlation.

# 6 Limitations and Recommendations

## Limitations and Recommendations

The tool allowed a range of conservation factors to be considered, collaboratively, by a range of species and habitat specialist to develop the output.

Overall the MCDA provided a reasonable assessment of conservation needs and drivers. However there were some anomalies that were not accounted for in the MCDA. For example the Roseate Tern was identified as a feature with high conservation needs and drivers. However due to the nature of the feature's ecology, the spatial preference of breeding sites can vary, and the Welsh population is now know to reside in Ireland. This factor could not be accounted for in the MCDA and there is no possibility to manage against this, so a decision was made not consider this as a high needs feature.

Amongst specialists there were some issues with confidence in the datasets used, although it was acknowledged that they represent the most applicable datasets and were deemed fit for the purpose. To account for this, the MCDA was designed with flexibility so the datasets can be updated, or new datasets added, so the assessment can be re-run using the best available knowledge and evidence. Due to the lower confidence in the condition assessments for bird and marine features, there was an acknowledgement that there should remain a focus on updating this data, an important criteria in the decision making process. The importance of this was highlighted by the high weighting of this criteria across all MCDAs. Also certain datasets such as ecosystem service, were seen as potentially important factors but given low weightings. Again, this reflected the lower confidence in the underlying data.

Another limitation of the MCDA was due to the lack of data explicitly dealing with sensitivity, urgency and vulnerability to decline. For example, woodland features appeared high within the needs analysis, but due to the low urgency for management intervention, the features were consider to be ranked relatively higher than expected.

It is recommended that work is undertaken to develop datasets/indices for the following criteria to include in future versions of the MCDA to all a more complete consideration of factors. A dataset to more explicitly take into account vulnerability to decline.

- Vulnerability to decline
- Rarity
- Requirement for management and restoration (i.e. amount of work needed)
- Impact of habitat fragmentation

For applicability to an MCDA any new datasets developed should be created consistently across all feature groups to allow easy and accurate comparison to be made.

It is also important to recognise that there are other factors not accounted for within the MCDA. For example, when implementing priority actions, there are also many practical considerations to take into account such as staffing, funding and logistics. These factors will therefore need to be considered when considering any outputs from the tool. Stakeholders have different remits and drivers for work, and do not have an interest in all N2K features. For this reason the list can filtered to focus on different feature groups which may be applicable to different work remits and sources of funding. For example, the habitats matrix was filtered to identify marine features with higher conservation needs and drivers.

# 7 Conclusion

The MCDA tool allows a range of conservation criteria to be considered together, alongside input from species and habitat specialists, to produce a comprehensive guide to aid strategic decision-making. It allows the needs and drivers affecting different features to be compared against each other to bring clarity to a complex raft of information.

There are data limitations for some criteria, however, the MCDA was not intended to be used in isolation or to derive a definitive list of conservation priorities. The flexibility of the tool means that it can be updated and re-run to reflect the latest and best available evidence.

In summary, the key achievements of the MCDA approach are:

- It allows a range of factors to be considered concurrently to rank features according to their conservation needs and drivers.
- It allows a consistent evidence-based assessment to be made across each feature group.
- It allowed for collaboration with a range of specialists who were able to influence and validate the outputs.

# Appendix 1: Annex I Habitat Features of Special Areas of Conservation in Wales

| SAC Feature Name | SAC Feature Name (informal) |
|---|---|
| Natural dystrophic lakes and ponds | Acid peat-stained lakes and ponds |
| Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) | Acidic scree |
| Active raised bogs | Active raised bogs |
| Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) | Alder woodland on floodplains |
| Alpine and subalpine calcareous grasslands | Alpine and subalpine calcareous grasslands |
| Alpine and Boreal heaths | Alpine and subalpine heaths |
| Annual vegetation of drift lines | Annual vegetation of drift lines |
| Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) | Atlantic salt meadows |
| Alkaline fens | Base-rich fens |
| Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*) | Base-rich scree |
| Atlantic acidophilous beech forests with *Ilex* and sometimes also *Taxus* in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*) | Beech forests on acid soils |
| *Asperulo-Fagetum* beech forests | Beech forests on neutral to rich soils |
| Blanket bogs | Blanket bog |
| Bog woodland | Bog woodland |
| Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* | Calcium-rich fen dominated by great fen sedge (saw sedge) |
| Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. | Calcium-rich nutrient-poor lakes, lochs and pools |
| Caves not open to the public | Caves not open to the public |
| Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* | Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels |
| Perennial vegetation of stony banks | Coastal shingle vegetation outside the reach of waves |
| Degraded raised bogs still capable of natural regeneration | Degraded raised bog |
| Depressions on peat substrates of the *Rhynchosporion* | Depressions on peat substrates |

| SAC Feature Name | SAC Feature Name (informal) |
|---|---|
| Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) | Dry grasslands and scrublands on chalk or limestone |
| European dry heaths | Dry heaths |
| Fixed dunes with herbaceous vegetation ("grey dunes") | Dune grassland |
| Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) | Dunes with *Salix arenaria* |
| Estuaries | Estuaries |
| *Salicornia* and other annuals colonising mud and sand | Glasswort and other annuals colonising mud and sand |
| Calaminarian grasslands of the *Violetalia calaminariae* | Grasslands on soils rich in heavy metals |
| Petrifying springs with tufa formation (*Cratoneurion*) | Hard-water springs depositing lime |
| Alpine pioneer formations of the *Caricion bicoloris-atrofuscae* | High-altitude plant communities associated with areas of water seepage |
| Humid dune slacks | Humid dune slacks |
| Mudflats and sandflats not covered by seawater at low tide | Intertidal mudflats and sandflats |
| Coastal lagoons | Lagoons |
| *Tilio-Acerion* forests of slopes, screes and ravines | Mixed woodland on base-rich soils associated with rocky slopes |
| Siliceous alpine and boreal grasslands | Montane acid grasslands |
| Natural eutrophic lakes with *Magnopotamion* or Hydrocharition-type vegetation | Naturally nutrient-rich lakes or lochs which are often dominated by pondweed |
| Siliceous rocky slopes with chasmophytic vegetation | Plants in crevices on acid rocks |
| Calcareous rocky slopes with chasmophytic vegetation | Plants in crevices on base-rich rocks |
| *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) | Purple moor-grass meadows |
| Reefs | Reefs |
| Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation | Rivers with floating vegetation often dominated by water-crowfoot |
| Sandbanks which are slightly covered by sea water all the time | Sandbanks which are slightly covered by sea water all the time |
| Submerged or partially submerged sea caves | Sea caves |
| Large shallow inlets and bays | Shallow inlets and bays |

| SAC Feature Name | SAC Feature Name (informal) |
|---|---|
| Embryonic shifting dunes | Shifting dunes |
| Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") | Shifting dunes with marram |
| Species-rich *Nardus* grassland, on siliceous substrates in mountain areas (and submountain areas in continental Europe) | Species-rich grassland with mat-grass, in upland areas |
| Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels | Tall herb communities |
| Turloughs | Turloughs |
| Vegetated sea cliffs of the Atlantic and Baltic coasts | Vegetated sea cliffs |
| Transition mires and quaking bogs | Very wet mires often identified by an unstable 'quaking' surface |
| Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles | Western acidic oak woodland |
| Northern Atlantic wet heaths with *Erica tetralix* | Wet heathland with cross-leaved heath |
| *Taxus baccata* woods of the British Isles | Yew-dominated woodland |

# Appendix 2: Annex II Species Features of Special Areas of Conservation in Wales

| SAC Feature Name | SAC Feature Name (English) |
|---|---|
| *Alosa alosa* | Allis shad |
| *Salmo salar* | Atlantic salmon |
| *Barbastella barbastellus* | Barbastelle |
| *Tursiops truncatus* | Bottlenose dolphin |
| *Lampetra planeri* | Brook lamprey |
| *Cottus gobio* | Bullhead |
| *Vertigo moulinsiana* | Desmoulin's whorl snail |
| *Gentianella anglica* | Early gentian |
| *Liparis loeselii* | Fen orchid |
| *Luronium natans* | Floating water-plantain |
| *Margaritifera margaritifera* | Freshwater pearl mussel |
| *Vertigo geyeri* | Geyer's whorl snail |
| *Triturus cristatus* | Great crested newt |
| *Rhinolophus ferrumequinum* | Greater horseshoe bat |
| *Halichoerus grypus* | Grey seal |
| *Trichomanes speciosum* | Killarney fern |
| *Rhinolophus hipposideros* | Lesser horseshoe bat |
| *Euphydryas (Eurodryas, Hypodryas) aurinia* | Marsh fritillary butterfly |
| *Vertigo angustior* | Narrow-mouthed whorl snail |
| *Lutra lutra* | Otter |
| *Petalophyllum ralfsii* | Petalwort |
| *Lampetra fluviatilis* | River lamprey |
| *Petromyzon marinus* | Sea lamprey |
| *Rumex rupestris* | Shore dock |
| *Drepanocladus (Hamatocaulis) vernicosus* | Slender green feather-moss |
| *Coenagrion mercuriale* | Southern damselfly |
| *Alosa fallax* | Twaite shad |
| *Austropotamobius pallipes* | White-clawed (or Atlantic stream) crayfish |

# Appendix 3: Annex I and regularly occurring migratory species of Special Protection Areas in Wales

| Species | Common Name | Season |
|---|---|---|
| Asio flammeus | Short-eared owl | Breeding |
| *Phalacrocorax carbo* | Great cormorant | Breeding |
| *Pyrrhocorax pyrrhocorax* | Red-billed chough | Breeding and wintering |
| *Sterna dougallii* | Roseate tern | Breeding |
| *Sterna paradisaea* | Arctic tern | Breeding |
| *Sterna hirundo* | Common tern | Breeding |
| *Anas acuta* | Northern pintail | Wintering |
| *Anas clypeata* | Northern shoveler | Wintering |
| *Anas crecca* | Eurasian teal | Wintering |
| *Anas penelope* | Eurasian wigeon | Wintering |
| *Anas strepera* | Gadwall | Wintering |
| *Anser albifrons albifrons* | Greater white-fronted goose | Wintering |
| *Anser albifrons flavirostris* | Greenland white-fronted goose | Wintering |
| Arenaria interpres | Turnstone | Wintering |
| *Calidris alpina alpina* | Dunlin | Wintering |
| *Calidris canutus* | Red knot | Wintering |
| *Cygnus columbianus bewickii* | Bewick's swan | Wintering |
| *Haematopus ostralegus* | Eurasian oystercatcher | Wintering |
| *Limosa lapponica* | Bar-tailed godwit | Wintering |
| *Limosa limosa islandica* | Black-tailed godwit | Wintering |
| *Mergus serrator* | Red-breasted merganser | Wintering |
| *Numenius arquata* | Eurasian curlew | Wintering |
| *Pluvialis squatarola* | Grey plover | Wintering |
| *Podiceps cristatus* | Great crested grebe | Passage |
| *Sterna albifrons* | Little tern | Breeding |
| *Tadorna tadorna* | Common shelduck | Wintering |
| *Tringa totanus* | Common redshank | Wintering |
| *Sterna sandvicensis* | Sandwich tern | Breeding and passage |
| Waterfowl assemblage | Waterfowl assemblage | Wintering |

| | | |
|---|---|---|
| *Gavia stellata* | Red-throated diver | Wintering |
| *Hydrobates pelagicus* | European storm-petrel | Breeding |
| Larus fuscus | Lesser black-backed gull | Breeding |
| *Melanitta nigra* | Black (common) scoter | Wintering |
| *Morus bassanus* | Northern gannet | Breeding |
| *Puffinus puffinus* | Manx shearwater | Breeding |
| Seabird assemblage | Seabird assemblage | Breeding |
| *Fratercula arctica* | Atlantic puffin | Breeding |
| *Circus cyaneus* | Hen harrier | Breeding |

# Appendix 4: Workshop report

This gives an outline of the workshop content and feedback.

**Date:** 12 March 2015

**Location:** Bangor

**Attendees:** NRW Staff. 20 specialists and generalists across NRW.

ADAS Staff: 4

**Purpose:** Discussion/debate on the criteria and scoring process as well as carrying out weighting process and producing a ranking and categorisation across the three feature classes.

***Layout of room:*** There were 3 groups or approximately equal number arranged to mix the specialists and generalists. Each group was facilitated by an ADAS staff member.

## Process

The purpose of the workshop was to have a discussion/debate on the criteria and scoring process as well as carrying out the weighting process and producing a ranking and categorisation. The workshop followed a six step process.

**Step 1 – Explain purpose and context for the MCDA**

The purpose of the N2K feature needs analysis exercise was explained, as was the rationale for using MCDA as a tool to aid the process.

**Step 2 – Agree criteria and criteria clustering**

The pre-selected criteria were introduced and justifications given for their selection and the exclusion of others. Participants were then asked to comment and critique the chosen clustering approach.

**Step 3 – Agree scoring**

The scoring method agreed for the criteria to be used in the MCDA was shown to the participants. They were then asked to review, critique, and either agree or suggest an alternative approach where appropriate.

**Step 4 – Elicit Weighting**

Participants performed a “swing” weighting exercise on the criteria within their groups. The results were then shared with the rest of the attendees.

**Step 5 – Review Results**

The weightings generated in Step 4 were combined with the scores from Step 3 to generate ranking tables and categorisation into High, Medium, and Low priority. Results were compared across groups and analysed.

**Step 6 – Discussion and Feedback**

The results and the overall methodology were discussed as a group, and feedback was assimilated for the purpose of improving the MCDA process.

## Results of Workshop

### Explain Purpose / Overall Approach

The key points raised were:

- Overall agreement with value of an MCDA approach.
- Assemblage features should be included in the Birds MCDA (notwithstanding data deficiencies).

### Agreeing Criteria

The key points raised were as follows:

- Habitats and species should be considered independently. Birds should also be considered separately from non-bird species. Marine features may also warrant separate assessment.
- The MCDA exercise should be repeated for a spatial assessment of sites.
- Water Framework Directive feature interest should be included in the "Legal and policy" cluster.
- A more robust criterion or cluster for vulnerability was required.
- More factors should be included for sensitivity (nitrates, connectivity).
- International conservation status should be retained.
- Trend and urgency should be considered as criteria.
- Different data sources were required for certain features, in particular birds where current datasets had gaps.

### Agreeing Scoring

The participants were generally satisfied with the scoring methods developed ahead of the workshop. However, criticisms and improvements were suggested to the following criteria.

**Wales Special Responsibility**

There are data issues for birds and marine features which are highly mobile, hence the viability of using a percentage of population based approach was challenged. Some particular sub-features of habitats may also be highly concentrated in Wales which would not be captured in the current approach.

**National Conservation Status**

If assessing birds and non-birds species together, then a common scoring system should be devised.

**Current Condition of Feature on N2K Sites in Wales**

The four way categorisation (entirely unfavourable -> entirely favourable) is not necessary and it would be equally valid to retain the original percentages and preserve the granularity.

**Number of Ecosystem Services**

Using the actual number was a false quantification as not all ecosystem services are equally valuable, and the evidence base for each feature varies in its accuracy. Introducing a "High", "Medium", and "Low" extent of service provision would be a more appropriate method.

**Frequency on N2K Sites**

The actual number of N2K sites designated for a certain feature is not necessarily a true reflection of rarity as the designation process was somewhat arbitrary. Therefore a categorical (High, Medium, Low) may be a fairer reflection or reality.

## Agreeing Weights

The results of the weighting exercise are shown in Table 5.1 below. The groups did vary somewhat in the weighting allocation to different criteria with Group 1 allocating weights more evenly whilst Groups 2 and 3 allocated little weight to value and rarity clusters and more to conservation status.

**Table 5.1 Comparison of Weights Across Groups**

| Criterion | Group 1 | Group 2 | Group 3 | Average |
|---|---|---|---|---|
| Habitats Directive Priority Feature | 0.13 | 0.09 | 0.14 | 0.12 |
| Section 42 | 0.08 | 0.15 | 0.11 | 0.12 |
| UK Special Responsibility | 0.13 | 0.09 | 0.10 | 0.11 |
| Wales Special Responsibility | 0.14 | 0.15 | 0.13 | 0.14 |
| National Conservation Status | 0.09 | 0.11 | 0.15 | 0.12 |
| Current Condition on N2K Site | 0.12 | 0.22 | 0.16 | 0.17 |
| Climate Change Vulnerability Index | 0.09 | 0.11 | 0.15 | 0.12 |
| Highly Water Dependent Feature | 0.08 | 0.02 | 0.01 | 0.04 |
| No. of Ecosystem Services | 0.07 | 0.01 | 0.01 | 0.03 |
| Frequency on N2K Sites | 0.07 | 0.02 | 0.03 | 0.04 |

## Results

Results were compiled for each group. Because each group had different weight allocations, they produced different rankings. To facilitate the integration of these rankings and the prioritisation of features, those which were ranked as "High" priority by all three groups have been summarised in Table 5.2 below.

**Table 5.2: High Priority Features Common to all Groups**

| N2K Feature | Common Name | Feature Type |
|---|---|---|
| Active raised bogs | Active raised bogs | Raised Bog, Mire, Fen |
| *Sterna dougallii* - breeding | Roseate tern | Bird |
| Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) | Alder woodland on floodplains | Forests |
| Alpine and boreal heaths | Alpine and sub-alpine heaths | Temperate Heath / Scrub |
| *Cygnus columbianus bewickii* (Western Siberia/North-eastern & North-western Europe) (W) | Bewick`s swan (W) | Bird |
| *Limosa lapponica* - non-breeding | Bar-tailed godwit | Bird |
| *Petalophyllum ralfsii* | Petalwort | Lower Plant |
| *Margaritifera margaritifera* | Freshwater pearl mussel | Invertebrate: Mollusc |
| *Liparis loeselii* | Fen orchid | Higher Plant |
| Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) | Atlantic salt meadows | Marine, Coastal, Halophytic |
| Blanket bogs | Blanket bog | Raised Bog, Mire, Fen |
| Bog woodland | Bog woodland | Forests |
| *Gentianella anglica* | Early gentian | Higher Plant |
| Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation | Rivers with floating vegetation often dominated by water-crowfoot | Freshwater |

| | | |
|---|---|---|
| Calcareous fen with *Cladium mariscus* and species of the *Caricion davallianae* | Calcium-rich fen dominated by great fen sedge (saw sedge) | Raised Bog, Mire, Fen |
| Vegetated seacliffs of the Atlantic and Baltic coasts | Vegetated sea cliffs | Coastal Cliff |
| *Tilio-Acerion* forests of slopes, screes and ravines | Mixed woodland on base-rich soils associated with rocky slopes | Forests |
| *Taxus baccata* woods of the British Isles | Yew-dominated woodland | Forests |
| Species-rich *Nardus* grassland, on siliceous substrate in mountain areas (and submountain areas in continental Europe) | Species-rich grassland with mat-grass in upland areas | Natural / Semi-Natural Grassland |
| Depressions on peat substrates of the *Rhynchosporion* | Depressions on peat substrates | Raised Bog, Mire, Fen |
| Petrifying springs with tufa formation (*Cratoneurion*) | Hard-water springs depositing lime | Raised Bog, Mire, Fen |
| Perennial vegetation of stony banks | Coastal shingle vegetation outside the reach of waves | Marine, Coastal, Halophytic |
| Estuaries | Estuaries | Marine, Coastal, Halophytic |
| European dry heaths | Dry heaths | Temperate Heath / Scrub |
| Fixed dunes with herbaceous vegetation ('grey dunes') | Dune grassland | Coastal Sand Dune / Continental Dune |
| Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp* | Calcium-rich nutrient-poor lakes, lochs and pools | Freshwater |
| Humid dune slacks | Humid dune slacks | Coastal Sand Dune / Continental Dune |
| Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles | Western acidic oak woodland | Forests |
| Large shallow inlets and bays | Shallow inlets and bays | Marine, Coastal, Halophytic |
| Molinia meadows on calcareous peaty or clayey-silt-laden soils (*Molinion caeruleae*) | Purple moor-grass meadows | Natural / Semi-Natural Grassland |
| Mudflats and sandflats not covered by seawater at low tide | Intertidal mudflats and sandflats | Marine, Coastal, Halophytic |
| Northern Atlantic wet heaths with *Erica tetralix* | Wet heathland with cross-leaved heath | Temperate Heath / Scrub |
| Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* -type vegetation | Naturally nutrient-rich lakes or lochs which are often dominated by pondweed | Freshwater |

## Review of Results

The results tables stimulated a healthy debate. The key points raised were:

- Classifying into High, Medium, and Low priority by thirds may not reflect the natural distribution. Consider using natural breaks in the results to classify.
- A ranked list can be dangerous and misleading in the wrong hands and lead to over-analysis and introspection. It is more important to know which features fall into which category.
- Relative de-prioritisation of species (especially birds) relative to habitats reflected the criteria chosen and some of the data quality issues. This strengthened the case to split up the prioritisation exercise into habitats, species, and birds.
- High priority allocated to woodland features may reflect the failure to have a criterion which reflects the urgency / need for maintenance / restoration work.
- The bird priority order did not seem to reflect the expectations of the bird expert. The Roseate tern in particular is no longer in Wales. Some other species might have been expected at a higher level than Bar-tailed godwit and Bewick's swan.
- Participants wanted more opportunity to inspect the results to see what criteria drive higher rankings, and have the ability to run sensitivity analyses.

## Summary of Feedback and Recommendations from Workshop

It was clear from the workshop that there was general buy-in to the concept of using MCDA as a method to prioritise N2K actions. However, there was also a broad feeling that trying to prioritise between 120 features crossing Habitats, Species, and Birds was unworkable. Although some questioned the feasibility of prioritising by feature altogether, the consensus was that a feature-based prioritisation could work provided that habitats, species, and birds (and possibly even marine features) were assessed separately. However, for this to be palatable to the NRW specialists (and externals) some work would be required in terms of sourcing and validating datasets.

Some participants expressed a desire to inspect the underlying datasets during the workshop and questioned some of the raw data values and suggested alternative sources. The intent of the workshop was to avoid this level of discussion and focus minds on the criteria selection and scoring process. However, the concerns about some of the raw data values would need to be addressed, otherwise the credibility of the whole MCDA process will suffer.

Notwithstanding the issues with the raw data, the criteria selection and scoring exercises ran well, generating useful feedback. The weightings exercise ran more quickly than expected. In part this reflected the value of using the icebreaker to explain the concept. However, facilitators did report that participants rushed the exercise and there could have been more consideration of the swing and a more democratic process to judge relative value.

Analysis of the weightings in Table 5.1 above shows that Number of Ecosystem Services, Frequency on N2K Sites, and Water Framework Directive feature interest were potentially redundant criteria. For Ecosystem Services, their view may reflect the scoring method used. Their low attribution to the other two criteria is worth greater scrutiny.

As such the following was recommended:

- Conduct MCDA separately for Habitats, Species, and Birds lists.
- Consider if reasonable to have a separate Marine class.
- Include International Conservation Status as a criterion (for Species and Birds).
- Consider the removal of Rarity and WFD feature interest.
- Consider/try to identify datasets for:
    - Trend.
    - Risk of loss.
    - Other sensitivities such as connectivity, nitrates, air quality.
- Consider changing the scoring approach for Current Condition to a straight percentage.
- Compare the outputs of using a 7 scale Article 17 reporting vs. a 3-scale Article 17 reporting for Annex II species (and think about how to include red list data in there).
- Investigate better datasets for Birds, including Article 12 reporting.
- Improve the spreadsheet to allow inspection of feature allocation. This will be more practical to explore in a workshop where we are only assessing habitats, non-birds, and birds separately.
- Add more sensitivity analysis outputs.

# Appendix 5: Guidance Document

This document provides guidance to the user as to how to use these spreadsheets in conjunction with the MCDA process, and should be read in conjunction. These spreadsheets are respectively named:

- NRW N2K MCDA (CEN4131) Habitats Prioritisation Matrix 090615
- NRW N2K MCDA (CEN4131) Species Prioritisation Matrix 090615
- NRW N2K MCDA (CEN4131) Birds Prioritisation Matrix 090615

### Overall Spreadsheet Orientation and Rules

The spreadsheets have been designed as flexible, transparent tools which are platform independent and do not require integration with NRW's IT systems. The tool is designed to be usable and modifiable by NRW staff. As such, other than some simple macros used to speed up the data manipulation, no additional code or add-ins are required to operate.

## Orientation

Each spreadsheet has four worksheets.

1. 'Raw Data ( )' contains the raw data for each potential criterion for each feature and enables users to transform this data to a usable format, where necessary.
2. 'Criteria and Scoring Method' is where a user selects specific criteria for the MCDA and assigns them to clusters. It is also where the user defines and calculates how the data will be converted into a score on a 0 – 100 scale.
3. 'Edited Data' is where a user defines weights using the swing approach and the calculation to produce the weighted score is made.
4. 'Results' is where weighted scores are represented in ranked order from highest to lowest in tabular and chart format.

The overall workflow is from 'Raw Data ( )' to 'Results', though once scoring has been formalised manipulation will focus on the last two sheets.

## Cell Protection

No cells are currently write-protected. It would be advisable to add this in to avoid accidental deletion or modification of essential formulae. Cells which should be open for manipulation are shaded in white, with the exception of areas in Criteria and Scoring Method for raw data transformation which are currently shaded either green, yellow, amber, or peach.

## Macros and Formulae

Macros are based on named ranges and should not require editing or changing unless there is a need to change the number of features or the maximum number of criteria, in which case the defined ranges will need to be modified in the "Formulas – Name Manager" as per the appropriate macro. The use of defined name ranges means that so long as the size and consistency of these tables does not change, they can be moved about the spreadsheet if there is a desire to change the layout.

Formulae have not been linked to defined name ranges. This is partly because many of the formulae that calculate scores are user definable and will need to change every time a user changes the content and order of criteria. It is also because the swing weight section calculation relies on a specific cell reference formula approach to establish which criteria belong to which cluster irrespective of how many criteria there are in a cluster. As such the Swing Weight section should not be moved, and the sheet should not

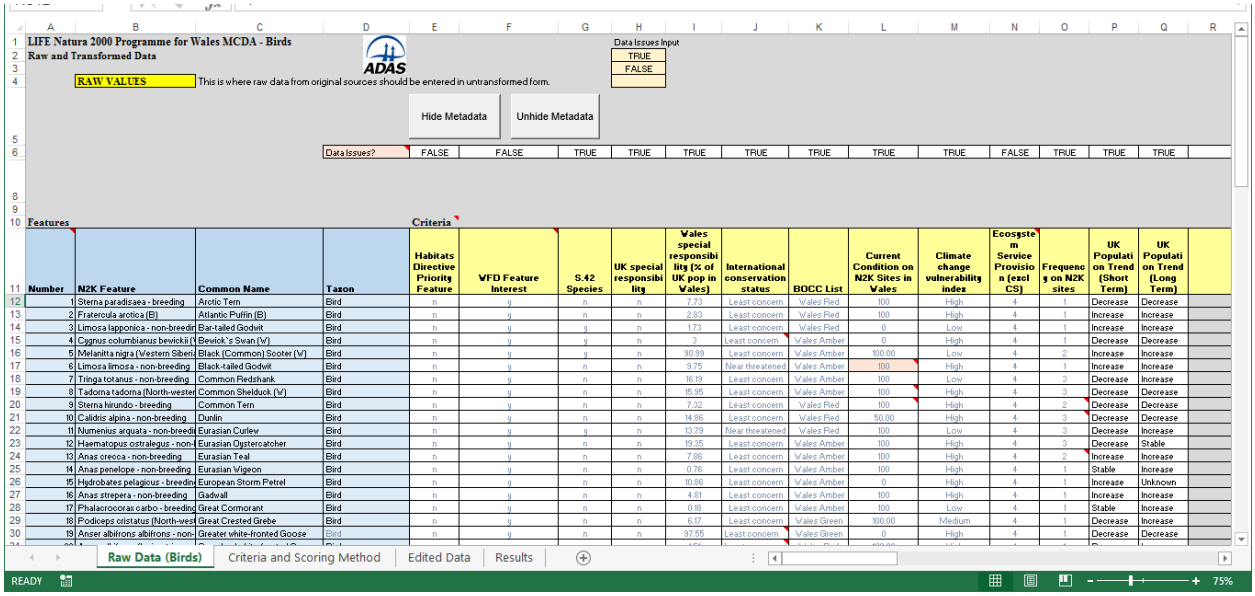
be used if there are more than 10 clusters, 15 criteria used in the MCDA, or more than 20 criteria required in the selection universe.

## Raw Data ( ) Sheet

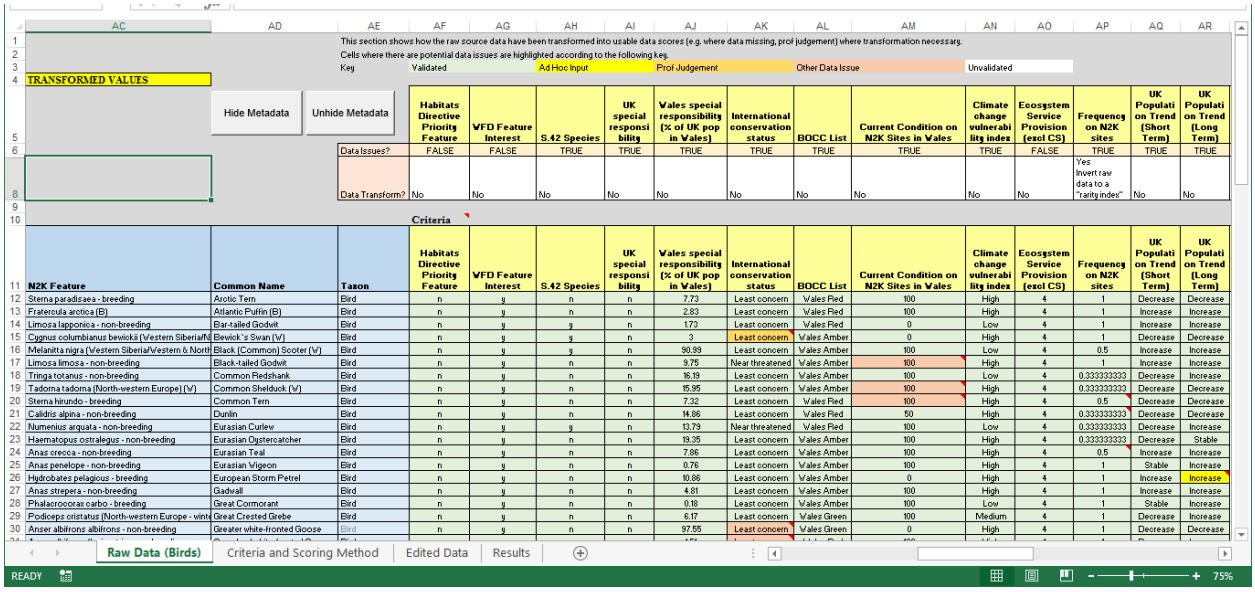
This sheet is intended to capture the raw data for each criterion as they appear in their original source and transform them into usable data sets. In some cases this requires modification of the data format. In others it might require imputation where data for a given criterion is missing.

## Sheet Orientation

The sheet has three main areas. Firstly there is an area where the raw data is input as per its original source.

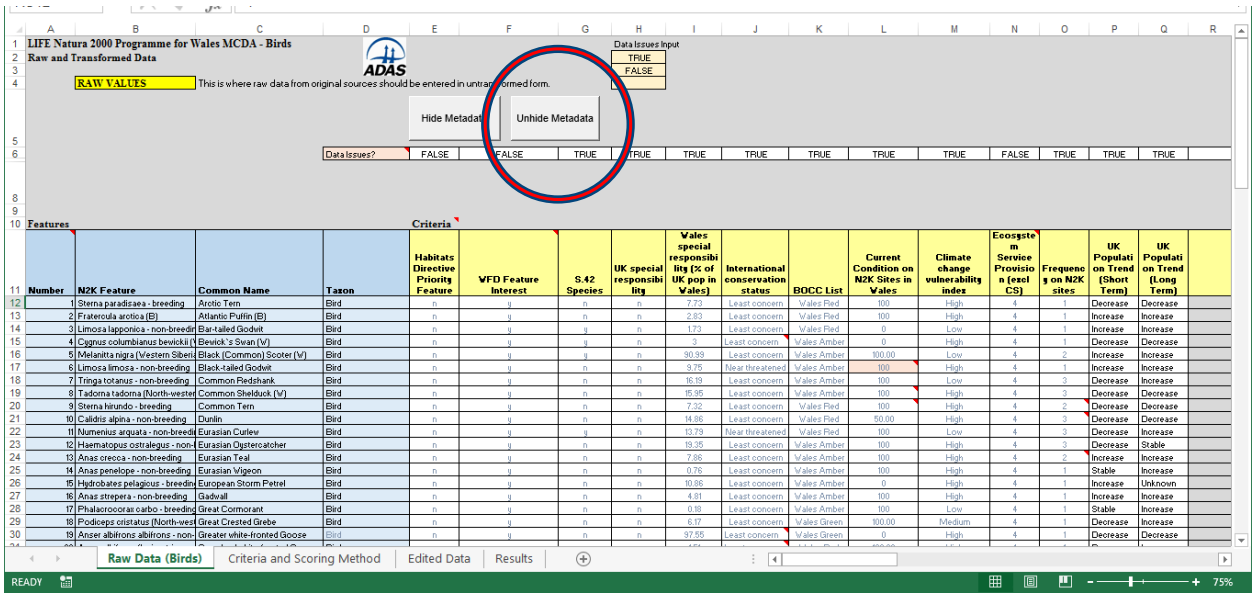


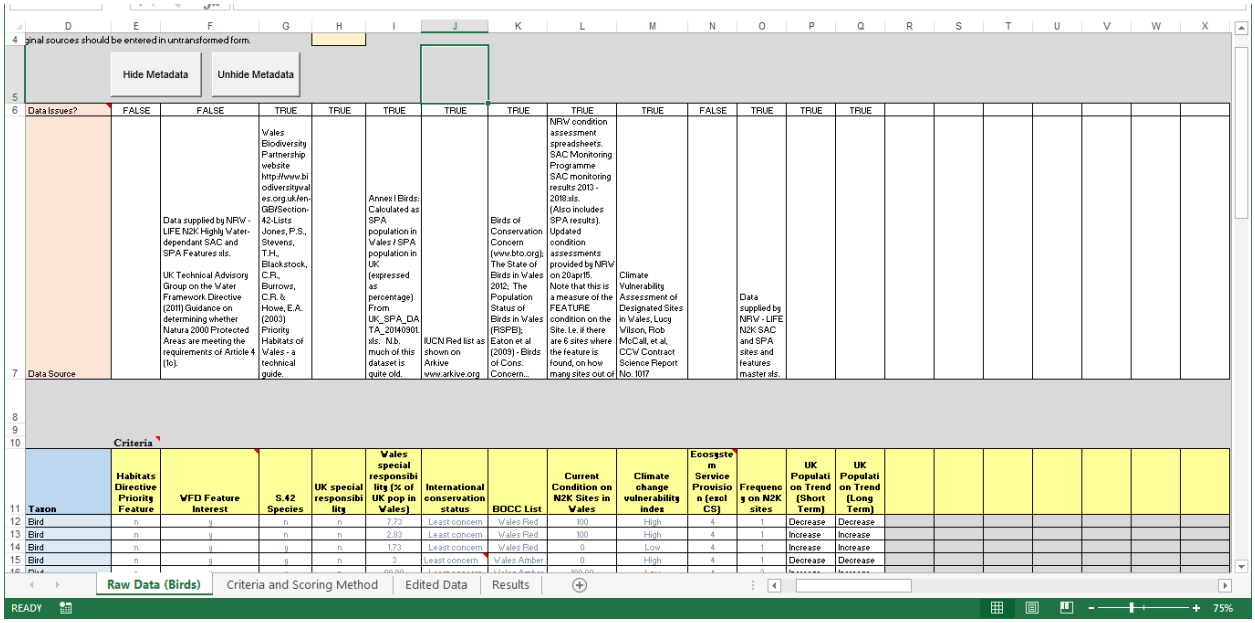

To the right of this there is an area where the user transforms the raw data to usable data.



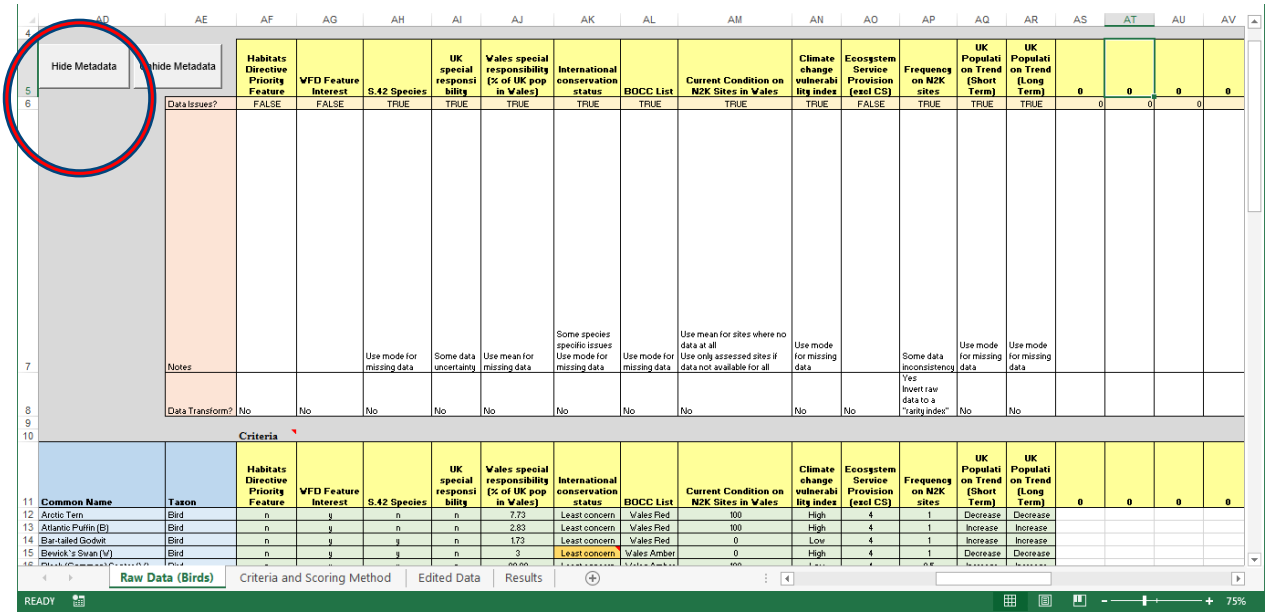

Metadata relevant to this sheet (i.e. data source, data issues) can be unhidden or hidden by the relevant button controls.

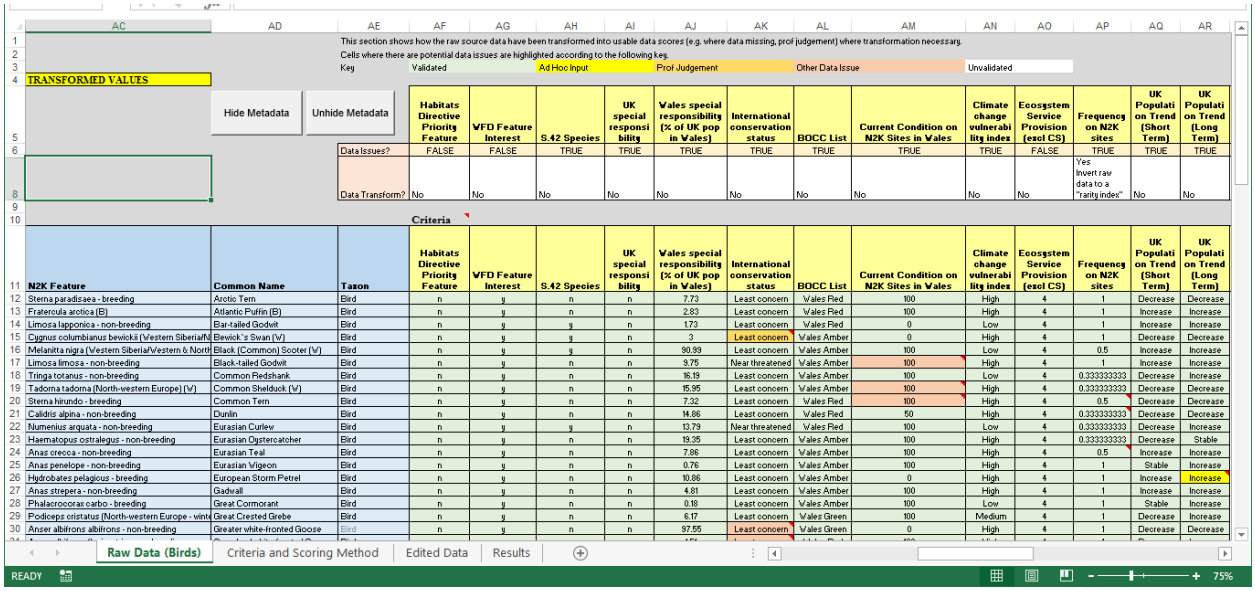
To unhide the metadata:




To hide the metadata:






## Sheet Usage

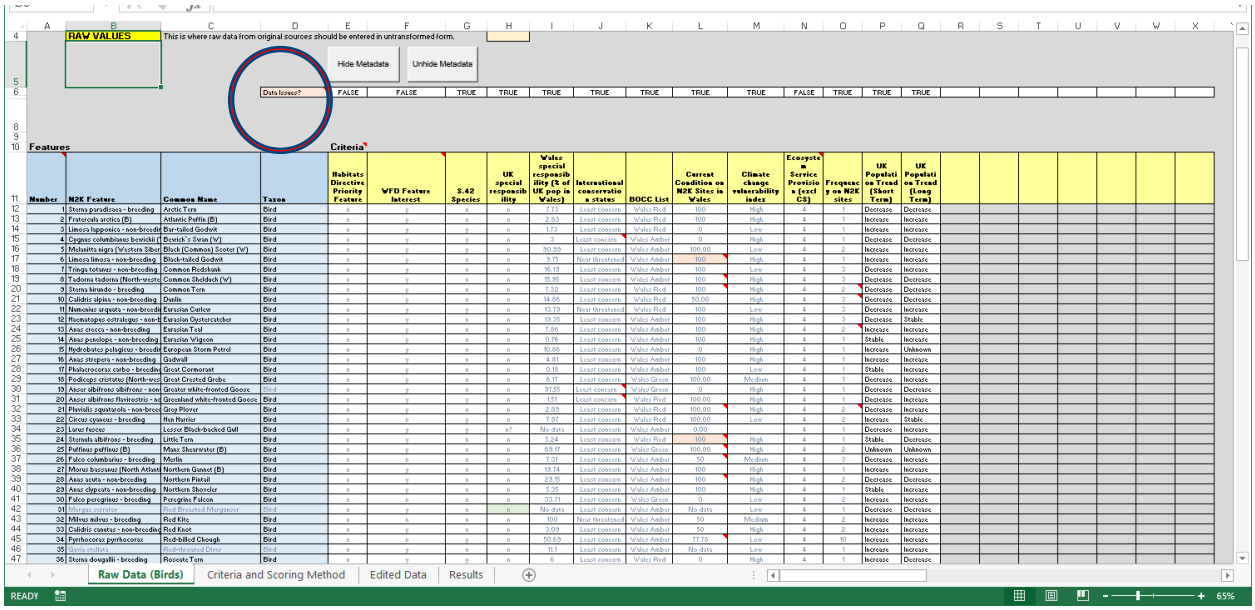
### Raw Data Area

There is space to enter up to 20 criteria but there is no requirement to use all of these in the final MCDA. Criteria names chosen will propagate through the workbook, so should only be amended here.

The spreadsheet has been designed to accommodate a predefined number of features. For Habitats this is 54, Non-Bird Species this is 28, and Birds this number is 41. If additional features are added or some are removed from consideration then this will require modification of key functionality – in particular the named ranges.

The "Number" column has no special meaning in the context of N2K features and just lists the features as they appear. However, it has a vital function in the worksheet's function and should not be modified or removed.

If there are issues with any of the underlying data points, it is advisable to record these in a comment field accompanying each entry. Then indicate in the row marked "Data Issues?" TRUE or FALSE to indicate if there are any issues with the data. This will act as a flag.



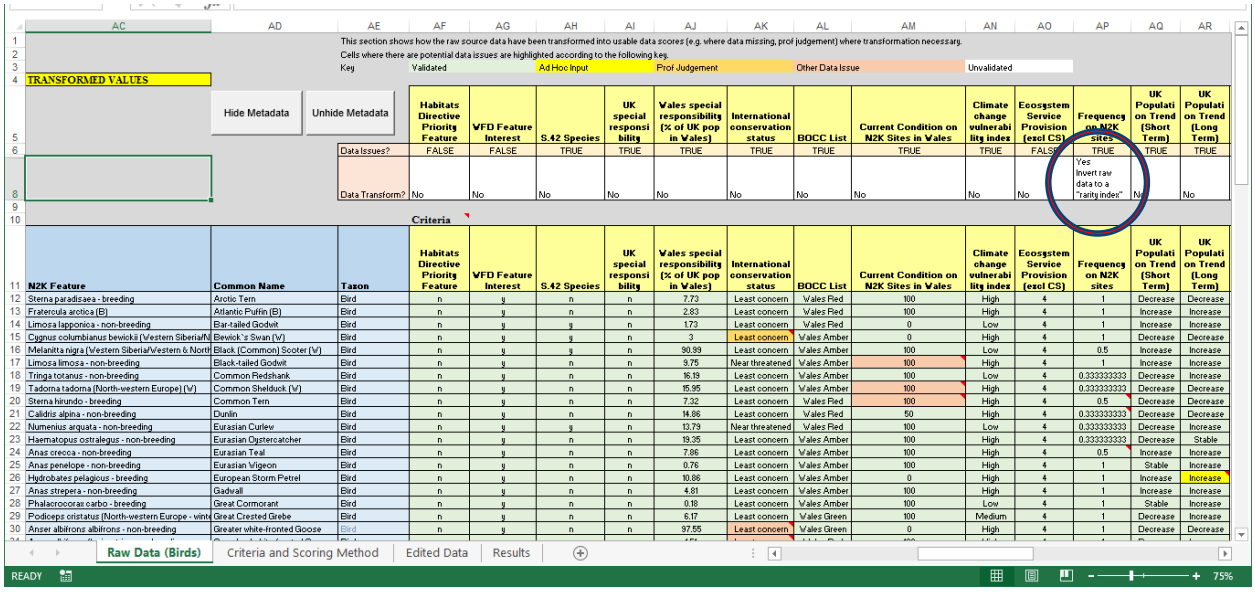
## Transformed Data Area

The criteria universe from the raw data area will automatically transfer over, as will the data issue flag. It is the job of the user to then decide if the raw scores need amending, and make notes accordingly.

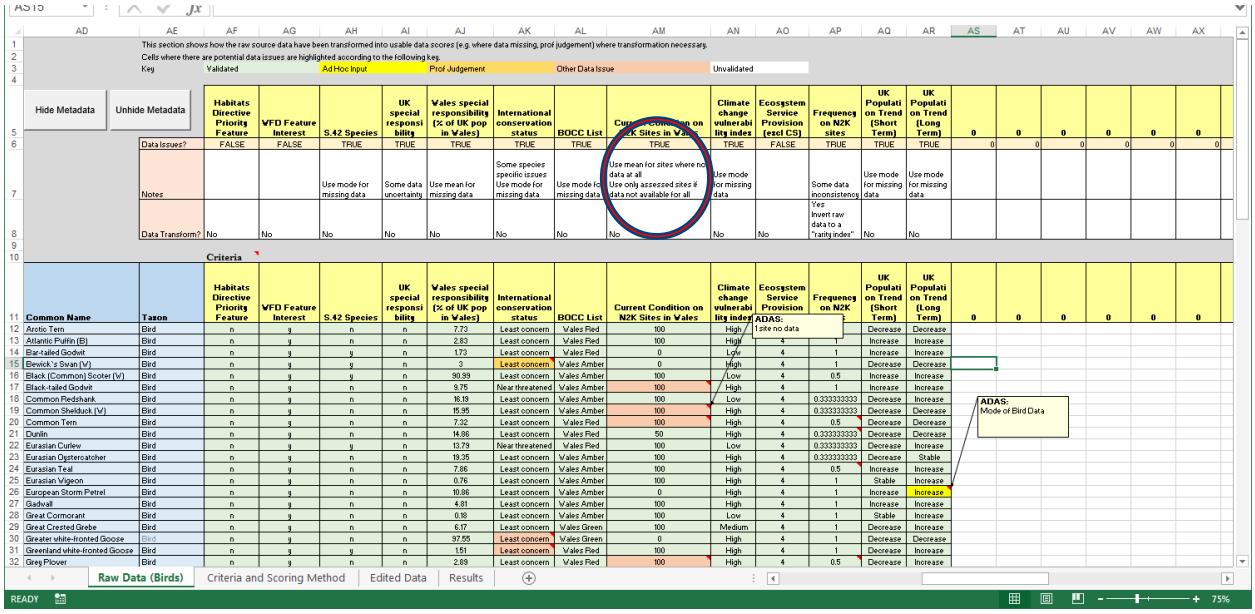
In the spreadsheets provided, formulae or copy/paste from the raw data can be used where there is no need to amend raw data or where the data transform is straightforward. These cells can be coloured green. Where data is missing and values are imputed, use the appropriate colour code to indicate ad hoc input, professional judgement, or some other data issues. White cells indicate non-validated data.

Where the whole dataset is transformed from one format to another (e.g. inverting data, changing from ratio to categorical, etc.), the transform should be noted and described in the appropriate row.

Users should take care with any formulae used in this area, as if they make changes to the criterion order or content in the Raw Data section this will have implications here.

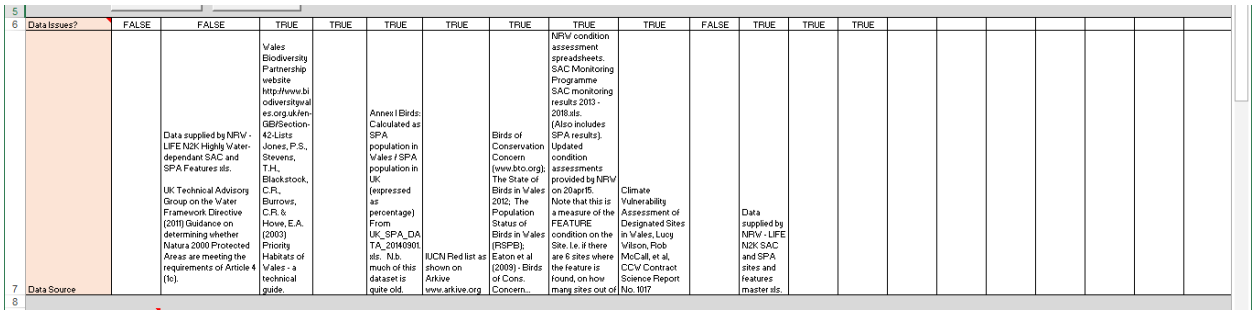



Where individual data has been modified this should be marked with a comment to provide additional information. A summary of these changes should be made in the metadata row (which may need to be unhidden – see above).



## Data Source Information

This metadata has no bearing on spreadsheet function, but should be recorded for reference purposes.



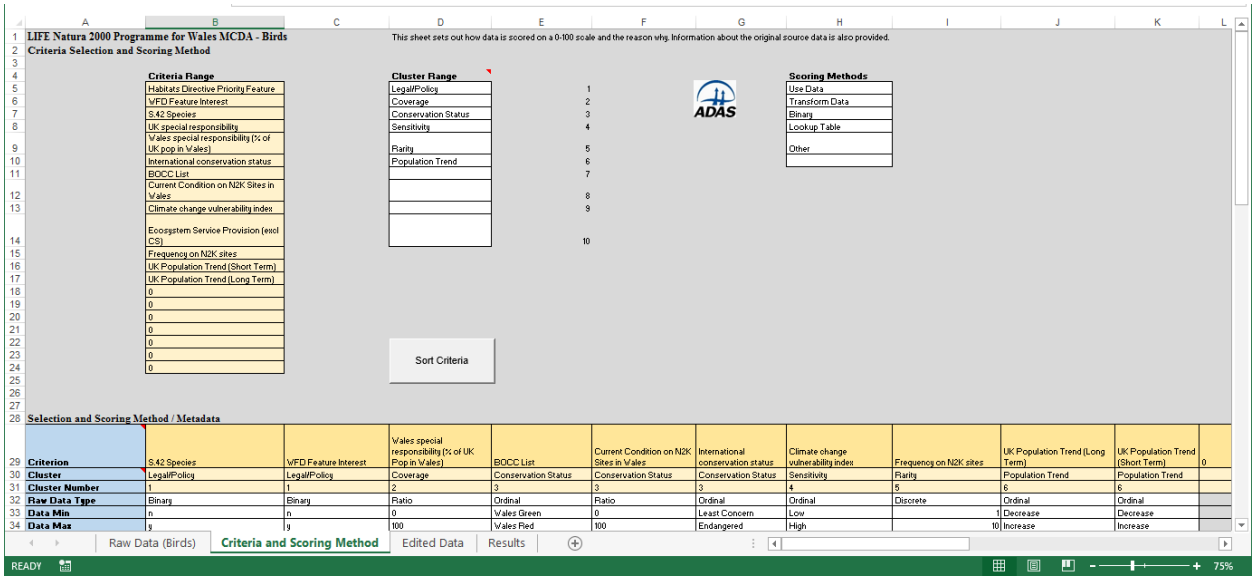
| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Data Issues? | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | FALSE | TRUE | TRUE | TRUE | | | | | | | | |
| 7 | Data Source | | Data supplied by NRW - LIFE N2K Highly Water-dependant SAC and SPA Features xls.<br><br>UK Technical Advisory Group on the Water Framework Directive (2011) Guidance on determining whether Natura 2000 Protected Areas are meeting the requirements of Article 4 (1c). | Wales Biodiversity Partnership website http://www.biodiversityvalues.org.uk/en-GB/Section-42-Lists<br>Jones, P.S., Stevens, T.H., Blackstock, C.R., Burrows, C.R. & Howe, E.A. (2003) Priority Habitats of Wales - a technical guide. | | Annex I Birds: Calculated as SPA population in Wales / SPA population in UK (expressed as percentage) From UK_SPA_DATA_20140901.xls. N.b. much of this dataset is quite old. | IUCN Red list as shown on Arkive www.arkive.org | Birds of Conservation Concern (www.bto.org); The State of Birds in Wales 2012; The Population Status of Birds in Wales (RSPB); Eaton et al (2009) - Birds of Cons. Concern... | NRW condition assessment spreadsheets. SAC Monitoring Programme SAC monitoring results 2013 - 2018.xls. (Also includes SPA results). Updated condition assessments provided by NRW on 29apr15. Note that this is a measure of the FEATURE condition on the Site. I.e. if there are 6 sites where the feature is found, on how many sites out of | Climate Vulnerability Assessment of Designated Sites in Wales, Lucy Wilson, Rob McCall, et al, CCW Contract Science Report No. 1017 | | Data supplied by NRW - LIFE N2K SAC and SPA sites and features master.xls. | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | |

## Criteria and Scoring Method Sheet

This is where a user selects and defines the scoring method to be used to transform data values into consistent 0-100 scores for use in the MCDA. It is the sheet where the user has the most flexibility and should be used carefully as configuration or formulaic mistakes here will impact on the workbook's accuracy and function. A stepwise methodology is proposed below.

## Sheet Orientation

The sheet consists of three main areas. Firstly there is an area where criteria and clusters (nodes) are chosen and sorted into a consistent order.



**LIFE Natura 2000 Programme for Wales MCDA - Birds**
**Criteria Selection and Scoring Method**

This sheet sets out how data is scored on a 0-100 scale and the reason why. Information about the original source data is also provided.

| Criteria Range |
|---|
| Habitats Directive Priority Feature |
| WFD Feature Interest |
| S.42 Species |
| UK special responsibility |
| Wales special responsibility (% of UK pop in Wales) |
| International conservation status |
| BOCC List |
| Current Condition on N2K Sites in Wales |
| Climate change vulnerability index |
| Ecosystem Service Provision (excl CS) |
| Frequency on N2K sites |
| UK Population Trend (Short Term) |
| UK Population Trend (Long Term) |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |

| Cluster Range | |
|---|---|
| Legal/Policy | 1 |
| Coverage | 2 |
| Conservation Status | 3 |
| Sensitivity | 4 |
| Rarity | 5 |
| Population Trend | 6 |
| | 7 |
| | 8 |
| | 9 |
| | 10 |

| Scoring Methods |
|---|
| Use Data |
| Transform Data |
| Binary |
| Lookup Table |
| Other |

Sort Criteria

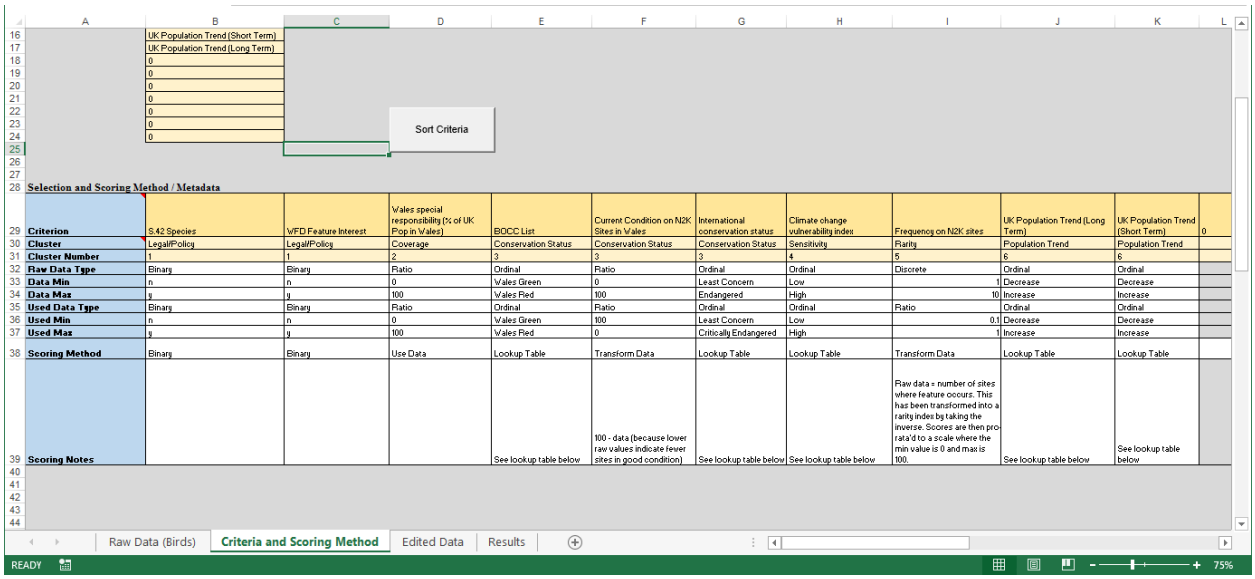
**Selection and Scoring Method / Metadata**

| Criterion | S.42 Species | WFD Feature Interest | Wales special responsibility (% of UK Pop in Wales) | BOCC List | Current Condition on N2K Sites in Wales | International conservation status | Climate change vulnerability index | Frequency on N2K sites | UK Population Trend (Long Term) | UK Population Trend (Short Term) | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cluster** | Legal/Policy | Legal/Policy | Coverage | Conservation Status | Conservation Status | Conservation Status | Sensitivity | Rarity | Population Trend | Population Trend | |
| **Cluster Number** | 1 | 1 | 2 | 3 | 3 | 3 | 4 | 5 | 6 | 6 | |
| **Raw Data Type** | Binary | Binary | Ratio | Ordinal | Ratio | Ordinal | Ordinal | Discrete | Ordinal | Ordinal | |
| **Data Min** | n | n | 0 | Wales Green | 0 | Least Concern | Low | 1 | Decrease | Decrease | |
| **Data Max** | y | y | 100 | Wales Red | 100 | Endangered | High | 10 | Increase | Increase | |

Raw Data (Birds) | Criteria and Scoring Method | Edited Data | Results

READY 75%

Below here the user enters some relevant metadata about the criteria and scoring method to be used.

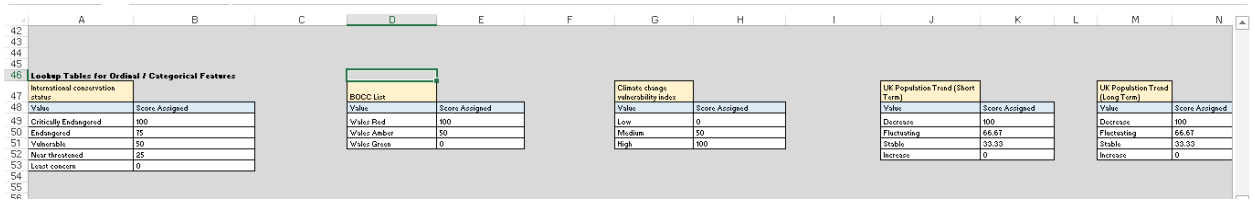


| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | | UK Population Trend (Short Term) | | | | | | | | | | |
| 17 | | UK Population Trend (Long Term) | | | | | | | | | | |
| 18 | | 0 | | | | | | | | | | |
| 19 | | 0 | | | | | | | | | | |
| 20 | | 0 | | | | | | | | | | |
| 21 | | 0 | | | | | | | | | | |
| 22 | | 0 | | | | | | | | | | |
| 23 | | 0 | | | | | | | | | | |
| 24 | | 0 | | | | | | | | | | |
| 25 | | | | Sort Criteria | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | **Selection and Scoring Method / Metadata** | | | | | | | | | | | |
| 29 | **Criterion** | S.42 Species | WFD Feature Interest | Wales special responsibility (% of UK Pop in Wales) | BOCC List | Current Condition on N2K Sites in Wales | International conservation status | Climate change vulnerability index | Frequency on N2K sites | UK Population Trend (Long Term) | UK Population Trend (Short Term) | 0 |
| 30 | **Cluster** | Legal/Policy | Legal/Policy | Coverage | Conservation Status | Conservation Status | Conservation Status | Sensitivity | Rarity | Population Trend | Population Trend | |
| 31 | **Cluster Number** | 1 | 1 | 2 | 3 | 3 | 3 | 4 | 5 | 6 | 6 | |
| 32 | **Raw Data Type** | Binary | Binary | Ratio | Ordinal | Ratio | Ordinal | Ordinal | Discrete | Ordinal | Ordinal | |
| 33 | **Data Min** | n | n | 0 | Wales Green | 0 | Least Concern | Low | 1 | Decrease | Decrease | |
| 34 | **Data Max** | y | y | 100 | Wales Red | 100 | Endangered | High | 10 | Increase | Increase | |
| 35 | **Used Data Type** | Binary | Binary | Ratio | Ordinal | Ratio | Ordinal | Ordinal | Ratio | Ordinal | Ordinal | |
| 36 | **Used Min** | n | n | 0 | Wales Green | 100 | Least Concern | Low | 0.1 | Decrease | Decrease | |
| 37 | **Used Max** | y | y | 100 | Wales Red | 0 | Critically Endangered | High | 1 | Increase | Increase | |
| 38 | **Scoring Method** | Binary | Binary | Use Data | Lookup Table | Transform Data | Lookup Table | Lookup Table | Transform Data | Lookup Table | Lookup Table | |
| 39 | **Scoring Notes** | | | | See lookup table below | 100 - data (because lower raw values indicate fewer sites in good condition) | See lookup table below | See lookup table below | Raw data = number of sites where feature occurs. This has been transformed into a rarity index by taking the inverse. Scores are then pro-rata'd to a scale where the min value is 0 and max is 100. | See lookup table below | See lookup table below | |
| 40 | | | | | | | | | | | | |
| 41 | | | | | | | | | | | | |
| 42 | | | | | | | | | | | | |
| 43 | | | | | | | | | | | | |
| 44 | | | | | | | | | | | | |

Raw Data (Birds) | Criteria and Scoring Method | Edited Data | Results

READY 75%

Below here there is another area where lookup tables can be inserted where users can define how categorical data will be transformed.



**Lookup Tables for Ordinal / Categorical Features**

| International conservation status | |
|---|---|
| Value | Score Assigned |
| Critically Endangered | 100 |
| Endangered | 75 |
| Vulnerable | 50 |
| Near threatened | 25 |
| Least concern | 0 |

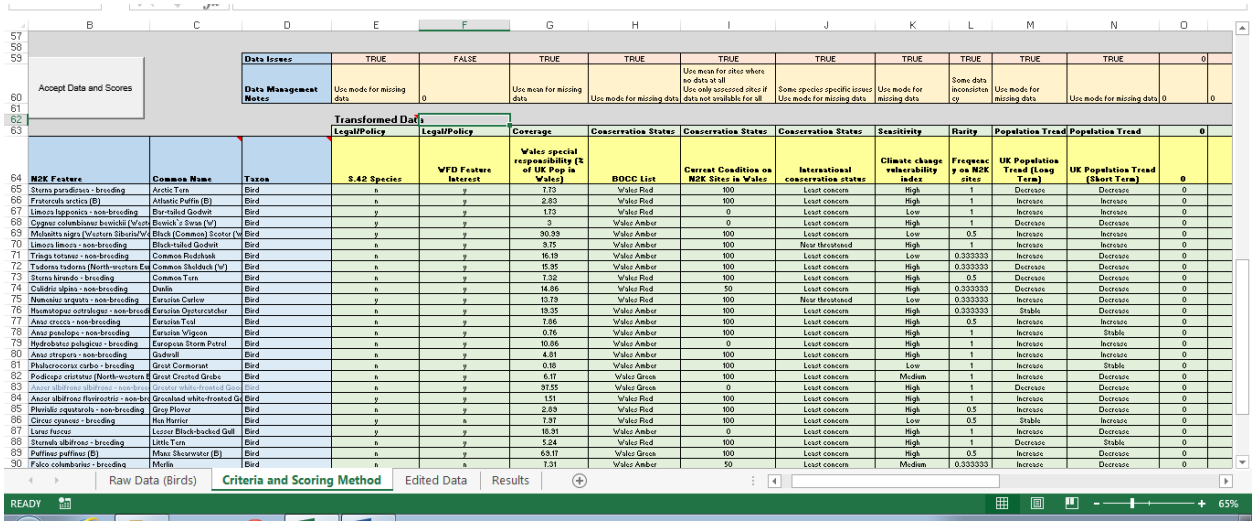
| BOCC List | |
|---|---|
| Value | Score Assigned |
| Wales Red | 100 |
| Wales Amber | 50 |
| Wales Green | 0 |

| Climate change vulnerability index | |
|---|---|
| Value | Score Assigned |
| Low | 0 |
| Medium | 50 |
| High | 100 |

| UK Population Trend (Short Term) | |
|---|---|
| Value | Score Assigned |
| Decrease | 100 |
| Fluctuating | 66.67 |
| Stable | 33.33 |
| Increase | 0 |

| UK Population Trend (Long Term) | |
|---|---|
| Value | Score Assigned |
| Decrease | 100 |
| Fluctuating | 66.67 |
| Stable | 33.33 |
| Increase | 0 |

There is an area where the transformed data from the Raw Data ( ) sheet is brought in, in accordance with the criteria selected for the MCDA.



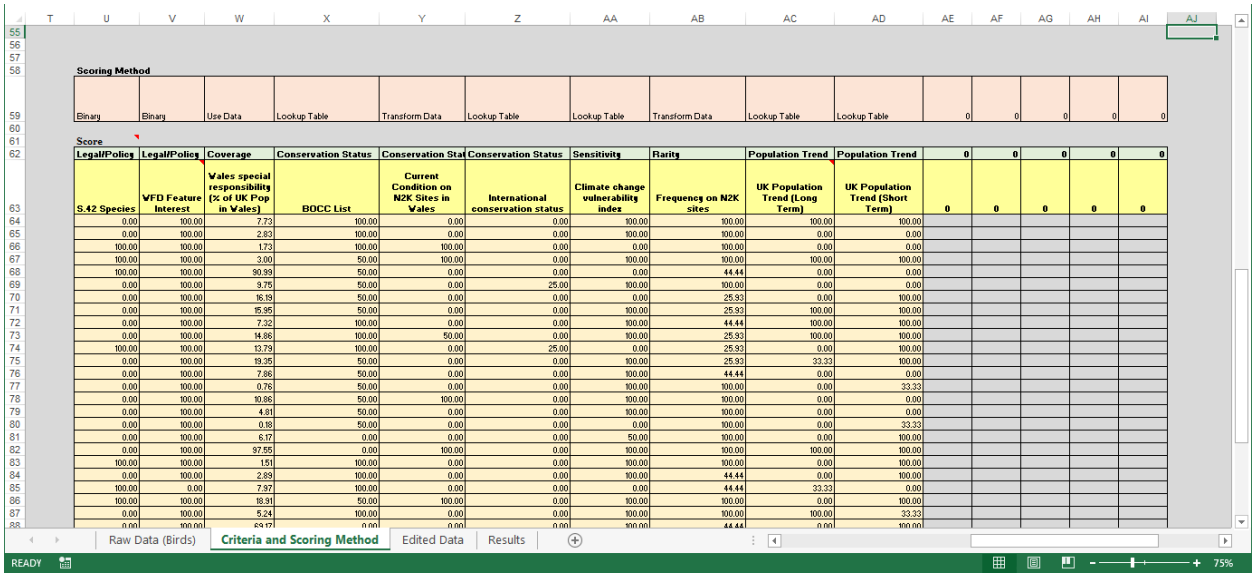
Accept Data and Scores

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Data Issues** | TRUE | FALSE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | 0 | |
| | | | **Data Management Notes** | Use mode for missing data | 0 | Use mean for missing data | Use mode for missing data | Use mean for sites where no data at all Use only assessed sites if data not available for all | Some species specific issues Use mode for missing data | Use mode for missing data | Some data inconsistency | Use mode for missing data | Use mode for missing data | 0 | 0 | |
| | | | **Transformed Data** | | | | | | | | | | | | | |
| | | | | **Legal/Policy** | **Legal/Policy** | **Coverage** | **Conservation Status** | **Conservation Status** | **Conservation Status** | **Sensitivity** | **Rarity** | **Population Trend** | **Population Trend** | **0** | | |
| | **N2K Feature** | **Common Name** | **Taxon** | **S.42 Species** | **WFD Feature Interest** | **Wales special responsibility (% of UK Pop in Wales)** | **BOCC List** | **Current Condition on N2K Sites in Wales** | **International conservation status** | **Climate change vulnerability index** | **Frequency on N2K sites** | **UK Population Trend (Long Term)** | **UK Population Trend (Short Term)** | **0** | | |
| 65 | Sterna paradisaea - breeding | Arctic Tern | Bird | n | y | 7.73 | Wales Red | 100 | Least concern | High | 1 | Decrease | Decrease | 0 | | |
| 66 | Fratercula arctica (B) | Atlantic Puffin (B) | Bird | n | y | 2.83 | Wales Red | 100 | Least concern | High | 1 | Increase | Increase | 0 | | |
| 67 | Limosa lapponica - non-breeding | Bar-tailed Godwit | Bird | y | y | 1.73 | Wales Red | 0 | Least concern | Low | 1 | Increase | Increase | 0 | | |
| 68 | Cygnus columbianus bewickii (Weste | Bewick's Swan (W) | Bird | y | y | 3 | Wales Amber | 0 | Least concern | High | 1 | Decrease | Decrease | 0 | | |
| 69 | Melanitta nigra (W.estern Siberia/W | Black (Common) Scoter (W | Bird | y | y | 30.33 | Wales Amber | 100 | Least concern | Low | 0.5 | Increase | Increase | 0 | | |
| 70 | Limosa limosa - non-breeding | Black-tailed Godwit | Bird | n | y | 9.75 | Wales Amber | 100 | Near threatened | High | 1 | Increase | Increase | 0 | | |
| 71 | Tringa totanus - non-breeding | Common Redshank | Bird | n | y | 16.19 | Wales Amber | 100 | Least concern | Low | 0.333333 | Increase | Decrease | 0 | | |
| 72 | Tadorna tadorna (North-western Eu | Common Shelduck (W) | Bird | n | y | 15.35 | Wales Amber | 100 | Least concern | High | 0.333333 | Decrease | Decrease | 0 | | |
| 73 | Sterna hirundo - breeding | Common Tern | Bird | n | y | 7.32 | Wales Red | 100 | Least concern | High | 0.5 | Decrease | Decrease | 0 | | |
| 74 | Calidris alpina - non-breeding | Dunlin | Bird | n | y | 14.86 | Wales Red | 50 | Least concern | High | 0.333333 | Decrease | Decrease | 0 | | |
| 75 | Numenius arquata - non-breeding | Eurasian Curlew | Bird | y | y | 10.78 | Wales Red | 100 | Near threatened | Low | 0.333333 | Increase | Decrease | 0 | | |
| 76 | Haematopus ostralegus - non-breed | Eurasian Oystercatcher | Bird | n | y | 19.35 | Wales Amber | 100 | Least concern | High | 0.333333 | Stable | Decrease | 0 | | |
| 77 | Anas crecca - non-breeding | Eurasian Teal | Bird | n | y | 7.86 | Wales Amber | 100 | Least concern | High | 0.5 | Increase | Increase | 0 | | |
| 78 | Anas penelope - non-breeding | Eurasian Wigeon | Bird | n | y | 0.76 | Wales Amber | 100 | Least concern | High | 1 | Increase | Stable | 0 | | |
| 79 | Hydrobates pelagicus - breeding | European Storm Petrel | Bird | n | y | 10.86 | Wales Amber | 0 | Least concern | High | 1 | Increase | Increase | 0 | | |
| 80 | Anas strepera - non-breeding | Gadwall | Bird | n | y | 4.81 | Wales Amber | 100 | Least concern | High | 1 | Increase | Increase | 0 | | |
| 81 | Phalacrocorax carbo - breeding | Great Cormorant | Bird | n | y | 0.18 | Wales Amber | 100 | Least concern | Low | 1 | Increase | Stable | 0 | | |
| 82 | Podiceps cristatus (North-western E | Great Crested Grebe | Bird | n | y | 6.17 | Wales Green | 100 | Least concern | Medium | 1 | Increase | Decrease | 0 | | |
| 83 | Anser albifrons albifrons - non-bree | Greater White-fronted Goo | Bird | n | y | 37.55 | Wales Green | 0 | Least concern | High | 1 | Decrease | Decrease | 0 | | |
| 84 | Anser albifrons flavirostris - non-br | Greenland white-fronted Go | Bird | n | y | 1.51 | Wales Red | 100 | Least concern | High | 1 | Increase | Decrease | 0 | | |
| 85 | Pluvialis squatarola - non-breeding | Grey Plover | Bird | n | y | 2.89 | Wales Red | 100 | Least concern | High | 0.5 | Increase | Decrease | 0 | | |
| 86 | Circus cyaneus - breeding | Hen Harrier | Bird | y | n | 7.37 | Wales Red | 100 | Least concern | Low | 0.5 | Stable | Increase | 0 | | |
| 87 | Larus fuscus | Lesser Black-backed Gull | Bird | y | y | 16.91 | Wales Amber | 0 | Least concern | High | 1 | Increase | Decrease | 0 | | |
| 88 | Sternula albifrons - breeding | Little Tern | Bird | n | y | 5.24 | Wales Red | 100 | Least concern | High | 1 | Decrease | Stable | 0 | | |
| 89 | Puffinus puffinus (B) | Manx Shearwater (B) | Bird | n | y | 68.17 | Wales Green | 100 | Least concern | High | 0.5 | Increase | Decrease | 0 | | |
| 90 | Falco columbarius - breeding | Merlin | Bird | n | n | 7.31 | Wales Amber | 50 | Least concern | Medium | 0.333333 | Increase | Decrease | 0 | | |

Raw Data (Birds) | Criteria and Scoring Method | Edited Data | Results

READY 65%

To the right of here is an area where these values are converted into the unweighted scores on a 0-100 scale.



Scoring Method

| Binary | Binary | Use Data | Lookup Table | Transform Data | Lookup Table | Lookup Table | Transform Data | Lookup Table | Lookup Table | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Score

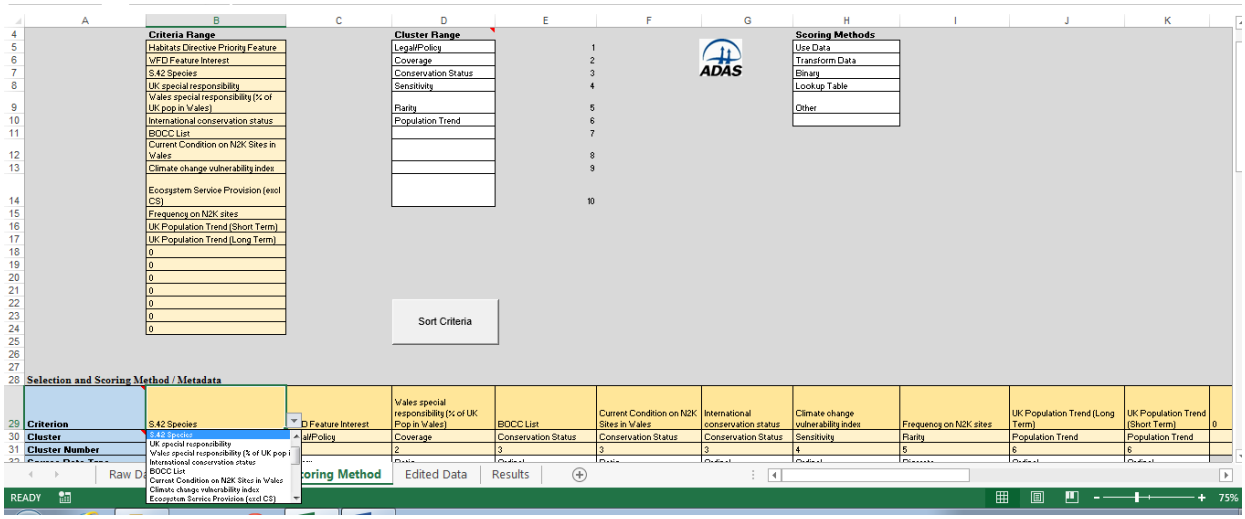
| Legal/Policy | Legal/Policy | Coverage | Conservation Status | Conservation Stat | Conservation Status | Sensitivity | Rarity | Population Trend | Population Trend | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.42 Species | WFD Feature Interest | Wales special responsibility (% of UK Pop in Wales) | BOCC List | Current Condition on N2K Sites in Wales | International conservation status | Climate change vulnerability index | Frequency on N2K sites | UK Population Trend (Long Term) | UK Population Trend (Short Term) | 0 | 0 | 0 | 0 | 0 |
| 0.00 | 100.00 | 7.73 | 100.00 | 0.00 | 0.00 | 100.00 | 100.00 | 100.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 2.83 | 100.00 | 0.00 | 0.00 | 100.00 | 100.00 | 0.00 | 0.00 | | | | | |
| 100.00 | 100.00 | 1.73 | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | | | | | |
| 100.00 | 100.00 | 3.00 | 50.00 | 100.00 | 0.00 | 100.00 | 100.00 | 100.00 | 100.00 | | | | | |
| 100.00 | 100.00 | 90.99 | 50.00 | 0.00 | 0.00 | 0.00 | 44.44 | 0.00 | 0.00 | | | | | |
| 0.00 | 100.00 | 9.75 | 50.00 | 0.00 | 25.00 | 100.00 | 100.00 | 0.00 | 0.00 | | | | | |
| 0.00 | 100.00 | 16.19 | 50.00 | 0.00 | 0.00 | 0.00 | 25.93 | 0.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 15.95 | 50.00 | 0.00 | 0.00 | 100.00 | 25.93 | 100.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 7.32 | 100.00 | 0.00 | 0.00 | 100.00 | 44.44 | 100.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 14.86 | 100.00 | 50.00 | 0.00 | 100.00 | 25.93 | 100.00 | 100.00 | | | | | |
| 100.00 | 100.00 | 13.79 | 100.00 | 0.00 | 25.00 | 0.00 | 25.93 | 0.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 19.35 | 50.00 | 0.00 | 0.00 | 100.00 | 25.93 | 33.33 | 100.00 | | | | | |
| 0.00 | 100.00 | 7.86 | 50.00 | 0.00 | 0.00 | 100.00 | 44.44 | 0.00 | 0.00 | | | | | |
| 0.00 | 100.00 | 0.76 | 50.00 | 0.00 | 0.00 | 100.00 | 100.00 | 0.00 | 33.33 | | | | | |
| 0.00 | 100.00 | 10.86 | 50.00 | 100.00 | 0.00 | 100.00 | 100.00 | 0.00 | 0.00 | | | | | |
| 0.00 | 100.00 | 4.81 | 50.00 | 0.00 | 0.00 | 100.00 | 100.00 | 0.00 | 0.00 | | | | | |
| 0.00 | 100.00 | 0.18 | 50.00 | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 | 33.33 | | | | | |
| 0.00 | 100.00 | 6.17 | 0.00 | 0.00 | 0.00 | 50.00 | 100.00 | 0.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 97.55 | 0.00 | 100.00 | 0.00 | 100.00 | 100.00 | 100.00 | 100.00 | | | | | |
| 100.00 | 100.00 | 1.51 | 100.00 | 0.00 | 0.00 | 100.00 | 100.00 | 0.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 2.89 | 100.00 | 0.00 | 0.00 | 100.00 | 44.44 | 0.00 | 100.00 | | | | | |
| 100.00 | 0.00 | 7.97 | 100.00 | 0.00 | 0.00 | 0.00 | 44.44 | 33.33 | 0.00 | | | | | |
| 100.00 | 100.00 | 18.91 | 50.00 | 100.00 | 0.00 | 100.00 | 100.00 | 0.00 | 100.00 | | | | | |
| 0.00 | 100.00 | 5.24 | 100.00 | 0.00 | 0.00 | 100.00 | 100.00 | 100.00 | 33.33 | | | | | |
| 0.00 | 100.00 | 53.17 | 0.00 | 0.00 | 0.00 | 100.00 | 44.44 | 0.00 | 100.00 | | | | | |

## Sheet Usage

A stepwise methodology is proposed as follows

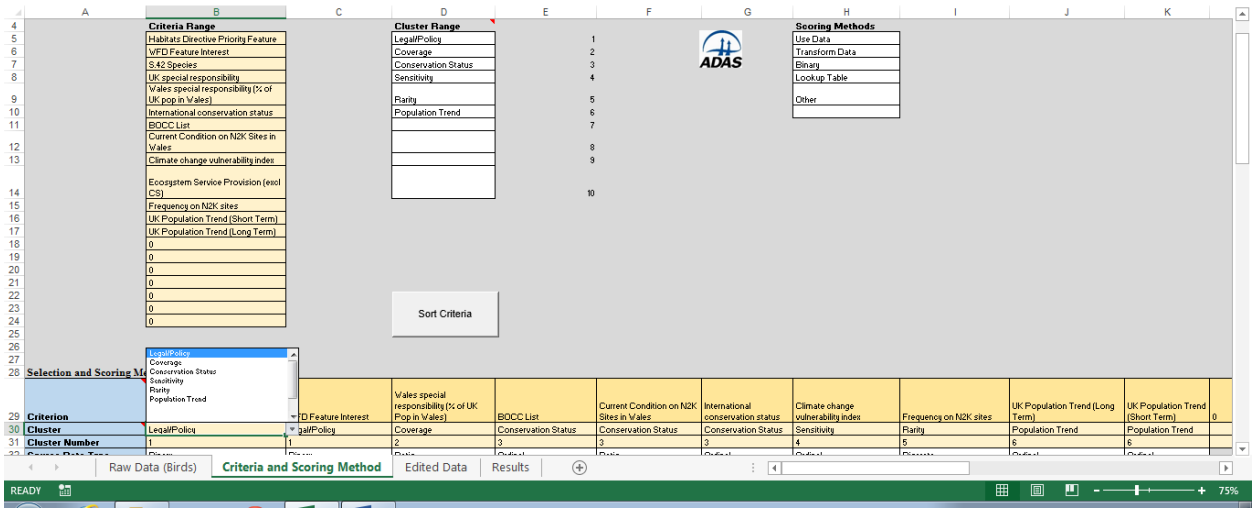
### 1. Select Criteria

From the drop down menu in the Criterion row, choose from one of the available criteria. The list of criteria in range B5:B24 is automatically populated from the Raw Data ( ) sheet.




### 2. Select Cluster

From the drop down menu, assign this criterion to one of the clusters. Users can define up to 10 clusters in range D5:D14, but the order in which they appear in this list will be the order in which they appear in the final output.



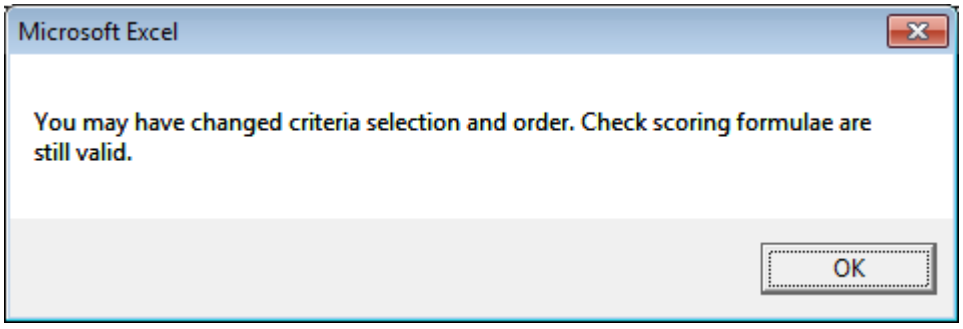

### 3. Complete selection

Repeat Steps 1 and 2 across the rest of the selection until the user has reached the desired number of criteria for the MCDA. Selection is capped at 15 criteria. There is no need to do this in a certain order as the next stage will be to sort.

### 4. Sort criteria

For the spreadsheet to work, the criteria need to be listed by cluster/node number in sequential order. The “Sort Criteria” button performs this task, rearranging the criteria first by node number and then alphabetically. If users have already entered metadata for each criterion then this will also be correctly sorted.

A message will appear when the macro has run. This is to remind users that the sorting process may have changed the criterion selection and order. As such, any formulae used in the scoring section of the worksheet may no longer refer to the correct cells and users should check this section carefully and amend accordingly.




**5. Add metadata**

This is where users should insert metadata of relevance to the scoring system. Fields to populate are:

*Raw Data Type*: The format of the raw data (i.e. Binary, Ordinal, Continuous etc.)

*Data Min*: The lowest value of the raw data.

*Data Max*: The highest value of the actual data

*Used Data Type*: The format of the used data (i.e. Binary, Ordinal, Ratio etc.)

*Used Min*: The value of the used data which will receive the lowest score. This will be the zero score in a local min system or a higher value in a global min system, depending on the user's preference[12]. Scoring should reflect the objective of the MCDA – low scores mean the feature has low need or urgency.

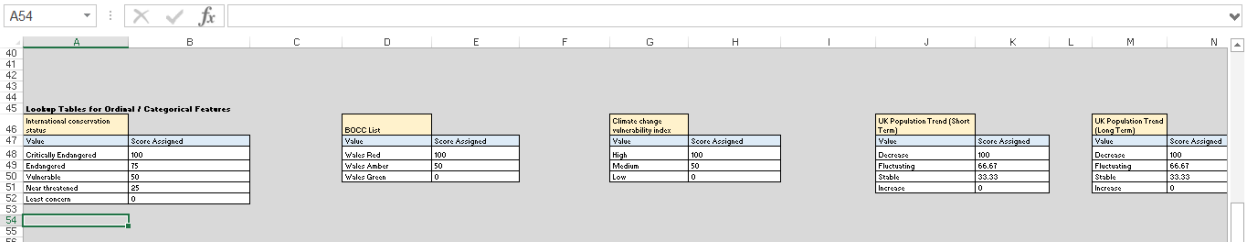
*Used Max*: The value of the used data which will receive the highest score. This will be the 100 score in a local min system or a lower value in a global max system, depending on the user's preference. Scoring should reflect the objective of the MCDA – high scores mean the feature has high need or urgency.

*Scoring Method*: Select from the drop down menu. The range of selection is

- Use Data: data values already map directly onto the 0-100 scale with no adjustment required;
- Transform Data: data values require a formulaic transform to rescale or adjust. This could include changing the direction of the value (i.e. a low data value could map to a high score – for example if the criterion is "Current Condition on N2K Sites in Wales");
- Binary: data values are yes/no and map onto a 0/100 or 100/0 depending on the their nature;
- Lookup Table: data values have been arranged in an ordinal scale and map onto a certain score in the 0-100 range;
- Other: any other methodology.

*Scoring Notes:* Indicate what kind of formula or methodology is used, if not already obvious from the above.

[12] See Methodology document for full discussion of the local and global scoring approaches.



Lookup Tables for Ordinal / Categorical Features

| International conservation status | |
|---|---|
| Value | Score Assigned |
| Critically Endangered | 100 |
| Endangered | 75 |
| Vulnerable | 50 |
| Near threatened | 25 |
| Least concern | 0 |

| BOCC List | |
|---|---|
| Value | Score Assigned |
| Wales Red | 100 |
| Wales Amber | 50 |
| Wales Green | 0 |

| Climate change vulnerability index | |
|---|---|
| Value | Score Assigned |
| High | 100 |
| Medium | 50 |
| Low | 0 |

| UK Population Trend (Short Term) | |
|---|---|
| Value | Score Assigned |
| Decrease | 100 |
| Fluctuating | 66.67 |
| Stable | 33.33 |
| Increase | 0 |

| UK Population Trend (Long Term) | |
|---|---|
| Value | Score Assigned |
| Decrease | 100 |
| Fluctuating | 66.67 |
| Stable | 33.33 |
| Increase | 0 |

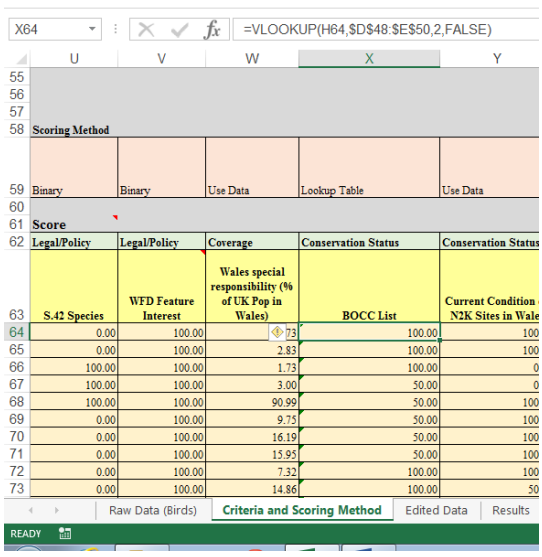
Users can choose whether to define the cells based on formulae or simply insert the appropriate number. If formulae are used, care should be taken as the sorting and selection process could render these calculations invalid.

## 6. Define Lookup Tables

If Lookup tables are required to convert categorical data, then these can be entered into the appropriate area of the spreadsheet. In general these will be simple two column, multi-row tables where categories are listed either High to Low or Low to High in terms of score.

## 7. Assign Scoring Formula

Transformed data in a usable format will already have propagated across to the appropriate section of the spreadsheet. To the right of this is the area where scores need to be defined. Insert a formula in the appropriate cell to convert the transformed data to the 0-100 score. For Use Data and Binary this is straightforward. Examples of lookup and pro-rata transformation formulae are given in the screenshots below.

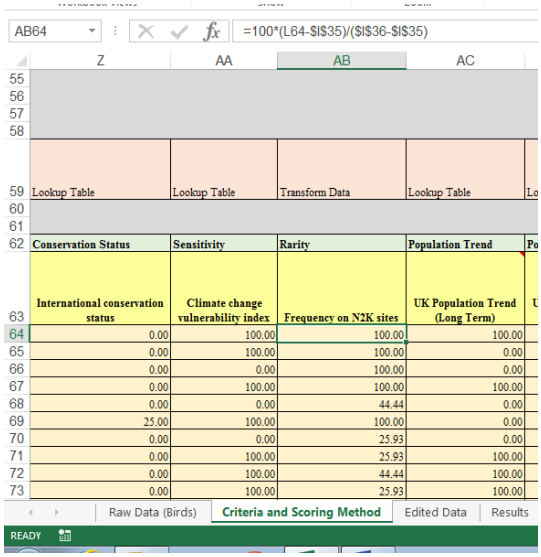


=VLOOKUP(H64,$D$48:$E$50,2,FALSE)

| | U | V | W | X | Y |
|---|---|---|---|---|---|
| 58 | Scoring Method | | | | |
| 59 | Binary | Binary | Use Data | Lookup Table | Use Data |
| 61 | Score | | | | |
| 62 | Legal/Policy | Legal/Policy | Coverage | Conservation Status | Conservation Status |
| 63 | S.42 Species | WFD Feature Interest | Wales special responsibility (% of UK Pop in Wales) | BOCC List | Current Condition N2K Sites in Wale |
| 64 | 0.00 | 100.00 | 73 | 100.00 | 100 |
| 65 | 0.00 | 100.00 | 2.83 | 100.00 | 100 |
| 66 | 100.00 | 100.00 | 1.73 | 100.00 | 0 |
| 67 | 100.00 | 100.00 | 3.00 | 50.00 | 0 |
| 68 | 100.00 | 100.00 | 90.99 | 50.00 | 100 |
| 69 | 0.00 | 100.00 | 9.75 | 50.00 | 100 |
| 70 | 0.00 | 100.00 | 16.19 | 50.00 | 100 |
| 71 | 0.00 | 100.00 | 15.95 | 50.00 | 100 |
| 72 | 0.00 | 100.00 | 7.32 | 100.00 | 100 |
| 73 | 0.00 | 100.00 | 14.86 | 100.00 | 50 |

Raw Data (Birds) | Criteria and Scoring Method | Edited Data | Results

READY



=100*(L64-$I$35)/($I$36-$I$35)

| | Z | AA | AB | AC |
|---|---|---|---|---|
| 59 | Lookup Table | Lookup Table | Transform Data | Lookup Table |
| 62 | Conservation Status | Sensitivity | Rarity | Population Trend |
| 63 | International conservation status | Climate change vulnerability index | Frequency on N2K sites | UK Population Trend (Long Term) |
| 64 | 0.00 | 100.00 | 100.00 | 100.00 |
| 65 | 0.00 | 100.00 | 100.00 | 0.00 |
| 66 | 0.00 | 0.00 | 100.00 | 0.00 |
| 67 | 0.00 | 100.00 | 100.00 | 100.00 |
| 68 | 0.00 | 0.00 | 44.44 | 0.00 |
| 69 | 25.00 | 100.00 | 100.00 | 0.00 |
| 70 | 0.00 | 0.00 | 25.93 | 0.00 |
| 71 | 0.00 | 100.00 | 25.93 | 100.00 |
| 72 | 0.00 | 100.00 | 44.44 | 100.00 |
| 73 | 0.00 | 100.00 | 25.93 | 100.00 |

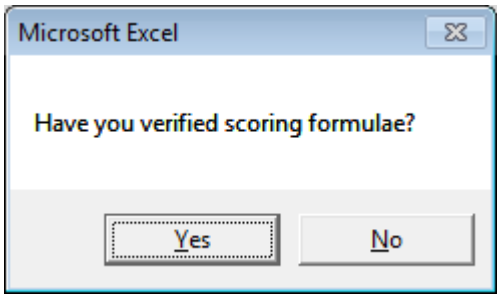
Raw Data (Birds) | Criteria and Scoring Method | Edited Data | Results

READY

## 8. Accept Data and Scores

When all formulae have been defined and the user is happy there are no mistakes and that the criteria selection is set, then the next step is to accept the data (and scores). This is done by pressing the "Accept Data and Scores" button, which runs a macro to copy the values into the next sheet ("Edited Data").

When the button is pressed, a warning message is presented to remind the user to first check that they are satisfied with their formulae. Pressing "Yes" will complete the process. Pressing "No" will exit the macro.

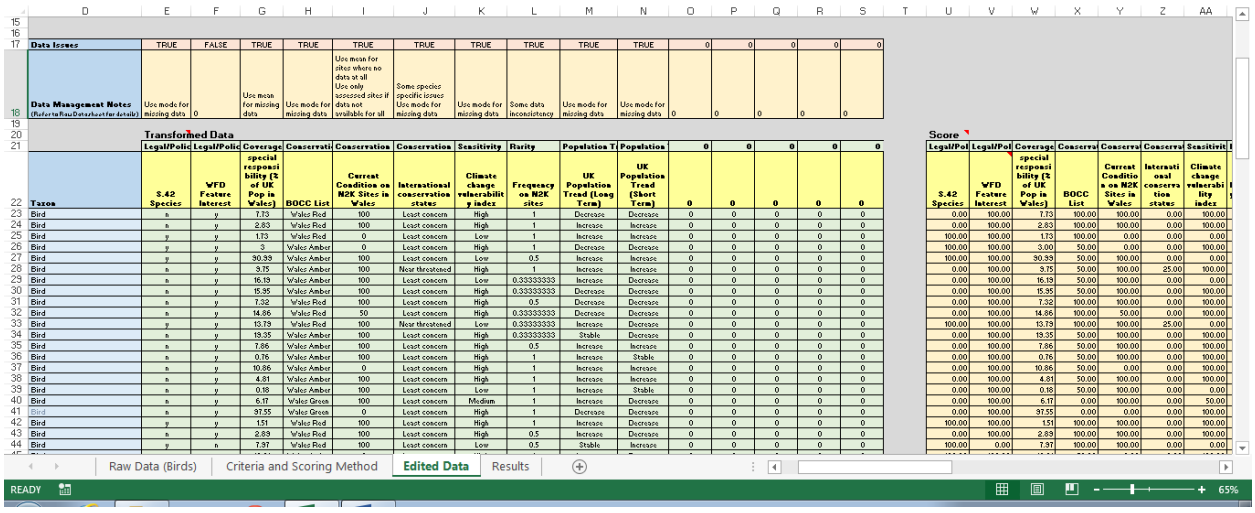


## Edited Data Sheet

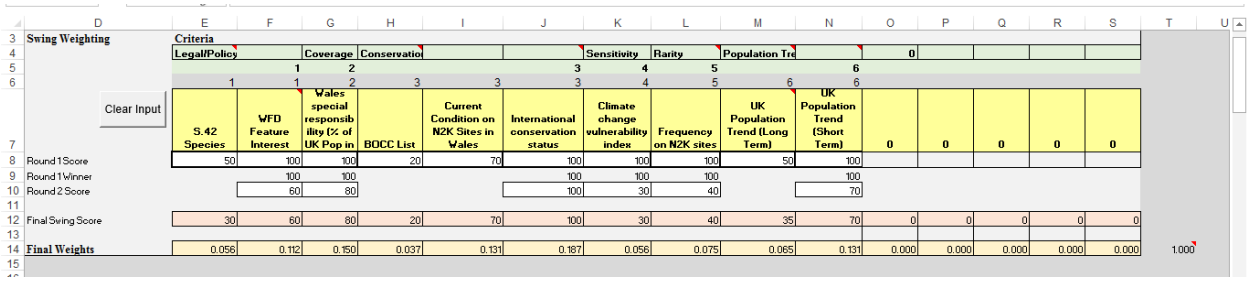
This sheet brings in the transformed data and scores together for the criteria selected. Users then carry out a swing weighting exercise to elicit the final weights to be used. These are multiplied by the scores to give the weighted scores and then summated to give an overall score. The user then captures the scores and sends them to the Results sheet for analysis.

## Sheet Orientation

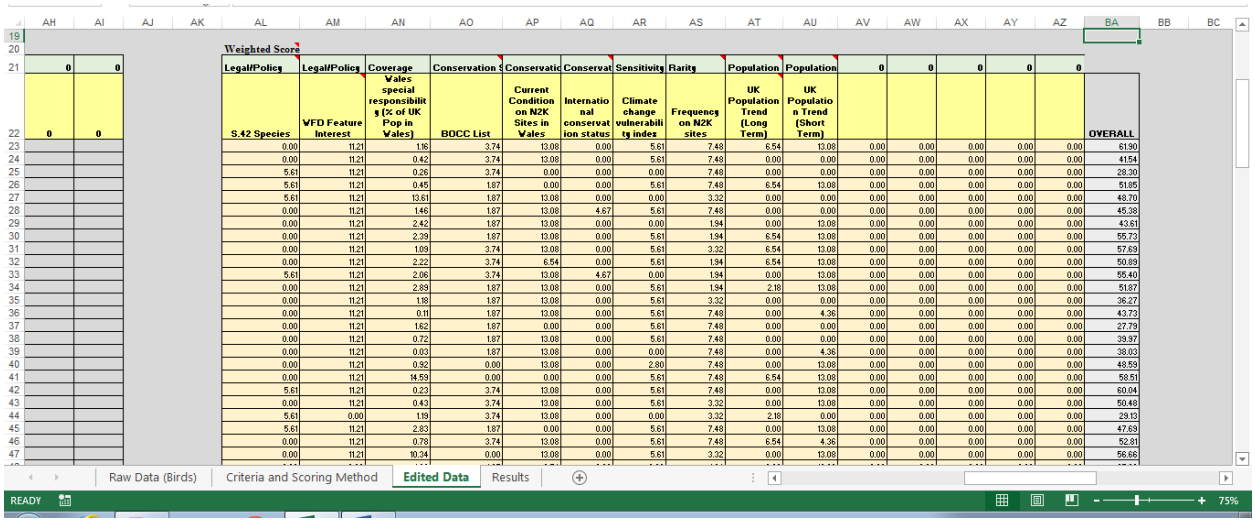
There are three main parts to the sheet. The first part is simply where the transformed data and scores from the previous sheet are imported after the “Accept Data and Scores” macro is run.




Above this is an area dedicated to the swing weighting exercise.



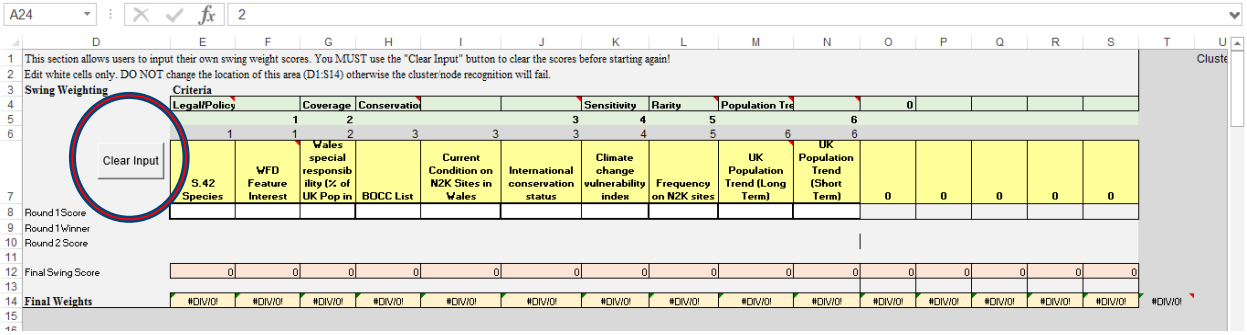

To the right of the worksheet is where the swing weights and scores are combined to compute the overall score.



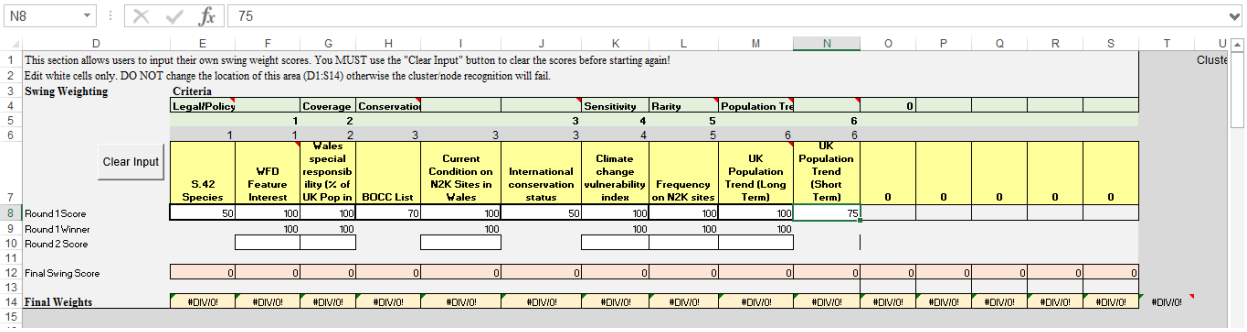
## Sheet Usage

As the data and scores have already been defined earlier in the process and imported, the user here should now focus on the swing weighting exercise[13].

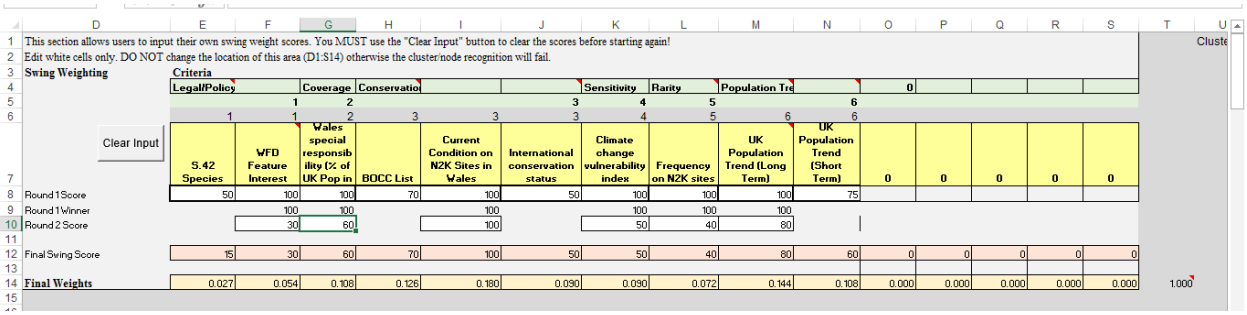
Begin by clearing the inputs from the previous run using the “Clear Input” button




Criteria have been arranged by clusters. In the Round 1 score row, insert the within-cluster swing score assigned to each criterion with 100 being assigned to the “winner”. The sheet will automatically pick up which criterion has “won” and only the winning criteria will have white box entries open for Round 2.

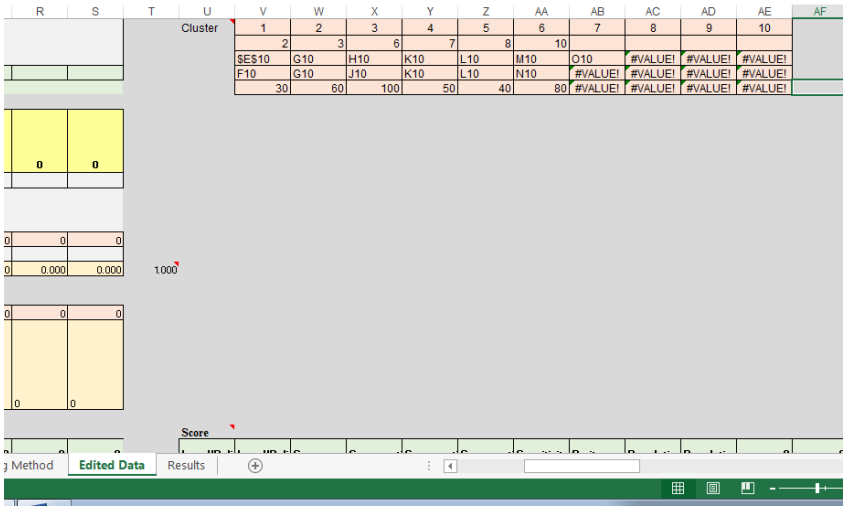



Enter the Round 2 scores (comparisons between clusters) with 100 being assigned to the winner. The spreadsheet will automatically calculate the pro-rata swing score for each criterion, and therefore the swing weight. All being well, the weights should sum to 1.00 (cell T14).

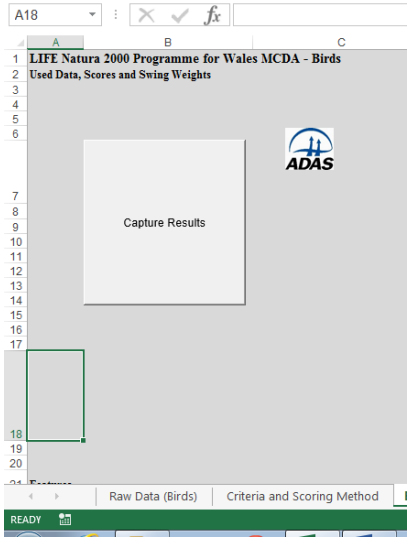



The swing weighting section relies on explicit cell references and relationships to deduce which criteria belong to which cluster for the pro-rata part of the exercise. As such, the swing weighting section should not be relocated in the spreadsheet from the D1:S14 range. Similarly, care should be taken not to overwrite the area to the right where these relationships are defined.

[13] See Methodology document for a full description of the swing weighting process.




When the swing weights have been successfully input, the user can run the Capture Results macro which will copy the weighted scores across to the Results sheet and arrange them in rank order.

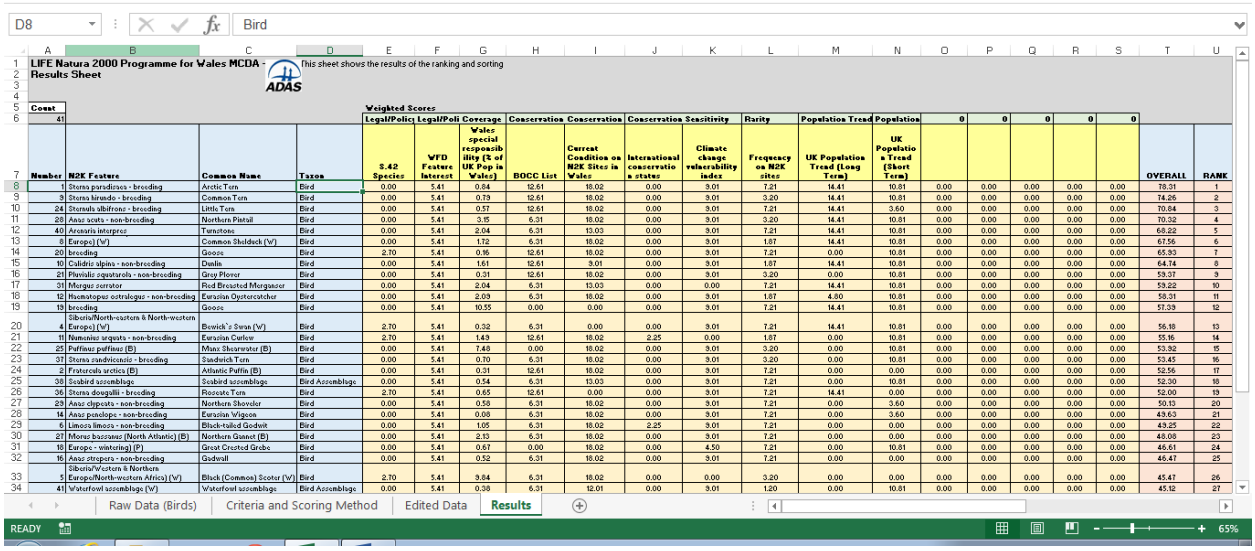


## Results Sheet

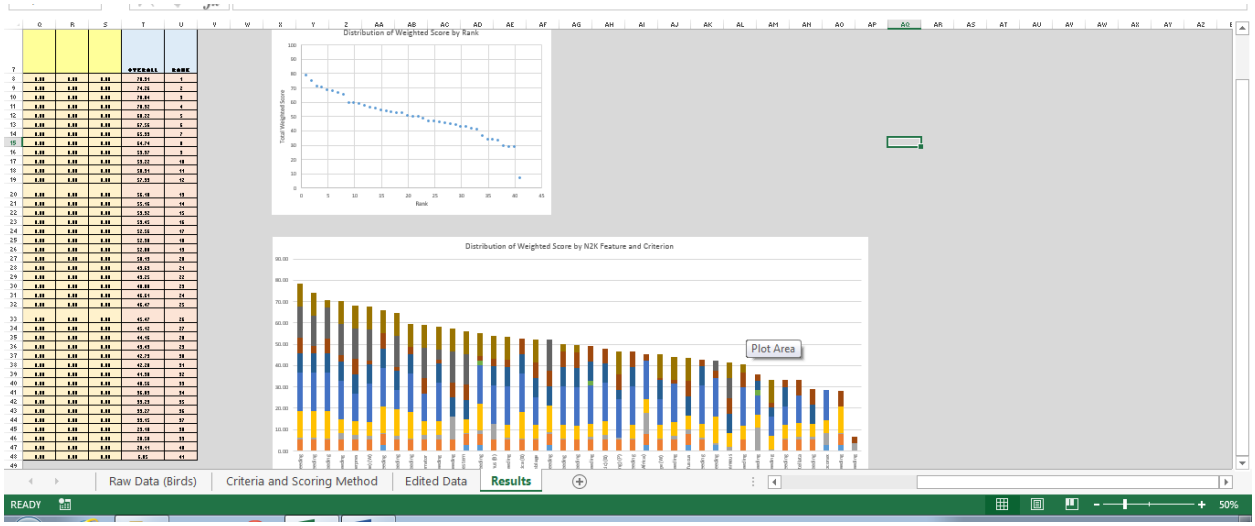
This sheet displays the results of the summation and ranking exercise in tabular and chart format.

## Sheet Orientation

There are two main sections to the sheet. The first displays the results of the weighting exercise in tabular format in ranked order. A rank of 1 means that that particular feature has the highest summed weighted score.

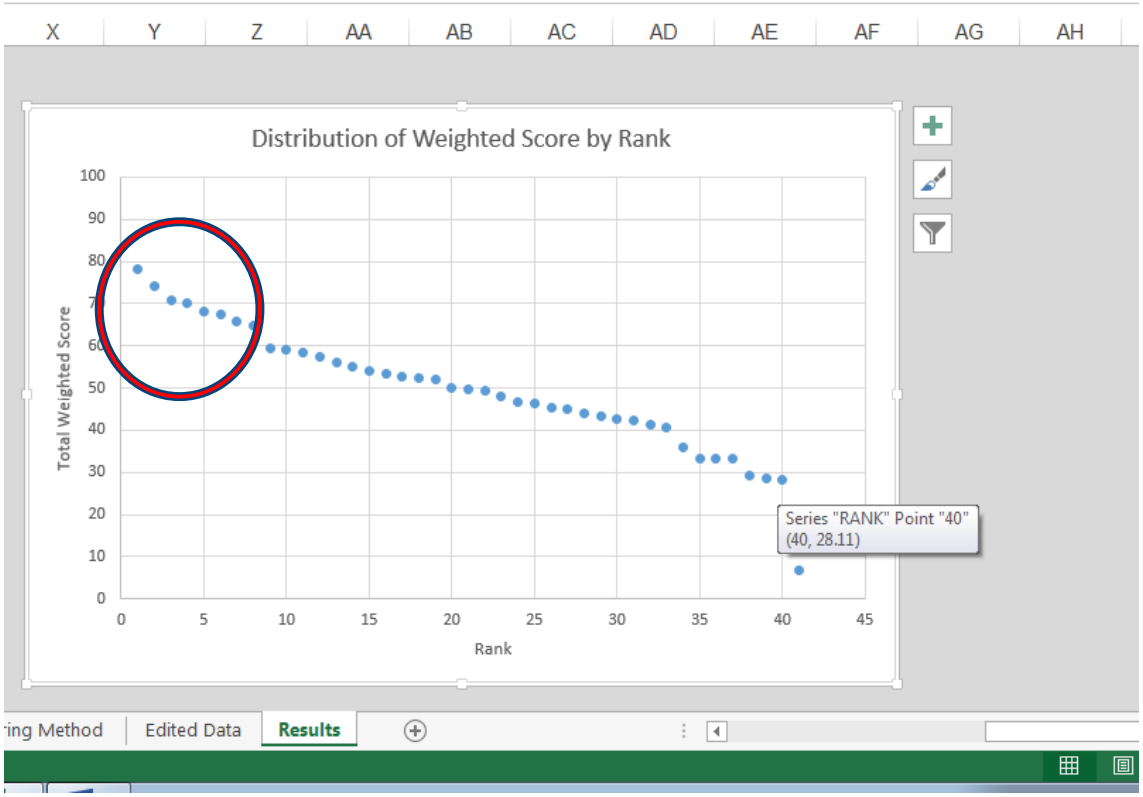



The other section displays the information from the table in chart format.




## Results Interpretation

The first chart show weighted score by rank. This can be used to visually identify natural groupings and breaks in the data, as illustrated below.




The second chart shows the breakdown of the scores for each N2K feature (in rank order) by each criterion. This can help identify if certain criteria are particular material factors in the results of the ranking exercise.