Llysdinam's contribution to ornithology in Mid-Wales

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Crynodeb
Saif Ystâd Llysdinam, sy'n eiddo teulu Dillwyn Venables Llewelyn, gyferbyn â phentref Pontnewydd ar Wy yng nghanolbarth Powys, gydag Afon Gwy rhyngddynt. Yn y 1900au cynnar, gosododd Syr Charles Dillwyn Llewellyn un o'r blychau nythu oedd yn cael eu monitro cyntaf yng Nghymru ar yr ystâd. Parhawyd y monitro gan ei fab, Syr Michael. Pan roddodd Syr Michael wahoddiad i'r hyn sy'n awr yn Brifysgol Caerdydd i agor Canolfan Faes yn Llysdinam, roedd wedi sefydlu cyfleuster a barhaodd archwiliadau adaryddol oedd eisoes mewn bod a datblygu rhai newydd, rhywbeth a ddaliodd ymlaen, mewn rhan, hyd yn oed wedi i Ganolfan Faes Llysdinam gau yn 2010. Mae'r adroddiad yna yn rhoi blas ar y rhychwant o destunau adaryddol a archwiliwyd yn ardal afonydd a choedwigoedd canolbarth Cymru dros yr hanner can mlynedd ddiwethaf, y bu gan Ganolfan Faes Llysdinam ran ynddynt.

Abstract
The Llysdinam Estate of the Dillwyn Venables Llewelyn family lies opposite the village of Newbridge-on-Wye in mid Powys, separated from it by the River Wye. In the early 1900s Sir Charles Dillwyn Llewellyn set up, on the estate, one of the earliest monitored nest box sites in Wales. Monitoring continued through his son Sir Michael. When Sir Michael invited what is now Cardiff University to open a Field Centre at Llysdinam he had established a facility that took over existing, and developed new, ornithological investigations which have continued, in part, even after the Llysdinam Field Centre closed in 2010. This report gives a flavour of the range of ornithological topics which have been undertaken in the mid-Wales rivers and woodlands over the last half century involving the Llysdinam Field Centre.

Introduction
Set on the Breconshire bank of the River Wye in mid-Wales is the Llysdinam Estate of the Dillwyn Venables Llewellyn family. The family has a historic interest in science and nature, originally centred around the Dillwyn Llewelyn side of the family and their home at Penllergaer near Swansea. Sir Charles Dillwyn Llewellyn came to Llysdinam on his marriage to Katherine Minna Venables in 1893 and by Royal Licence became a Dillwyn Venables Llewelyn. In approximately 1909 he reported that he erected "a few nest boxes in my garden" which, in the first year, attracted "a few tits, Redstarts and Robins" along with "one nest of Pied Flycatcher". More boxes were added and proportionately more Pied Flycatchers *Ficedula hypoleuca* nested in them with "the effect of driving away the Redstarts and Robins which have now almost ceased to use the boxes". The design of these original boxes is not given but the presence of Robins *Erithacus rubecula* suggests they were of a somewhat open construction. This was probably one of first systematically-recorded series of bird boxes in the United Kingdom and, with breaks around the First and Second World Wars, monitoring has continued up to the present time. Unfortunately, many of the historic records, stored in a property in the village during the Second World War, were destroyed it was said, by itinerants illegally using the cottage and used its store of documents as fuel for the fire.

At this time, the Pied Flycatcher seems to have been considered a predominantly riverside bird, as

Sir Charles noted "The Pied Flycatcher had previously nested in fair numbers in trees along the riverbank and still continues to do so". Bingham quoted by Swainson (1893) reported it "not uncommon along the rivers Elan and Claerwen", their waters entering the Wye some kilometres upstream of Llysdinam. Swainson (1893) also noted that Pied Flycatchers were principally associated with the Usk and its tributaries in south Breconshire. Indeed, Vaughan (1919) noted "on April 16 1919 while fishing on the Usk just below Brecon I saw a cock Pied Flycatcher in very fine plumage flying about and feeding by some willows on the bank of the river" and commented on its rarity. A century ago, the Wye at Llysdinam was lined by mature trees, presumably with plenty of nesting opportunities for small passerines. Today there are riverside trees, but few of great age. Nevertheless, nest boxes on these riverside trees are often occupied by early Pied Flycatcher arrivals. However, the concept of them being riverside birds may relate more to the fact that most early records come from the salmon *Salmo* spp. fishing gentry on aristocratic estates, who rarely found sporting or other reason to venture to the hillside Sessile Oak *Quercus petraea* woodlands where these birds are, and no doubt were, well established (see Campbell 1954).

Although not intended as ornithological records, the Llysdinam Game Books (Slater 1995) give a brief glimpse between 1911 and 1939 into upland birds, particularly on the estate uplands around Drum Ddu northwest of Llysdinam and on their holdings on the Mynydd Epynt south of Builth Wells. In both areas Red Grouse *Lagopus lagopus*, Black Grouse *Lyrurus tetrix*, Grey Partridges *Perdix perdix*, Pheasants *Phasianus colchicus* and Corncrake *Crex crex* were recorded in the game books. In August/September 1911 at Upper Chapel on the Mynydd Epynt 37 grouse, five blackgame and four corncrakes were shot. Partridges seemed widespread, appearing in the game bags of the mid-1930s from Llandewi in north Radnorshire, to Pencerrig and Garth near Builth, Wyecliff near Hay on to Penllegaer near Swansea. Red grouse records between 1933 and 1935 come from Mynydd Epynt sites, as well as Maesllwch, Painscastle. In September 1936 34 grouse and one blackgame were shot on the Llysdinam uplands towards Drum Ddu. Blackgame occurred in small numbers and intermittently at Upper Chapel throughout the period 1924 to 1939. Not in the game books, but from verbal records of farmers, who in the pre-second world war period reported Corncrake in fields around Llysdinam and a stuffed specimen hit by a train near Howey from about the same period adorned the mantlepiece of a retired local railway worker.

In 1924 Sir Charles erected 36 new boxes "of various types" at Llysdinam, all with 28.5mm holes and moveable lids. They were erected between *c*.91cm and *c*.137c) off the ground. This compares well to our subsequent boxes which, except for experimental boxes, had 28-30mm holes (about optimum according to Lundberg and Alatalo 1992) and were erected at a height of 140cm. Occupancy and breeding success rose until, in 1931 16 nests produced 82 young, a rate of success in this woodland which has not since been exceeded due, probably, to the current height of the canopy at about 35m with peripheral Wellingtonias *Sequoiadendron giganteum* up to 43m and considerable ornamental understorey. Today, most of our nest boxes are in oak *Quercus* spp.dominated woodlands but 20 of these 36 boxes which retained their original position from 1926-33 were on diverse species with half on pine *Pinus* spp. or spruce *Picea* spp. and the others equally spread between oak, Sweet Chestnut *Castanea sativa*, Wych Elm *Ulmus glabra*, Ash *Fraxinus excelsior* and Beech *Fagus sylvatica* with little apparent difference in Pied Flycatcher nest box occupancy between the tree species. During this period there were 82 Pied Flycatcher, 20 Blue Tit *Cyanistes caeruleus*, six Great Tit *Parus major*, four Coal Tit *Periparus ater* (all on ash) and three Nuthatch *Sitta europaea* nests, giving a 72% occupancy rate.

In 1932 Sir Charles submitted a note to British Birds on Pied Flycatchers laying abnormal eggs in two seasons. This was updated in his 1934 paper; what he presumed to be the same bird laid similarly

very small infertile eggs in a box in the same vicinity of the woodland as used in the previous two years. From this he concluded that (without the benefit of ringing) birds did return to the same woodland over several years. Such eggs are occasionally found in our area and were the subject of a paper Slater and Jennings (1987) and, most recently, small eggs were found in one of our nest boxes in 2020.

The arrival of Cardiff University at the Llysdinam Field Centre

After the Second World War, the Venables Llewelyn family returned to Llysdinam in the early 1950s. Sir Charles' son, Sir Michael Venables Llewelyn, who also had an interest in natural history and was a founder of the Herefordshire and Radnorshire Nature Trust (now Radnorshire Wildlife Trust), took on the mantle of the Llysdinam nest boxes. In 1970, the University of Wales Institute of Science and Technology (UWIST) acquired a Field Centre at Llysdinam and appointed me as its first Director in 1974, where I remained until retirement in 2010, the site having passed through various iterations of university ownership finally being part of Cardiff University's School of Biosciences. In the early 1960s Chris Mead added Llysdinam and some other nearby sites to his annual June tours of mid-Wales nest boxes, first weekend for tits, second for Pied Flycatchers. In the mid-1970s I joined him on these ringing pilgrimages to boxed woodlands from Hereford to the Tywi Valley where Tim Stowe (Stowe 1987) was studying the management of Sessile Oakwoods for Pied Flycatchers. Being a good ambassador for ringing, he encouraged me to train for my ringing licence, and, once qualified, encouraged me to establish the Field Centre's own nest-boxed woodlands. A thousand or so boxes later, many made by Maurice Slater, my uncle, and erected in some thirty sites, mainly in and around mid-Wales, plus a few in Shropshire, have led to many short- and long-term studies. For example, while Lundberg and Alatalo (1992) had earlier commented on the importance of nest box height, and although for convenience, rather than any other factor, Llysdinam boxes were erected at more or less 1.5m off the ground, we conducted an experiment using 30 boxes on ten deciduous trees at 1.5m, 3.0m and 4.5m above the ground. Five boxes were used; three by Pied Flycatchers and one each by Great Tit and Blue Tit. All five of these were in the 4.5m high boxes. The experiment was repeated in a Western Hemlock *Tsuga heterophylla* plantation with boxes at 1.5 and 4.5m on ten trees. Only three boxes were used, one each by Pied Flycatcher, Coal Tit and Wren *Troglodytes troglodytes* and all at 4.5m.

Before it was regarded as a health hazard, all our boxes prior to 1990 were dipped in creosote as a preservative. To investigate if treatment affected box selection, 20 freshly creosote dipped and 20 undipped boxes were erected alternately on a grid in a 20-year-old Norway Spruce *Picea abies* plantation. Occupancy was expected to be low and only six were used, all creosoted and all used by Coal Tits and Blue tits. 24 creosoted and 24 undipped boxes were similarly arranged in a nearby Pedunculate Oak *Quercus robur* woodland. Seven creosoted boxes were used (Pied Flycatcher, Blue Tit, Great Tit, Tree Sparrow *Passer montanus*) and eleven untreated boxes occupied by Pied Flycatchers and Blue Tits. We continued to use treated boxes dipped in autumn giving them at least six months before occupancy (Slater 1998). On one occasion, in late April, we found a couple of new boxes which had not been erected and, without much hope of occupancy, dipped them in creosote early one morning, erected them (still wet) an hour or so later, and by the following morning there was nesting material in one box which went on to produce a full brood of Pied Flycatchers.

Bird studies take off

Our early work centred on using the boxes in a non-specific way, measuring things such as nest temperature fluctuations, and food removal rates from feeders (Slater 1979, 1993, 1998a) as well as autumn use of nest boxes by moths (Morgan and Slater 1984) and a brief glance at species such as Golden Oriole (Slater 2000). Jo Robertson became the first PhD student at the Centre to use our nest

boxes for her studies on the influence of supplementary feeding on the condition and breeding success of titmice (Robertson 1998). Dr Roberton also produced interesting work on seasonal movements of Blue and Great Tits (Robertson and Slater 1997). Long-term data from the boxes were also used to describe first-egg-date fluctuations and migration returns (Slater 1998b, 1999a, 1999b). Over some 14 successive summers Professor Mike Kern came from the University of Wooster, Ohio, to study Pied Flycatchers in several of our local woodlands, exploring a range of ecological and biological aspects including nest humidity, water loss in eggs and the significance of egg volume (Kern, Cowie and Yeager 1992, Kern and Cowie 1995, Kern and Cowie 1996, Kern and Cowie 2000b), experimental changes in clutch size (Kern, Cowie and Slater 2000a), ptilochronology (Kern and Cowie 2002), blood metabolism (Kern *et al*. 2001, 2005, 2007) and return rates and dispersal distance of ringed Pied Flycatchers. On a metabolic theme, Nicola Goodship, under the supervision of Dr Katherine Buchanan, studied for her PhD on the relationship between nestling begging and testosterone in Pied Flycatchers, using our boxes for her study (Goodship 2006, Goodship and Buchanan 2006, 2007). More recently, Tyrrell (2017) has undertaken a pilot study into aspects of the diet of Pied Flycatchers using, in part, data from our woodlands. The Llysdinam work on Pied Flycatchers has, therefore, become more widely known and our data have contributed to Europe-wide studies into climate change and laying date (Both *et al*. 2004), yolk carotenoids (Eeva *et al*. 2010), variation in egg mass (Ruuskanen 2011), and parasite transfer in Pied Flycatchers (Jones *et al*. 2018).

Llysdinam's connection to birds has not been all about Pied Flycatchers, however. Professor Steve Ormerod, Professor of Ecology at Cardiff University, studied for his PhD at Llysdinam and, as he says in his University profile: "I came to Cardiff in 1980 for the prestigious UWIST MSc in Applied Hydrobiology, from there completing a PhD on water quality and invertebrates in the Wye river-system. Simultaneously, I developed an interest in the ecology of river birds, showing for the first time how this group was affected by acid rain. These major themes of multiple global-scale pressures on freshwater ecosystems, river invertebrates and birds in aquatic habitats, have continued to provide my major research models". His interest in river birds particularly involved Dippers *Cinclus cinclus*, often centring on the mid-Wye, and produced numerous publications, often with his collaborator Dr Steph Tyler (e.g. Ormerod *et al.* 1985; Ormerod and Tyler 1990; Tyler and Ormerod 1994). Steve brought Professor John O'Halloran, currently Professor of Zoology and interim President (previously Vice President) of University College, Cork, to the Centre to work on Dippers (O'Halloran *et al*. 1990). While at Llysdinam, John's interests also extended to swans *Cygnus* spp. in the Wye valley (Slater *et al*. 1990, 1992) where he collaborated with Dr John Foster. Steve also brought to the Centre to study Dippers, Dr Sonja Yoerg, then a Lecturer at the University of California, Berkeley, who looked mainly at foraging behaviour from fledging to dispersal (Yoerg 1990, 1994, 1998; Yoerg and O'Halloran 1991). Dr Richard Jenkins also began his research career at Llysdinam studying Water Rail *Rallus aquaticus* under the supervision of Steve Ormerod (Jenkins *et al*. 1995) and is now UK Manager of the Global Species Programme of IUCN in Cambridge.

More recent times

In the decade before the Field Centre's closure in 2010, the fickleness of funding took Llysdinam into research into biomass crops such as short rotation willow *Salix* spp. coppice and Elephant Grass *Miscanthus* sp.. Dr Tsehaye Semere worked on biomass grass crops on the Herefordshire-Powys border (Semere and Slater 2007), producing several well-quoted research papers, including his observations on birds in biomass crops. Dr Danielle Fry took for the title of her PhD thesis "Biodiversity of short rotation willow coppice in Wales: with particular reference to birds" (Fry 2008, 2011). Her studies also allowed her to compare her work in Wales to willow coppice in New Zealand (Fry and Slater 2008). The final PhD student to study birds in biomass crops, in this case biomass

grasses, was Dr Jennifer Clapham who looked at the abundance and diversity of small mammals and birds in mature crops of perennial rhizomatous biomass grasses (Clapham 2011, Clapham *et al*. 2008). Even after the closing of the Field Centre, Cardiff University PhD student Jez Smith used our boxes at Ty Mawr as an important part of his studies into the impact of climate change on woodland birds.

Since the closure of the Field Centre, nest boxes at four sites have continued to be monitored and pulli ringed. Sir Charles' original Llysdinam woodland sites, Ty Mawr Llanwrthwl and Coed y Cilau, are therefore still contributing data with the aim of updating the Slater (1999) paper on first egg-dates using some of the statistical methodology used by Reese and Tucker (2019).

A lot of water has passed under the Wye bridge in Newbridge since the Venables Llewelyns first took an interest in the birds of the area. Some of the original woodlands have now outgrown Pied Flycatchers, being too tall with too much understory. But without that start our knowledge of the avian fauna of mid-Wales and further afield may never have developed in the way that it has. The Llysdinam Field Centre may be no more but its contribution to Wales' ornithology will live on in the literature and the alumni it has nurtured.

References

Both, C.,Artemyev, A.A., Blaauw, B., Cowie, R.J., Dekhuijzen, A.J., Eeva, T., Enemar, A., Gustafsson, L., Ivankina, E.v., Jarvinen, A., Metcalfe, N.B., Nyholme, N.E.I., Potti, J., Ravussin, P-A., Sanz, J.J., Silverin, B., Slater, F.M., Sokolov, L.V., Torok, J., Winkel, W., Wright, J.,Zang, H. and Visser, M.E. 2004. Large-scale geographical variation confirms that climate change causes birds to lay earlier. *Proceedings of the Royal Society of London B: Biological Sciences* 271: 1657-1662.

Campbell, B. 1954. The breeding distribution and habitats of the Pied Flycatcher (*Muscicapa hypoleuca*) in Britain. *Bird Study* 1: 81-101.

Clapham, S. J., Slater, F. M. and Booth, E. 2008. The biodiversity of established biomass grass crops. *Aspects of Applied Biology* 90: 325-329.

Clapham, S. J. 2011. *The abundance and diversity of small mammals and birds in mature crops of the perennial grasses* Miscanthus x giganteus *and* Phalaris arundinacea *grown for biomass energy.* PhD thesis, Cardiff University.

Eeva, T., Ruuskanan, S., Salminen, J-P., Belskii, E., Järvinen, A., Kerimov, A., Korpimäki, E., Krams, I., Moreno, J., Morosinotto, C., MäR., Orell, M., Qvarnström, A., Siitari, H., Slater, F.M., Tilgar, V., Visser, M.E., Winkel, W., Zang, H. and Laakksonen, T. 2010. Geographical trends in the yolk carotenoid composition of the pied flycatcher (*Ficedula hypoleuca*). *Oecologia*. 165: 277-287.

Fry, D. and Slater, F. 2008. Birds of New Zealand willow coppice. *Ringers' Bulletin*, Summer 2008: p13.

Fry, D. A. 2008. *Biodiversity of short rotation willow coppice in Wales, with particular reference to birds*. PhD thesis, Cardiff University.

Fry, D.A. and Slater, F.M., 2011. Early rotation short rotation willow coppice as a winter food resource for birds. *Biomass and Bioenergy* 35: 2545-2553.

Goodship, N. M. 2006. *Endocrine control of nestling begging behaviour in the pied flycatcher,* Ficedula hypoleuca. PhD thesis, Cardiff University.

Goodship, N. M. and Buchanan, K. L. 2006. Nestling testosterone is associated with begging behaviour and fledging success in the pied flycatcher, Ficedula hypoleuca. *Proceedings of the Royal Society B: Biological Sciences* 273: 71-76.

Goodship, N.M. and Buchanan,K.L. 2007. Nestling testosterone controls begging behaviour in the

pied flycatcher *Ficedula hypoleuca*. *Hormones and Behaviour* 52: 454-460.

Jenkins, R.K.B., Buckton, S.T. and Ormerod S.J. 1995. Local movements and population density of Water Rails *Rallus aquaticus* in a small inland reedbed. *Bird Study* 42: 82-87.

Jones, W., Kulma, K., Bensch, M., Cichon, M., Kerimov, A., Krist, M., Laaksonen, T., Moreno, J., Munclinger, P., Slater, F.M., Szollosi, E., Visser, M.E. and Qvarnstrom, A. 2018. Interspecific transfer of parasites following a range-shift in *Ficedula* flycatchers. *Ecology and Evolution* 8: 12183-12192.

Kern, M. D., Cowie, R. J., and Yeager, M. 1992. Water loss, conductance, and structure of eggs of pied flycatchers during egg laying and incubation. *Physiological Zoology* 65: 1162-1187.

Kern, M. D. and Cowie, R. J. 1995. Humidity levels in Pied Flycatcher nests measured using capsule hygrometers. *The Auk* 112: 564-570.

Kern, M. D. and Cowie, R. J. 1996. The Size and Shape of Eggs from a Welsh Population of Pied Flycatchers: Testing Hoyt's Use of Egg Dimensions to Ascertain Egg Volume. *Journal of Field Ornithology* 67: 72-81.

Kern, M., Cowie, R.J. and Slater, F.M. 2000a. Responses of egg-laying pied flycatchers to experimental changes in clutch size: a re-examination. *The Condor* 102: 428-432.

Kern, M. D. and Cowie, R. J. 2000b. Female pied flycatchers fail to respond to variations in nest humidity. *Comparative Biochemistry and Physiology Part A: Molecular and Integrative Physiology* 127: 113-119.

Kern, M., Bacon, W., Long, D. and Cowie, R. J. 2001. Possible roles for corticosterone and critical size in the fledging of nestling pied flycatchers. *Physiological and Biochemical Zoology* 74: 651-659.

Kern, M. D. and Cowie, R. J. 2002. Ptilochronology proves unreliable in studies of nestling Pied Flycatchers. *Ibis* 144: 23-29.

Kern, M., Bacon, W., Long, D. and Cowie, R. J. 2005. Blood metabolite and corticosterone levels in breeding adult pied flycatchers. *The Condor* 107: 665-677.

Kern, M. D., Bacon, W., Long, D. and Cowie, R. J. 2007. Blood metabolite levels in normal and handicapped pied flycatchers rearing broods of different sizes. *Comparative Biochemistry and Physiology Part A: Molecular and Integrative Physiology* 147: 70-76.

Kern, M., Slater, F. and Cowie, R. 2014. Return rates and dispersal distances of Welsh Pied Flycatchers *Ficedula hypoleuca* and factors that influence them. *Ringing & Migration* 29: 1-9.

Lundberg, A and Alatalo, R. 1992. *The Pied Flycatcher.* London, T.&A.D. Poyser.

Morgan, M.J. and Slater, F.M. 1984. Unexpected nest-box occupants. *Nature in Wales, New Series* 2: 110-111.

O'Halloran, J., Gribbin, S.D., Tyler, S.J. and Ormerod S.J. 1990. The ecology of dippers *Cinclus cinclu*s (L.) in relation to stream acidity in upland Wales: time-activity budgets and energy expenditure. *Oecologia* 85: 271-280.

Ormerod, S.J., Tyler, S.J. and Lewis J.M.S. 1985. Is the breeding distribution of Dippers influenced by stream acidity? *Bird Study* 32: 32-39.

Ormerod, S.J. and Tyler, S.J. 1990. Population characteristics of Dipper (*Cinclus cinclus*) roosts in mid and south Wales. *Bird Study* 37: 165-170.

Reese, R.A. and Tucker, J.J. 2019). Descriptive models for first arrival dates of migrants in an inland UK county. *Ringing & Migration* 29: 1-9.

Robertson, J.C. and Slater, F.M. 1997. Seasonal movements of Blue Tits *Parus caeruleus* and Great

Tits *P. major* in mid-Wales. *Welsh Birds* 1: 38-40.

Robertson, J. C. 1998. *The influence of supplementary feeding on the condition and breeding success of titmice* (Paridae). PhD thesis, University of Wales.

Ruuskanen, S., Siitari, H., Eeva, T., Belskii, E., Järvinen, A., Kerimov, A., Krams, I., Moreno, J., Morosinotto, C., Mänd, R., Möstl, E., Orell, M., Qvarnström, A., Salminen, J-P., Slater, F., Tilgar, V.,Vissser, M. E., Winkel, W., Zang, H. and Laaksonen, T. 2011. Geographical variation in egg mass and egg content in a passerine bird. *PLoS ONE* 6: p.e25360.

Semere, T. and Slater, F.M. 2007. Ground flora, small mammals and bird species diversity in miscanthus (*Miscanthus x giganteus*) and reed canary-grass (*Phalaris arundinacea*) fields. *Biomass and Bioenergy* 31: 20-29.

Slater, F.M. 1979. Temperature changes as a measure of Nestbox activity in the Pied Flycatcher. *Breconshire Birds* 4: pp 23-25.

Slater, F.M. 1993. Food removal rate from feeders as a measure of bird activity in rural woodland fringe. *Welsh Bird Report* 6: 73-76.

Slater, F.M. 1994. A Squirrel resistant peanut feeder. *Ringer's Bulletin* 8: 79.

Slater, F.M. 1995. Extracts from the Llysdinam Game Books. *Welsh Birds* 1: 21-24.

Slater, F. M. 1998a. Nestbox use in relation to height and wood treatment. *Ringers' Bulletin* 4: 74.

Slater, F.M. 1998b. Three quarters of a century of Pied Flycatchers *Ficedula hypoleuca* in Mid Wales. *Welsh Birds* 2: 16-20.

Slater, F.M. 1999a. Pied Flycatcher *Ficedula hypoleuca* migration from some woodlands in the upper Wye Valley. *Welsh Birds* 2: 109-112.

Slater, F.M. 1999b. First-egg date fluctuations for the Pied Flycatcher *Ficedula hypoleuca* in the woodlands of mid-Wales in the twentieth century. *Ibis* 141: 489-506.

Slater, F.M. 2000. Golden Orioles in Radnorshire. *Welsh Birds* 2: 227.

Slater, F.M., Foster, J. and O'Halloran, J. 1990. Mute, Bewick's and Whooper Swans in mid Wales and the Lower Wye Valley. *Radnorshire Society Transactions* LX: 12-26.

Slater, F.M., Foster, J. and O'Halloran, J. 1992. Population trends in Mute Swans (*Cygnus olor*) in mid-Wales and the Lower Wye Valley. *Welsh Bird Report* 4: 74-79.

Slater, F.M. and Jennings, P.P. 1987. Aberrant eggs of Pied Flycatcher *Ficedula hypoleuca* in mid-Wales. *Bird Study* 34: 185-186.

Smith, J.A., 2019. *Impacts of Climate Change on Woodland Birds; From Individual Behaviour to Population Change*. PhD thesis, Cardiff University.

Stowe, T.J. 1987. The Management of Sessile Oakwoods for Pied Flycatchers. In C. James Cadbury & Michael Everell (eds.) *RSPB Conservation Review* 1: 78-83.

Swainson E.A. 1893. Survey in "The Field". *Zoologist* Ser 3 17: 420-424.

Tyler, S.J. and Ormerod, S.J. 1994. *The Dippers*. London, T.&A.D. Poyser.

Tyrrell, C. 2017. Molecular analysis of the diet of Pied Flycatchers *(Ficedula hypoleuca*) in the context of climate change: productivity and carry-over effects: a pilot study. *Birds in Wales* 14: 20-34.

Venables Llewelyn, C. 1932. Pied Flycatcher laying abnormal eggs in two seasons. *British Birds* 26: 95.

Venables Llewelyn, C. 1934. On some breeding-habits of the Pied Flycatcher. *British Birds* 27: 251-255.

Vaughan, H.J. 1919. Pied Flycatcher in South Wales. *British Birds* 13: 27.

Yoerg, S.I. 1990. Infanticide in the Eurasian Dipper. *The Condor* 92: 775-776.

Yoerg, S.I. 1994. The development of foraging behaviour in the Eurasian dipper, *Cinclus cinclus,* from fledging until dispersal. *Animal Behaviour* 47: 577-588.

Yoerg, S.I. 1998. Foraging behavior predicts age at independence in juvenile Eurasian dippers (*Cinclus cinclus*). *Behavioral Ecology* 9: 471-477.

Yoerg, S.I. and O'Halloran, J. 1991. Dipper Nestlings fed by a Gray Wagtail. *The Auk* 108: 427-440.