

A STUDY OF THE PRESENT STATE OF AN IRISH COLONY OF THE SLOW WORM (*ANGUIS FRAGILIS* LINNAEUS, 1758) (SQUAMATA: ANGUIDAE) IN THE BURREN, COUNTIES CLARE AND GALWAY 2015 – 2019

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Abstract

There is a colony of slow worms, the legless lizard, *Anguis fragilis* Linnaeus, 1758 (Squamata: Anguidae) in the glacial karst landscaped Burren region of Counties Clare and Galway in the west of Ireland. This is a report of a five-year investigation into the lifestyle, habits, age and sexual dimorphism, and terrain inhabited by the current population. From the total encounters of 743, the ratio of male, female and juvenile slow worms was monitored as was the possibility of a home range and repeated individual refugia preference by adult females compared to the transient habit of males. The variation of preferred habitat, the refugia employed and pertinent temperatures are also reported.

Key words: *Anguis fragilis*, slow worm, Ireland, Burren, distribution, sex ratio, gravidity, birth, lifestyle, habits, age, sexual dimorphism, terrain, refugia.

Introduction

The first slow worms (*Anguis fragilis* Linnaeus, 1758) recorded in Ireland were reported by the then schoolboy Seamus Kelly on farmland at Tulla Park, County Clare. Mr Kelly (pers. comm) recalls that it was during 1972 when he discovered two slow worms which he estimated to be at least a foot long and as thick as a finger. McCarthy (1977) suggests that they may have been mating and reported that one of them, a male, measured 34cm long and 29g weight. McGuire and Marnell (2000) in a study over a three-day period in July 1998 and also from May to October 1999, reported finding three and eighty-nine slow worms respectively.

The origin of slow worms in Ireland is not known but it is generally accepted, though without any evidence or credibility, that they were introduced from Britain during the 1970s. Common in Britain and much of Europe, slow worms are rarely seen during daylight hours even though large numbers may inhabit gardens and other publicly frequented areas. Also, being semi-fossorial, slow worms spend much time underground including during their hibernation period (Inns, 2009).

Cold blooded, slow worms require thermoregulation but, unlike the common lizard (*Zootoca vivipara* (Jacquin, 1787)) prefer to bask under sun-heated objects rather than overtly (Street, 1979). This habit facilitates the use of artificial cover objects (ACOs hereafter called covers)

when seeking them out. These covers are commonly of corrugated tin, roofing felt, carpet squares and hardboard (Riddell, 1996) and, if placed in suitable locations, will be used by the slow worms to supplement their other habitations which often include flat rocks and debris (Inns, 2009).

During the summer of 2012, I found a dead male slow worm on a lane in the townland of Derryowen, County Clare. As a result, I decided that I would try and find a slow worm in the Burren area. I began the research in Autumn 2015 and now as they hibernate at the end of 2019, my total slow worm encounters number 743.

The Burren is a mix of limestone pavement, agricultural grassland and cultivated fields with only sporadic farm and residential buildings. It has been farmed for thousands of years with land reclaimed from bare rock and hazel dominated vegetation. The area generally accepted as The Burren is bordered by the villages of Tubber, Corofin, Kilfenora, Lisdoonvarna, Ballyvaughan and Kinvara (Anon., 2020a).

A townland in the Republic of Ireland is the smallest administrative division of land containing an average area of 325 acres (Anon., 2020b).

Methods

2015. I began in the townland of Keelhilla, County Clare where, at the end of August, I placed a 50cm² corrugated tin to act as a cover at the base of a dry-stone wall. Nearby I happened upon a similar sized square of steel sheet in the undergrowth, an old discarded road sign, and I placed that near a dry-stone wall. These two covers remained in place over years.

2016. Cover numbers were supplemented by adding three more of similar dimensions at Keelhilla, one on farmland in the townland of Cappaghmore, County Galway, one at Cappacasheen, County Galway, two at Ballaghaglash, County Clare, three at Coolorta, County Clare, one at Creehaun, County Clare and one at Attyslany, County Clare. The total of 14 covers consisted of corrugated tin x 11, steel sheet x 1, tin sheet x 1 and carpet tile x 1.

2017. Only the original two covers were retained at Keelhilla, two additional covers were placed at Cappacasheen. Three covers were retained at Coolorta and one at Creehaun. Two were placed at Poulataggle, County Clare, three at Cloosh in County Galway and one remained in Attyslany. The total of 14 covers consisted of corrugated tin x 11, steel sheet x 1, tin sheet x 1 and carpet x 1.

2018. The two covers remained at Keelhilla. Access was regained at Cappaghmore and one cover placed. An additional three covers were placed at Cappacasheen, two were positioned on scrub farmland in Funshin Beg, County Galway, four items fit for purpose were already situated in a wild garden at Cahererillan, County Galway, two covers were positioned at Funshin More, County Galway, three at Cloonselherny in County Clare, two at Fahee North, County Clare and four at Knocknagroagh in County Clare. The total of twenty-six covers consisted of corrugated

tin x 9, steel sheet x 3, corrugated bitumen x 8, tin sheet x 2, bitumen mat x 3 and carpet x 1.

2019. The steel sheet only remained at Keelhilla, two sites were used at Rockvale, County Clare incorporating five covers, three covers were placed in Quakerstown townland, County Clare, two sites were used at Cappacasheen where three additional covers were placed totalling nine, three were placed at Killinny West, County Galway, the four remained at Cahererillan, two remained at Funshin More, three sites were utilized at Fahee North with five covers. Glencolumbkille North in County Clare received three covers. Individual covers were placed during the summer at Derreenatloghtan, County Clare, Poulataggle, County Clare and Ballybush South in County Galway. The total of 38 covers consisted of corrugated bitumen x 16, corrugated tin x 10, steel sheet x 5, tin sheet x 2, bitumen mat x 4 and carpet x 1. Covers were approximately 0.5m square other than at Cahererillan where the steel sheets were 2.5m x 1.5m and the carpet 1.5m x 0.5m. The steel sheets at Quakerstown measured 2m x 1m and 1m x 0.5m.

The terrain at the sites varied with open windswept and sparsely vegetated limestone pavement at 155m, 130m down to just 18m above sea level, Burren scrubland, wild garden, agricultural grassland, intimate sheltered copses, roadside verges and the edges of thickets with some high trees.

Any structure on site was utilized with covers placed hard up against dry-stone walls, under thick briars and bushes, tucked into dense hedgerows and adjacent to any feature that might receive some sunshine and offer shelter to vulnerable reptiles during daylight hours. The main vegetation at these sites comprised bracken (*Pteridium aquilinum*), heather (*Erica cinerea*), ivy (*Hedera helix*), nettles (*Urtica dioica*), blackthorn (*Prunus spinosa*), buckthorn (*Rhamnus cathartica*), hawthorn (*Crataegus monogyna*), hazel (*Corylus avellana*), various grasses and wild flower spp., juniper (*Juniperus communis*), ash (*Fraxinus excelsior*), goat willow (*Salix caprea*) and brambles (*Rubus fruticosus*).

Along with the covers, all manner of natural and human miscellanea that might also be employed by slow worms were checked. These items included planks of wood, off-cuts of hardboard, bits of tin or metals, scrap roofing felt and plastic sheet. Looking under stones in the Burren, a recommended method, was only briefly practiced being considered environmentally detrimental.

During 2015, I checked the covers initially on 4 September and finally on 9 October when hibernation was assumed. In 2016, the placing and checking of covers began in March until October, in 2017 February through to October, in 2018 early March to late October and in 2019 placing and checking of covers began in early February and concluded in early November when hibernation was assumed. For statistical accuracy I endeavoured to monitor all the covers at least twice, but more usually three times weekly.

On the visits during 2015, 2016 and 2017, the date and time each cover was checked, the air

temperature at that time and the weather conditions along with details of any slow worms found were recorded. The daily minimum and maximum air temperatures were also noted. Additionally, during 2018 and 2019, the temperature of each cover was recorded whether slow worms were present or not.

The timing of visits was varied on an *ad hoc* basis, for example whether the mid-morning sun after a wet night affected encounter numbers or the value of heavy cloud in late afternoon during periods of hot weather. Covers were not checked during torrential rain or storm conditions though they were should snow lie on the ground and during periods of frost. To facilitate repeat sightings certain covers were left in place over the entire study or, if removal was necessary, replaced in late winter.

It immediately became apparent that my initial results inferred an imbalance according to various research papers regarding the ratio of male to female encounters. Consequently, I was vigilant in recording the sex of each adult. Although individual identification was not always possible, the marking and colouration of animals was usually sufficient for gender assessment. Young slow worms were allocated either adult or juvenile status dependent on their markings and colour thus sub-adult classification was not implemented.

A photograph was taken of each slow worm where possible with a Panasonic Lumix TMZ-T25 10x and downloaded onto a computer. It is a habit of slow worms, even when in darkness under covers, to bury their head into vegetation therefore often obscuring the important individual markings of head and neck areas. Also, in warm weather the disturbance of lifting the cover would occasionally result in a rapid departure though they would often return within minutes. To minimise disturbance, particularly to facilitate repeat sightings, no slow worm was ever picked up.

Results

2015. Keelhilla, two covers produced 13 encounters from 4 September to 9 October. Corrugated tin 13, steel sheet 0.

Of 13 encounters: Male 1; Female 12; Juvenile 0. Repeat sighting F#1, F#2.

2016. Keelhilla, five covers produced 82 encounters from 4 April until 26 September. The five covers had 76 slow worms, two were seen openly basking and 4 were found under stones. Corrugated tin 76, steel sheet 0.

Cappacasheen, one cover produced 15 encounters from 18 August until 29 September. Tin sheet 15.

Cappaghmore, one cover produced 22 encounters from 14 July to 31 August. All were classed as juveniles. Corrugated tin 22.

Ballaghglash, two covers produced none but an openly basking female was noted partially exposed in sphagnum moss adjacent to a cover. Corrugated tin 0.

The covers at Coolorta, Creehaun, and Attyslany resulted in no sightings.

Of 120 encounters: Male 6; Female 44; Juvenile 70. Repeats F#1 (2nd year), F#2 (2nd year). Regularly seen F#18, F#32, F#58.

2017. Keelhilla, two covers produced 13 encounters from 31 March to 25 August. Corrugated tin 9, steel sheet 4.

Cappacasheen, three covers produced 43 encounters from 9 March to 26 September. Tin sheet 26, corrugated tin 17.

The covers at Coolorta, Creehaun, Poulataggle, Cloosh and Attyslany produced no sightings.

Of 56 encounters: Male 0; Female 53; Juvenile 3. Repeats F#1 (3rd year), F#58 (2nd year). Regularly seen F#65, F#68, F#69.

2018. Keelhilla, two covers produced 13 encounters from 16 May to 26 September. Corrugated tin 6, steel sheet 7.

Cappacasheen, six covers produced 78 encounters from 8 April to 15 October. Corrugated tins 43, tin sheet 15, corrugated bitumen 7, bitumen mat 13.

Cahererillan, four covers produced 54 encounters from 21 May to 21 September. Steel sheets 44, tin sheet 6, carpet 3. 1 dead.

Cappaghmore, one cover produced three encounters. Corrugated bitumen 3.

Funshin Beg, two covers produced two encounters. Corrugated bitumen 2. The covers were removed when the slow worms were recorded.

No slow worms were found at Cloonselherny, Funshin More, Fahee North and Knocknagroagh.

Of 150 encounters: Male 8; Female 90; Juvenile 52. Repeats F#58 (3rd year), F#65 (2nd year), F#68 (2nd year). Regularly seen F#97, F#107, F#115.

2019. Keelhilla, One* cover produced 10 encounters from 23 March to 13 September. Steel sheet 10. *The corrugated tin was vandalised (burned) and therefore removed.

Cappacasheen site A, six covers produced 205 encounters from 20 February to 13 October. Tin sheet 49, corrugated tins 101, bitumen mats 55.

Cappacasheen site B, two covers produced 16 encounters from 3 May to 17 October. Corrugated bitumen 11, debris (hardboard and wood plank) 5.

Cahererillan, four covers produced 120 encounters from 25 February to 17 October. Tin sheet 19, steel sheets 90, debris (scrap felt and plastic) 11, carpet 0.

Quakerstown, three covers produced 49 encounters from 22 July to 23 October. Corrugated tin 17, steel sheets 26, debris (wood plank, broken concrete) 6.

Killinny West, three covers produced one encounter on 3 August. Corrugated bitumen 1. The covers were removed when the slow worm was recorded.

Derreenatloghtan (1) cover had 1 encounter on 17 September. Corrugated tin 1. Cover removed when slow worm recorded.

Sundry sightings - Leitra, under a wheelie bin, 1 encounter; Ballybornagh, while crossing a lane, 1 encounter.

No slow worms were found at Rockvale, Funshin More, Glencolumbkille North, Fahee North, Ballybush South or Poulataggle.

The 404 encounters in 2019 consisted of Males 30, Females 222 and Juveniles 152. Repeats F#58 (4th year), F#65 (3rd year), F#68 (3rd year), F#97 (2nd year) F#115 (2nd year), J#116 (2nd year), J#121 (2nd year), others regularly seen F#135 x 28, F#145 x 17, F#152 x 11. A breakdown of the encounters by year is as follows: -

2012. Total encounters	1	M 1 (not included in total).
2015. Total encounters	13	M 1, F 12.
2016. Total encounters	120	M 6, F 44, J 70.
2017. Total encounters	56	M 0, F 53, J 3.
2018. Total encounters	150	M 8, F 90, J 52.
2019. Total encounters	404	M 30, F 222, J 152.

Repeat sightings

There appeared to be a discrepancy with the ratio of adult sexes during the present study compared to previous research which suggested a female to male encounter bias ratios of approximately 2/1. Examples being F/M 49/26 (Fish, 2016), the previous Burren study 31/18 (McGuire and Marnell, 2000), 186/81 (Hubble and Hurst, 2015) and 72/33 (Platenberg and Langton, 1996). The closest ratio to my result was a ratio of 67/12 during a relocation check when the numbers of repeatedly sighted females were noted (Fuke, 2011). This discrepancy may be attributed to the number of repeatedly sighted females in my research. Generally, it would seem that F/M ratio might be expected at approximately 2/1, whereas I consistently discovered 9/1.

The most notable attendees were the following slow worms. Female #58, first encountered in August 2016 and thereafter on numerous occasions each year to date (2019). Of photographs of F#58 submitted for confirmation to the Herpetological Society of Ireland the results were positive dated 14 August 2016, 18 August 2016, 29 September 2016, 8 May 2017, 30 June 2017, 4 August 2017, 21 August 2017, 6 August 2018, 31 August 2018 and 20 February 2019. Discarded were 11 poor quality images lacking identifiable markings and a further five that were likely to be female #58 but could not be confirmed. Since then, she was also encountered on 8 August 2019 in company with two gravid females though she was not herself.

Female #65 was the first inhabitant of the steel sheet at Keelhilla, a cover that had remained unused for 22 months before her attendance, having been placed in late August 2015. Female #65 appeared on 2 June 2017, 9 August 2017, 13 August 2017, 25 August 2017, 16 May 2018, 22 May 2018, 18 June 2018, 22 August 2018, 7 September 2018, 5 August 2019 and 29 August

2019. Only two other adults and one juvenile were encountered there. Female #68 was encountered during 2017, 2018 and 2019. Other multiple sightings occurred under a bitumen mat during 2019 when there was of a total 47 encounters, F#135 contributed 28 of these.

Other notable specimens repeatedly seen were F#68 2017, 2018 and 2019, F#97 2018 and 2019, and juvenile #116 from birth 2018, through spring and autumn 2019. Juvenile #121 born September 2018 was again encountered April 2019 and September 2019. Total encounters from a specific cover could mean just one or maybe two individuals e.g. the small steel sheet at Quakerstown placed in June 2019 totalled 14 encounters by year-end, 11 were of (gravid) female #152 thus distorting any estimated population figures.

Over the five years, townlands that produced slow worms were Derryowen, Keelhilla, Ballaghaglash, Quakerstown, Derreenatloghtan, Ballybornagh and Leitra in County Clare and Cappacasheen, Cappaghmore, Funshin Beg, Cahererillan and Killinny West in County Galway

And those that did not yet produce any slow worms were Attyslany, Coolorta, Creehaun, Knocknagroagh, Rockvale, Glencolumbkille North, Poulataggle, Fahee North and Cloonselherny in County Clare and Ballybush South, Cloosh and Funshin More in County Galway.

The area the slow worms were discovered inhabiting measured approximately 44km² in extent. In comparison, McGuire and Marnell (2000) reported coverage of approximately 17km²

According to Froglife (1999), because of the number of covers used in this study, the frequency that they were checked and the period of time involved, the results did indicate a 'likely absence' of slow worms in all the sites that did not produce individuals. According to local knowledge and reliable reports, slow worms had been discovered at Glencolumbkille North and Fahee North previously.

2019 is shown as an example of cover preference due to the fair representation of materials used that year (Fig. 1). Of a total number of 38 covers, twenty failed to produce a result. The successful covers and debris materials are noted here. Metals were clearly favoured with corrugated tin, steel sheet and tin sheet the top three. Corrugated bitumen gave a poor return with various debris materials preferred.

Sex ratio of encountered slow worms

Individual females were encountered regularly through each summer with some being observed over two, three and four years. They would usually appear under a specific cover even though weeks or months elapsed between attendance. Adult males were rarely seen on more than six occasions and at most over just five or six weeks (Fig. 2).

As with adult males, sub-adults were similarly transient, inhabiting a cover for just a few weeks before absenting. Various new-born slow worms were seen to inhabit the same covers from their birth in late August or September until hibernation only to reappear the following

spring, remaining there for much of that summer, often into Autumn and their second year.

The movement habits of the sexes resulted in the following encounter ratios: -

2015	Male 1, Female 12, Juvenile 0.	Juvenile percentage 0%
2016	Male 6, Female 44, Juvenile 70.	Juvenile percentage 58.3%
2017	Male 0, Female 53, Juvenile 3.	Juvenile percentage 5.66%
2018	Male 8, Female 90, Juvenile 52.	Juvenile percentage 34.67%
2019	Male 30, Female 222, Juvenile 152.	Juvenile percentage 37.6%

A female encounter bias of 9.35 to 1.

Gravid females

During 2019, a total of 49 encounters were recorded at the tin sheet Cappacasheen 1 with the initial sighting on 20 February (Fig. 3). From that date until 5 July, during which time 40 checks were made, ten slow worms were encountered, all single sightings only one of which was male. From 6 July to August 11 that cover was checked on 13 occasions with the total number of slow worms encountered 32. All bar one was gravid, plus one juvenile. The visits comprised one blank visit, on four occasions two were present and on eight occasions three were there. Average cover temperature was 31°C, with 30°C or more on eight visits and top temperature 38°C on three visits. From 13 August until the final search on 23 October just six single sightings were made, the last on 9 September. Cover temperatures pre 6 July and post 11 August averaged 28.5°C with a low of 17°C and a high of 43°C.

Gravidity and birth

At Cahererillan site, the latest gravid female sighting was made on 19 August 2019. New-born appeared there on 4 September. At Quakerstown site, a female was still gravid on 6 September 2019. She next appeared under her particular cover on 20 September having birthed. New-born appeared there on 17 October. At Keelhilla, F#65 was gravid on 24 August 2018. On 7 September she had birthed. The first new-born was observed on 26 September.

Length

Although the longest slow worms are said to be female, the longest one that I discovered was a male of 43cm which incidentally had blue spots, a rare colouration. It is interesting that this pigmentation exists in this Irish population. The second longest was also a male and was the second of only two blue spotted animals discovered to date. Many females were longer than 35cm with one at 41cm and the new-borns measured in September and October 2019 averaged 8.9cm. At one-year old juveniles measured 16.8cm and at two years 21.2cm. To measure the length of a slow worm, a short piece of tailor's tape was placed adjacent to the animal and a

photograph taken.

Ants and other cover inhabitants

Within hours, certainly days of placing a cover, colonies of ants would form, mainly *Formica* sp. but also *Myrmica rubra* (Linnaeus, 1758) and sometimes both. These colonies would be so active that it seemed impossible for a slow worm to exist within the writhing mass, but they did. Slow worms were regularly discovered partially buried in the soft ant-worked soil where they would emerge from or disappear into upon disturbance. The soft soil was also utilized to best effect by juveniles. Under one cover Common Carder bees (*Bombus pascuorum* (Scopoli, 1763)) had nested in the moss of an old mammal's nest. A particular slow worm, F#84, spent the summer sharing that nest. A remarkable sight to see bees leaving the nest with a slow worm in among them with much of its body length inside the nest. Ants were still active when covers were checked on 29 December 2019.

Other sightings under covers were Wood mice (*Apodemus sylvaticus* (Linnaeus, 1758)), Common frog (*Rana temporaria* Linnaeus, 1758), Pigmy shrew (*Sorex minutus* Linnaeus, 1766), Bank vole (*Myodes glareolus* (Schreber, 1780)), Smooth newt (*Lissotriton vulgaris* (Linnaeus, 1758)) and many Common lizards (*Zootoca vivipara*) of varying ages. Numerous invertebrates were found including in October mating pairs of Devil's Coach Horse (*Ocypus olens* (Müller, O.F., 1764)) (Coleoptera: Staphylinidae). Over the study period 24 species of butterfly were observed, many in defined localities, such was the diversity of habitats populated by slow worms.

Discussion

Although there is no evidence, the slow worms in the Burren are regarded as introductions. Slow worms have been noted at various venues across Ireland over many years and these sightings are probably attributed to their previous availability as pets. The vast open wild countryside of Ireland, uninhabited and rarely, if ever visited, could hold colonies. Video footage shows a slow worm in a garden during 2014 in the midlands. Why was it there and how did it get there? Dare I suggest that it, and others live there, and have done for decades. A reliable sighting was made during 2018 on Inishmaan in the Aran Islands (Anon., pers. comm.) and in the Mayo hills (Harris, 2015). Animals are not known to exist until someone reports them and I expect other colonies, currently unreported, will eventually come to light.

It appears that in the Burren region slow worms, females at least, have what might be loosely termed a home range without the author knowing where and how far this zone extends. Individual covers were frequently discovered occupied by particular slow worms both regularly and sporadically over time. This behaviour immediately became apparent during the initial period in 2015 when two females constituted twelve of thirteen encounters. The fact that

recognizable individuals would appear for a few days or weeks under a certain cover only to vacate for further varying periods indicates the use of other, alternative stations within their domain. Is it scent that guides them?

Males were seen considerably less frequently than females. Males also lingered for shorter periods under covers with six weeks the lengthiest period any male was repeatedly encountered. Whereas juveniles would be encountered in their first and second years, older juveniles and those that would be classed as sub-adults were also rarely seen over any period. Are the males and young females seeking out new territory to increase the range of the species and to prevent inbreeding of a closed colony (Haley, 2014)?

The inference, due to the fact that the colony lives in the general area, is that the Burren, a limestone dominated region, is a preferred habitat for slow worms. The authors of the previous survey (McGuire and Marnell, 2000) suggest that ‘limestone outcrops’ are one of the elements that contribute to habitat suitability. Now, I am convinced that it is not. To quote McGuire and Marnell (*op. cit.*) ‘Based on preliminary findings of the present study, however, it appears that mosaics of open and well vegetated habitats such as calcareous grassland and scrub with outcrops of limestone pavement, offer the diversity of vegetational structure and the thermal conditions that best suit the slow worm in the Burren region’.

It appears, through the results of cover placement at a variety of habitats over several years, that the limestone pavement is an unattractive one and that the larger colony of slow worms exist in purely vegetated areas. Verdant grassland, deep rich hedgerows and dry-stone walls smothered in herbage and thickly foliated areas of garden are preferable. They also suit an abundance of food items in the form of invertebrates. The vast expanses of limestone pavement contain little structure and vegetation other than dry-stone walls and sparse scrub and contribute few individual slow worm encounters with female re-sightings and juveniles the main contributors to the encounter totals.

There are fertile ‘oasis – like’ areas within the vast pavement, vegetated with grasses, shrubs, bushes, trees and some structure or feature and these pockets are more highly populated than the harsh grey featureless and windswept rock. In contrast, areas in the general vicinity or towards the (generally accepted) edge of the Burren, or those that have been cleared of rock for farming and housing or naturally limestone free, comprising lush vegetation in gardens, fields and thick hedgerows showed a habitat preference for slow worms with a population expansion year on year.

These lush, damp areas certainly offer more suitable habitat for the food of slow worms, the invertebrates, slugs such as *Derocerus* sp. (Inns, 2009) in particular and snails than open barely vegetated crag. The only positive with limestone is that the stone retains heat and in winter the ground temperature rarely drops below 6°C but at that time the slow worms are in hibernation. Cahererillan has an area with no surface limestone, richly vegetated with farmed grassland,

dense hedgerows, bushes and trees, where a very large part-cultivated/part-wild garden has been available to access during 2018 and 2019. The owners, very keen gardeners, only noted their first slow worm six years ago. Using only the facilities that were already in place, I encountered 54 and 120 animals over those two summers.

Are slow worms slowly migrating out of the harsh limestone pavement into more richly vegetated areas far more suited to their cryptic and semi-fossorial life style than open windswept and barely vegetated crag?

A comparison of 'grey' limestone sites to vegetated 'green' sites during the 2019 season:- Keelhilla RS (a grey site) – 1 cover - 10 encounters; Cappacasheen 3 (a grey site) - 3 covers - 16 encounters; Cappacasheen 2 (a green site) - 5 covers - 156 encounters and Cahererillan (a green site) - 4 covers - 120 encounters.

Heavy cloud appears to be a major positive for encountering slow worms under covers. During periods of very warm weather and bright sunshine, covers that availed of some shade produced the most sightings. Even with very warm air temperatures, heavy cloud reduced the surface temperatures of covers as did the shade of bushes, tree canopy and even a large picnic table on top of a steel sheet. The table required removal prior to checking under the steel sheet. This sheet was often 10°C cooler than an exactly similar uncovered sheet next to it. The difference in slow worms inhabiting the two sheets was considerable. Slow worms certainly seek out the area of any cover that was most appropriate, temperature wise. A cover surface can have varying temperature areas due to a variety of factors such as vegetation around the edges (a popular venue of juveniles), canopy shade, even pooled rainwater.

Covers holding gravid females were checked at least every three days during July, August and into September in the hope of sighting a new born clutch. All females remained in position during this period with only occasional temporary absence. Then one by one they departed the covers, some returning days later obviously having birthed elsewhere.

Are slow worms on the increase? Two sites give an indication. The four covers at Cahererillan in 2018 produced 54 encounters over 48 visits while in 2019, they produced 120 encounters over 44 visits. The six covers at Cappacasheen in 2018 produced 78 encounters while in 2019, they produced 205 encounters.

On 22 March 2017, F#58 was discovered under her cover at 13:50 h with pockets of snow still on the ground an air temperature at 9°C and a night temperature of 3°C. Six days later she was there again, part buried in soft ant soil with an air temperature of 14°C at 14:30 after a night temperature of zero. On 20 February 2019, F#58 made her first appearance of that year after a night temperature of 3°C. Was she emerging from underground as the cover warmed or was the ant worked soil of a suitably comfortable temperature for her to lie in? Had she spent the winter burrowed within the friable soil? Slow worms of all ages were regularly found partly submerged

in the soft soil during all summers.

Juveniles also use the ant worked soil and they disappear into what has often become a deep dry dust when disturbed. Two juveniles in particular appeared to spend the first two years of their lives in or on the tilth of a particular cover and into which they would disappear when disturbed. Are they buried there all winter? Will I find them there in 2020? Many slow worms appeared to be asleep when a cover was lifted. Perhaps thermoregulation is simply an added but very important benefit of covers, a unit more suited, actually tailor-made, to their requirements than the natural substances of stones, wood or discarded debris. When is a cover a thermoregulation unit and when is it a shelter? The fact that covers are usually placed adjacent to thick cover and thus safety, must make them desirable. Do slow worms bask in the sun more than we think? Of the total of 743 encounters, only four were in the open. How many did I walk past?

In conclusion. I set out to find a slow worm with no plan. The search then took on its own shape and, without a scientific background or any expert assistance, I hope that five years of potentially valuable study have not been wasted.

Acknowledgements

Grateful thanks to Seamus Kelly and to all the landowners who very kindly allowed me access to their land.

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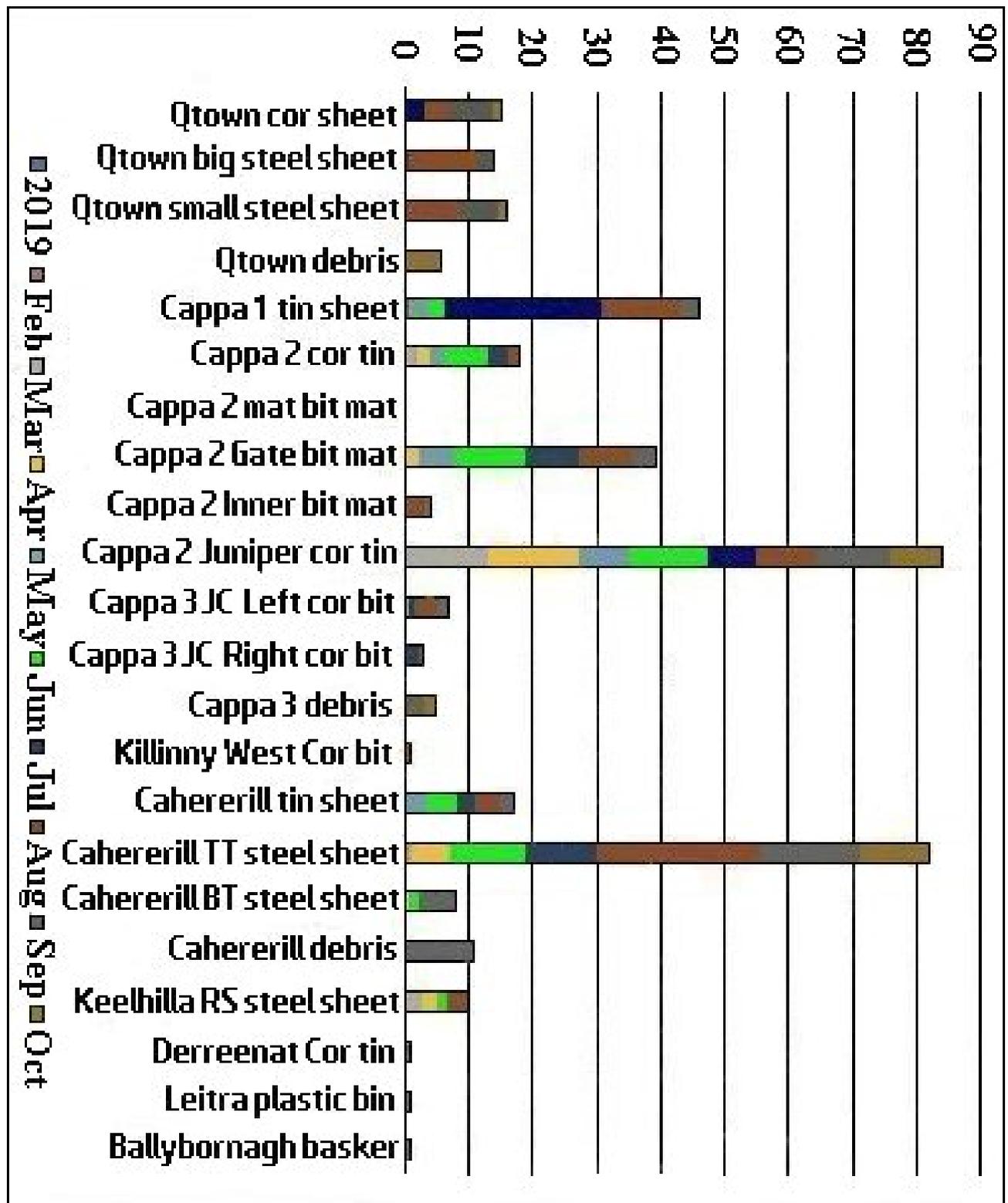


FIGURE 1. Cover preference in 2019.

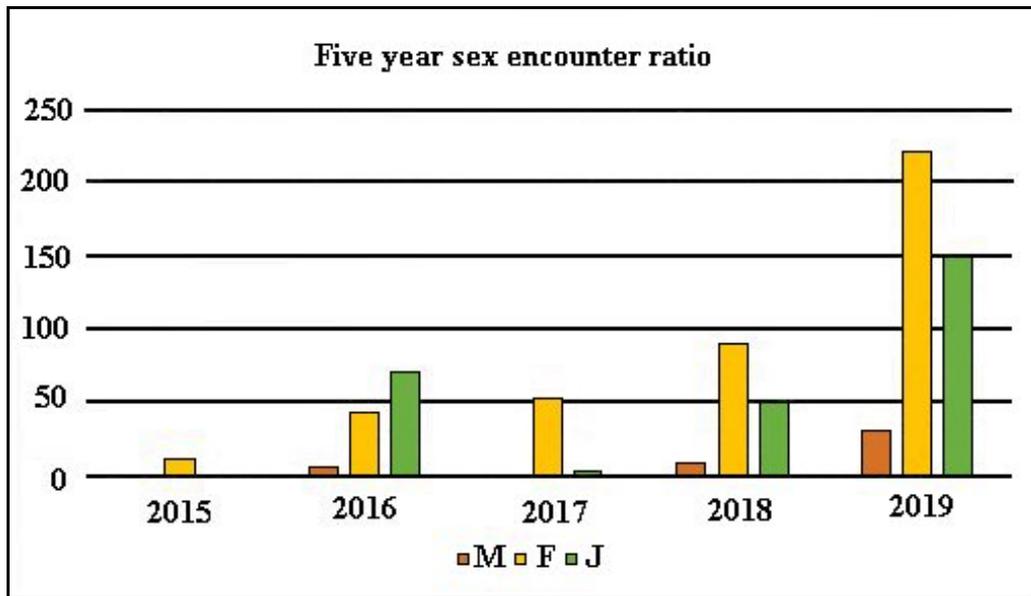


FIGURE 2. Sex encounter ratio chart, 5 years.

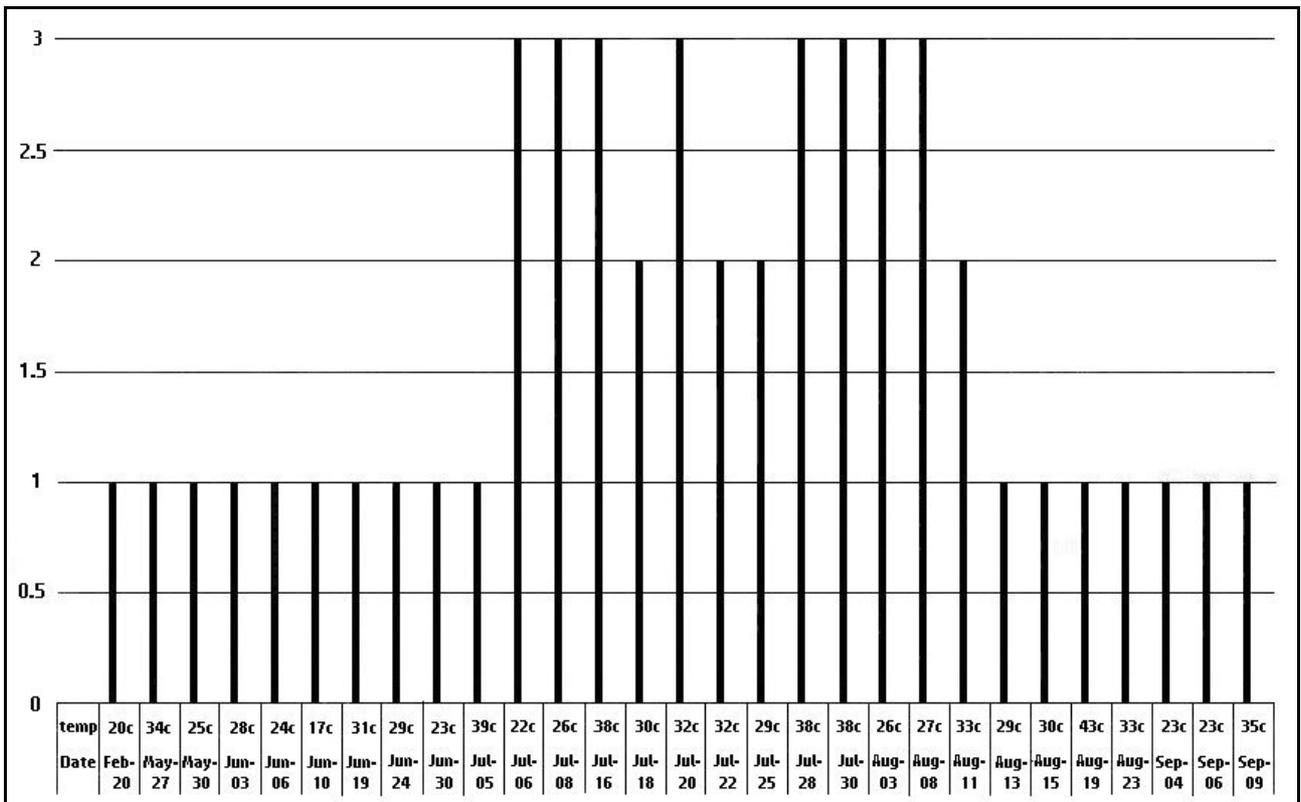


FIGURE 3. All 2019 Cappacash 1 tin occupation with cover temperatures in °C emphasising gravid female use during July and August 2019.



PLATE 1. Male slow worm (*Anguis fragilis*), with blue spots, the Burren, Ireland, 24 September 2019. Photograph © Nicholas Parry.



PLATE 2. Female slow worm (*Anguis fragilis*), the Burren, Ireland, 3 August 2018. The tin cover had just been removed. Photograph © Nicholas Parry.