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CONTENTS

Contributions should be addressed to Dr. A. d'A. Bellairs, St. Mary's Hospital Medical School, London, W.2. Articles should be typed in double spacing on *one side* of the paper only. Figures should be drawn in *Indian ink* on plain white paper, or preferably Bristol Board.

THE DISTRIBUTION OF AMPHIBIANS AND REPTILES IN ENGLAND AND WALES, SCOTLAND AND IRELAND AND THE CHANNEL ISLES: A REVISED SURVEY

By

R. H. R. Taylor

Introduction

A survey of the distribution of the British amphibians and reptiles has previously been published by the author (Taylor, 1948). The distribution maps for the various species used in that article have been reproduced by Smith in the two editions of his book (1951, 1954). Some of the original records on which these maps were based are over 50 years old, and it has become increasingly apparent that a revised survey is needed.

The new maps prepared for the present study are based on many additional records made since 1948. As before, the system of designating areas by vice-counties has been followed, but the county of London is regarded as a vice-county of its own. Different symbols are used to distinguish the areas referred to in the older records (before 1948) from those referred to in more recent ones. A list of the vice-counties shown in map 1 is given on page 100, and the symbols used on the other maps are explained on page 101.

It has unfortunately proved impossible to publish the full details of the records from which these new maps have been compiled. Some of the new records and data on distribution obtained since 1948 have appeared in published form; a selection of the more important and comprehensive studies is given in the bibliography (p. 99). For the majority of the new records, however, I am indebted to the kindness of individuals and the good offices of regional natural history societies who have personally communicated them to me; a list of these correspondents appears on page 99. Two typed manuscripts containing detailed particulars of the data on which this survey is based, including authorities and the localities to which they refer, have been prepared. One has been deposited in the archives of the Nature Conservancy, 19 Belgrave Square, London, S.W.1, and the other at the office of the Nature Conservancy in Scotland, 12 Hope Terrace, Edinburgh, 9. They can be seen on application to the appropriate authority. I also wish to thank the Royal Society for their grant which has enabled this paper to be published.

Notes on the various species have been added, summarising the distribution of each so far as it is known at the present time. There are still many areas on which information is scanty, and it is hoped that readers will help to remedy omissions and errors by sending in further observations to the author (address on page 100). Such contributions are of special interest since they make possible the accurate demarcation of areas in which species are now absent.

No maps have been prepared for the introduced forms.

NOTES ON THE SPECIES.

AMPHIBIA

1. *Hyla arborea* (Linn.). European or Green Tree-frog.

A colony of this frog was introduced into the Isle of Wight in 1906 and is still present. Another colony exists in Hampshire South.

2. *Hyla ewingii* Dum. & Bibr. Ewing's Frog.

This species was successfully introduced from Tasmania into West Cornwall in 1951.

3. *Bufo bufo* (Linn.). Common Toad. Map 2.

Although absent from Ireland, the Common Toad is otherwise widely distributed, ranging from the Channel Isles to the Orkneys. Ponds, canals and ditches where the water is deepish are selected for spawning. Hibernation takes place on land, often far from the breeding sites.

4. *Bufo calamita* Laurenti. Natterjack. Map 3.

The Natterjack is gregarious and mainly confined to the coastal areas of East Anglia, Lincolnshire, Liverpool Bay and Solway Firth. Its numbers have decreased, particularly in the Liverpool Bay area. It is also found at the head of Dingle Bay in County Kerry. Its distribution inland is now more or less restricted to the boundary between Surrey and Hampshire.

This toad is a burrower and is always found on sandy soil. During hibernation it often buries itself to a depth of about a foot. Unlike the common toad, it spawns in shallow water.

5. *Bufo viridis* Laurenti. European or Green Toad.

A number were introduced into the Isle of Wight in 1958.

6. *Alytes obstetricans* (Laurenti). Midwife Toad.

Colonies have been introduced into Bedfordshire in about 1900, into Yorkshire Mid West in 1933 and Yorkshire South West in 1947. All still exist.

7. *Rana temporaria* Linn. Common Frog. Map 4.

The Common Frog is the most widely distributed of our amphibians and there are few areas where it is not found. Recent reports show, however, that it is not as abundant in many districts as it used to be. The capture of frogs for laboratory work, and changes in methods of agriculture involving the filling in of many ponds are probably responsible. Shallow water in ponds and ditches is preferred for spawning. After the spawning season the frog spends most of its time on land.

8. *Rana esculenta* Linn. Edible Frog.

This frog was first introduced into East Anglia in the first half of the 19th century. The original colonies have now died out. A few colonies, also resulting from introductions, are still holding their own in southern England. This frog is very aquatic; the adults hibernate in the mud in or beside their ponds.

9. *Rana ridibunda* Pallas. Marsh Frog.

This frog was introduced at Stone in Oxney (East Kent) and has established itself most successfully. It is now distributed over a large area, including the Romney, Welland and Denge Marshes and the Rother and Pett Levels. It appears to have ousted the Common Frog from these areas.

10. *Rana dalmatina* Bonaparte. Agile Frog.

This frog is a native of Jersey where it was previously mistaken for the Common Frog. It is not found further north.

11. *Triturus vulgaris* (Linn.). Smooth Newt. Map 5.

This newt is very widely distributed and is the only newt found in Ireland. It does not usually occur in mountainous country, and for this reason is rare or absent in West Wales and West and North Scotland. It is also absent in Cornwall. It is the least aquatic of the three British newts. The winter is spent near the pond; hibernation in the water is rare.

12. *Triturus cristatus* (Laurenti). Great Crested or Warty Newt. Map 6.

This newt is widely but locally distributed over England and East Scotland. It is rare or absent in Cornwall, in the area around the Wash, in West Wales and West and North Scotland. It is absent in Ireland and the Channel Isles. It is the most aquatic of the three British newts and prefers reasonably deep ponds. It appears to like clay and chalk rather than a sandy soil. It usually hibernates on land.

13. *Triturus helveticus* (Razoumowski). Palmate Newt. Map 7.

This newt is a montane species and it is in hilly country that it is most frequently found. With the exception of a few localities it is absent in the East of England from the Thames to Mid Yorkshire and throughout the Midlands. Its reported presence in East Norfolk and Suffolk is still awaiting confirmation as it may have been confused with the Smooth Newt. The colony in the north of Northamptonshire was introduced about 1953. It is not present in Ireland. Any size of pond appears to suit it, and in coastal areas it has been found in brackish water.

REPTILIA

1-5. Marine turtles. Map 8.

Records of species stranded on our shores or captured at sea in home waters include: *Eretmochelys imbricata* (Linn.), Hawksbill; *Caretta caretta* (Linn.), Atlantic Loggerhead; *Lepidochelys kempi* (Garman), Kemp's Loggerhead or Atlantic Ridley; *Chelonia mydas* (Linn.), Green Turtle; *Dermochelys coriacea* (Linn.), Leathery Turtle.

6-9. Terrapins.

The following terrapins have been introduced at several places during the last 70 years: *Emys orbicularis* (Linn.), European Pond-terrapin; *Chrysemys picta* (Schneider), Painted Terrapin; *Chelydra serpentina* (Linn.), Snapper. *Emys orbicularis* is still to be found in the Isle of Wight and Surrey.

10. *Anguis fragilis* Linn. Slow-worm. Map 9.

The Slow-worm is widely distributed in England, Wales, Scotland and the Channel Isles. It likes dry country, but otherwise is not particular as to its habitat.

The Blue-spotted Slow-worm (var. *colchica*) appears to have a greater range than was previously thought. The most northerly record is from South Aberdeenshire.

11. *Lacerta vivipara* Jacquin. Common or Viviparous Lizard. Map 10.

The Viviparous Lizard is widely distributed and there are few areas in England, Wales, Scotland and Ireland from which it has not been recorded. It is to be found in all types of country from mountainous districts to coastal sand dunes.

12. *Lacerta agilis* Linn. Sand Lizard. Map 11.

The Sand Lizard used to inhabit the coastal sand dunes from Devon to Sussex, and also those of East Anglia, Lincolnshire, Northumberland, Lancashire, Cheshire and North Wales. Owing to urbanisation the areas where it can now be found are greatly reduced. It also occurs in decreasing numbers on the sandy heathlands of Hampshire and Surrey. There is considerable doubt as to whether it exists on the Isle of Man. The record for Cornwall West is for a single specimen in 1949; none has been seen there since. This lizard is a burrower, but also uses the abandoned workings of voles and field mice.

13. *Lacerta muralis* (Laurenti). Wall Lizard.

The Wall Lizard is native to Jersey. Colonies have been successfully introduced into South Devon, the Isle of Wight and Surrey.

14. *Lacerta viridis* (Laurenti). Green Lizard.

The Green Lizard is native to Jersey and Guernsey. Its introduction into Southern England and Wales has not been very successful and it is doubtful if any now exist.

15. *Coronella austriaca* Laurenti. Smooth Snake. Map 12.

The Smooth Snake inhabits heathlands and wooded areas where the soil is sandy. It is said to be fond of water. Its distribution in England is very limited and it is now confined to Dorset, Hampshire, Surrey and the Isle of Wight.

16. *Natrix natrix* (Linn.). Grass or Ringed Snake. Map 13.

This snake is widely distributed over England and Wales. Its northern limit now appears to be Westmoreland and South Northumberland. It is very doubtful whether specimens in a wild state are to be found in Scotland. Records from Scotland have either been labelled by observers as 'escapes' or have turned out to be based on wrong identification.

The Grass Snake lives principally in open woodlands, hedgerows and marsh land. It prefers districts near water, but is also found on heaths and chalk downs. Eggs are usually deposited in places where warmth is generated, such as manure and compost heaps, and hay-ricks.

17. *Vipera berus* (Linn.). Adder or Viper. Map 14.

The adder is widely distributed over England, Wales and Scotland. In recent years, however, it has become rare in Central England owing to urbanisation and land clearance. Except in a few areas, where it is rare, the Adder is now absent over a wide belt running north from Hertfordshire to North Lancashire.

It is found in both marshy and dry localities. Open moorlands, heaths, woodlands and hillsides that catch the sun are often chosen. Its distribution is often very local, but in those places where it occurs it is frequently abundant.

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PERSONAL COMMUNICATIONS

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Ackworth School Nat. Hist. Soc., Adams, B. A., Adams, S. N., Adler, K. K., Allen, D. E., Ambleside Field Soc., Annand, J. K., Annfield Plain & Stanley Nat. Club, Armagh Field Nats. Soc., Baal, H. J., Bacup Nat. Hist. Soc., Baker, J. P., Ballard, J. O., Bardsey Bird & Field Observatory, Barnsley Nat. & Sci. Soc., Battersby, J. C., Beebee, T., Bishops Stortford Coll. Nat. Hist. Soc., Blackwell, K., Bloxham, N., Botanical Soc. of the Brit. Isles, Boyce, F., Boyce, G., Brewis, A., Bristol Nats. Soc., Brit Nat Assoc. (Northumberland & Durham Branch), Brit. Nat. Assoc. (Torridge & Dist. Branch), Brown, E. R., Bryanston School Nat. Hist. Soc., Bull, P., Burden, G. S., Burke, N., Burton-on-Trent Nat. Hist. & Arch. Soc., Bustard, H. R., Buteshire Nat. Hist. Soc., Butler, R. H., Buxton, E. M., Callan, H. G., Canford School Nat. Hist. Soc., Carlisle Nat. Hist. Soc., Carter, H., Carter, M., Christian, G., Clarke, A. S., Cleveland Nats. Field Club, Clifford, P. J., Cohen, E., Cooper, J. E., Corby Young Nats. Club, Coventry & Dist. Nat. Hist. & Sci. Soc., Cowcill, L. A., Crosshills Nats. Soc., Dale Fort Field Centre, Davis, T. A. W., Denham, D., Dennis, R. A., Derby Nat. Hist. Soc., Donaldson, L. L., Dumfriesshire & Galloway Nat. Hist. & Antiq. Soc., Eastwood, D. T., Eden Field Club, Edinburgh Nat. Hist. Soc., Essex Field Club, Faris, R. C., Fitter, R. S. R., Fletcher, F., Flower, W. U., Floyd, C. M., Frazer, J. F. D., Freeman, D., Freshwater Fisheries Laboratory (Pitlochry), Frost, R., Giffard, W. H., Gilbert, J. L., Green, M., Green, V. A., Gush, G. H., Hadden. N. G., Hancock Museum (Newcastle-upon-Tyne), Harper, G. H., Harrogate & Dist. Nat. Soc., Haslemere Nat. Hist. Soc., Hayward, A. F., Hayward, R. F., Hazelwood, E., Heath, A. W., Hewitt, D. R., Hogan, B., Hook, O., Hopkins. P. W., Hull Sci. & Field Nats. Club, Hunter, W. R., Hurrell, H. G., Isle of Man Nat. Hist. & Antiq. Soc., Jackson, J. S., Jones, I., Kaulback, R., Kendal Nat. Hist. Soc., Kilmarnock Glenfield Ramblers, Kimbolton School Nat. Hist. Soc., King Edward VI Grammar School, Birmingham Nat. Hist. Soc., Lambert, D. G., Lambert, M. R. K., Larking, L. M., Latuskie, J. F.,

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LIST OF VICE-COUNTIES

ENGLAND AND WALES

Peninsula

1 West Cornwall with Scilly
2 East Cornwall
3 South Devon
4 North Devon with Lundy
5 South Somerset
6 North Somerset

Channel

7 North Wilts
8 South Wilts
9 Dorset
10 Isle of Wight
11 Hants, South
12 Hants, North
13 West Sussex
14 East Sussex

Thames

15 East Kent
16 West Kent
17 Surrey
18 South Essex
19 North Essex
20 Herts
21 Middlesex
22 Berks
23 Oxford
24 Bucks

Anglia

25 East Suffolk
26 West Suffolk
27 East Norfolk
28 West Norfolk
29 Cambridge
30 Bedford and detached part of Hunts
31 Hunts
32 Northampton

Severn

33 East Gloucester
34 West Gloucester
35 Monmouth
36 Hereford
37 Worcester
38 Warwick
39 Stafford and Dudley
40 Shropshire

South Wales

41 Glamorgan
42 Brecon
43 Radnor
44 Carmarthen
45 Pembroke
46 Cardigan

North Wales

47 Montgomery
48 Merioneth
49 Caernarvon
50 Denbigh and parts of Flint and Caernarvon
51 Flint
52 Anglesey

Trent

53 South Lincoln
54 North Lincoln
55 Leicester with Rutland
56 Nottingham
57 Derby

Mersey

58 Cheshire
59 South Lancashire
60 Mid Lancashire

Humber

61 South-east York
62 North-East York
63 South-west York
64 Mid-west York
65 North-west York

Tyne

66 Durham
67 Northumberland, South
68 Cheviotland, or Northumberland, North

Lakes

69 Westmoreland with North Lancashire
70 Cumberland
71 Isle of Man

SCOTLAND

W. Lowlands

72 Dumfries
73 Kirkcudbright
74 Wigtown
75 Ayr
76 Renfrew
77 Lanark

E. Lowlands

78 Peebles
79 Selkirk
80 Roxburgh
81 Berwick
82 East Lothian
83 Midlothian
84 West Lothian

E. Highlands

85 Fife with Kinross
86 Stirling
87 South Perth with Clackmannan and parts of Stirling
88 Mid Perth
89 North Perth
90 Angus or Forfar
91 Kincardine
92 South Aberdeen
93 North Aberdeen
94 Banff
95 Moray or Elgin
96 Easterness (East Inverness with Nairn)

W. Highlands

97 Westerness (West Inverness with North Argyll)
98 Argyll (Main)
99 Dunbarton
100 Clyde Isles
101 Kintyre
102 South Ebudes (Islay etc.) and Scarba
103 Mid Ebudes (Mull etc.)
104 North Ebudes (Skye etc.)

N. Highlands

105 West Ross
106 East Ross
107 East Sutherland
108 West Sutherland
109 Caithness

North Isles

110 Outer Hebrides
111 Orkney
112 Shetland

IRELAND

113 South Kerry
114 North Kerry
115 West Cork
116 Mid Cork
117 East Cork
118 Waterford
119 South Tipperary
120 Limerick
121 Clare with Aran Isles
122 North Tipperary
123 Kilkenny
124 Wexford
125 Carlow
126 Leix
127 South-east Galway
128 West Galway
129 North-east Galway
130 Offaly
131 Kildare
132 Wicklow
133 Dublin
134 Meath
135 Westmeath
136 Longford
137 Roscommon
138 East Mayo
139 West Mayo
140 Sligo
141 Leitrim
142 Cavan
143 Louth
144 Monaghan
145 Fermanagh
146 East Donegal
147 West Donegal
148 Tyrone
149 Armagh
150 Down
151 Antrim
152 Derry

Symbols used on maps

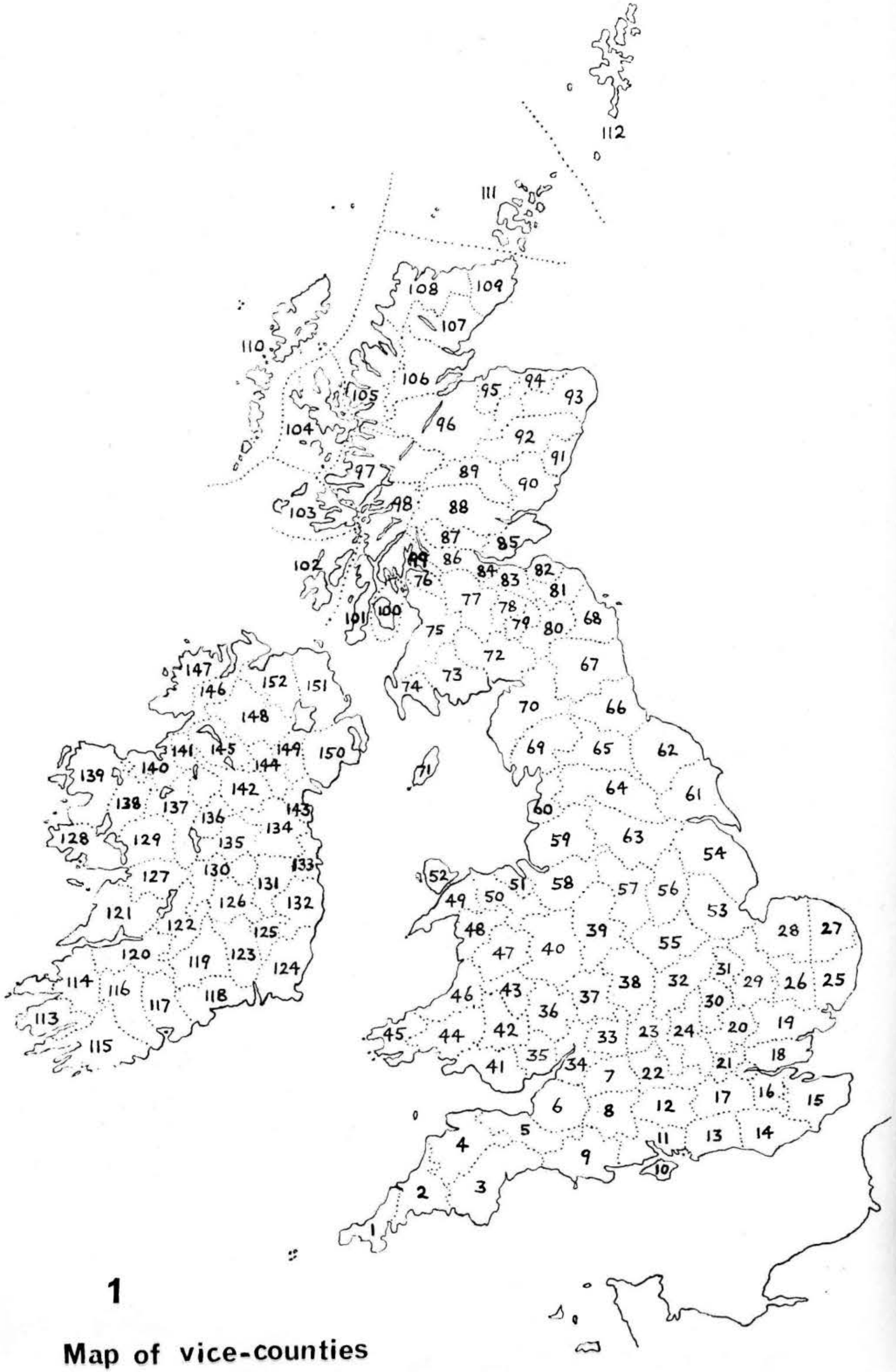
-|- **Stated to be present in records prior to 1948. No locality given.**

× **A definite locality where species was found prior to 1948.**

O **Stated to be present in records since 1947. No locality given.**

• **A definite locality where the species has been found since 1947.**

? **Doubtful record.**

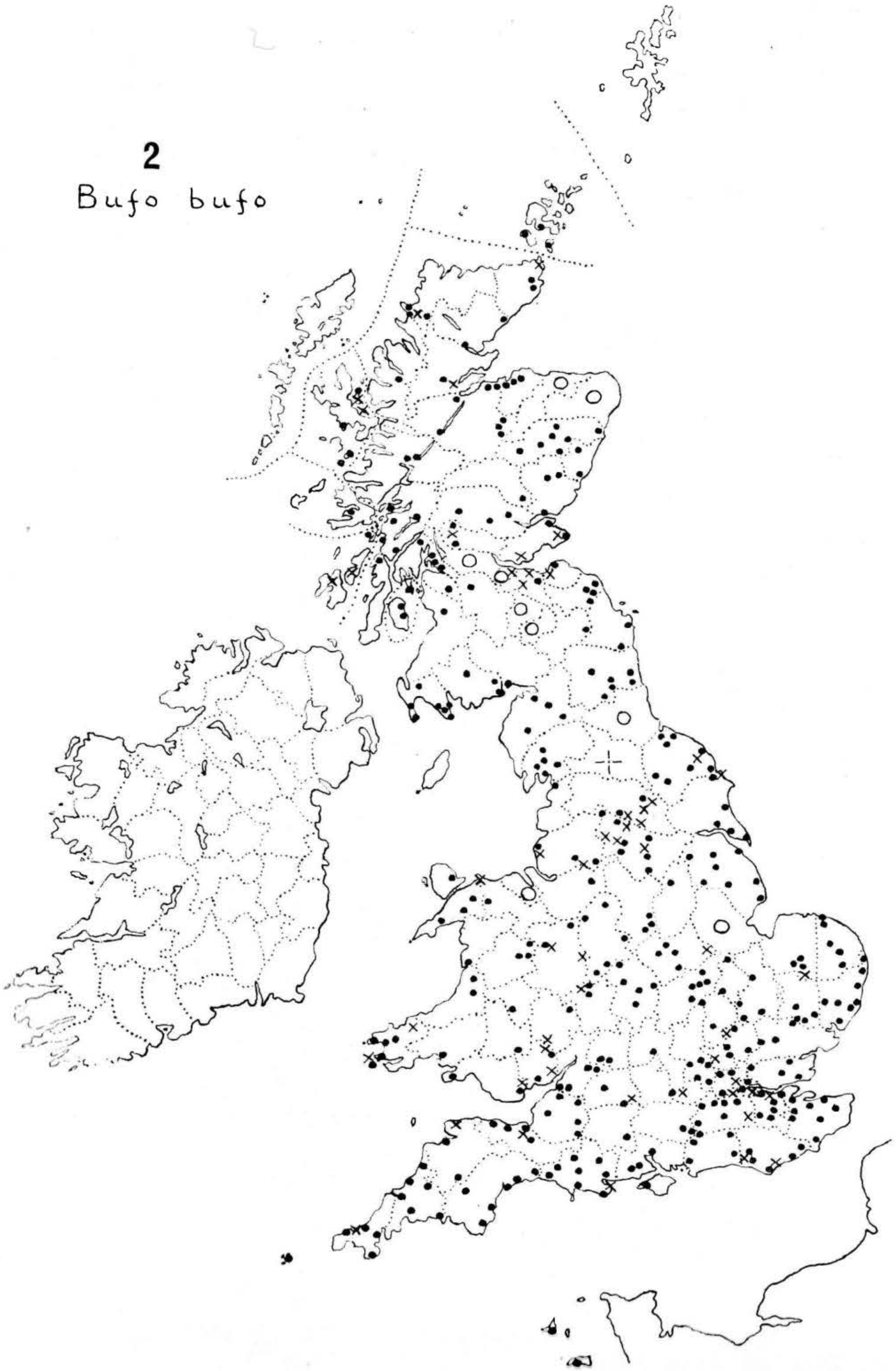


1

Map of vice-counties

2

Bufo bufo

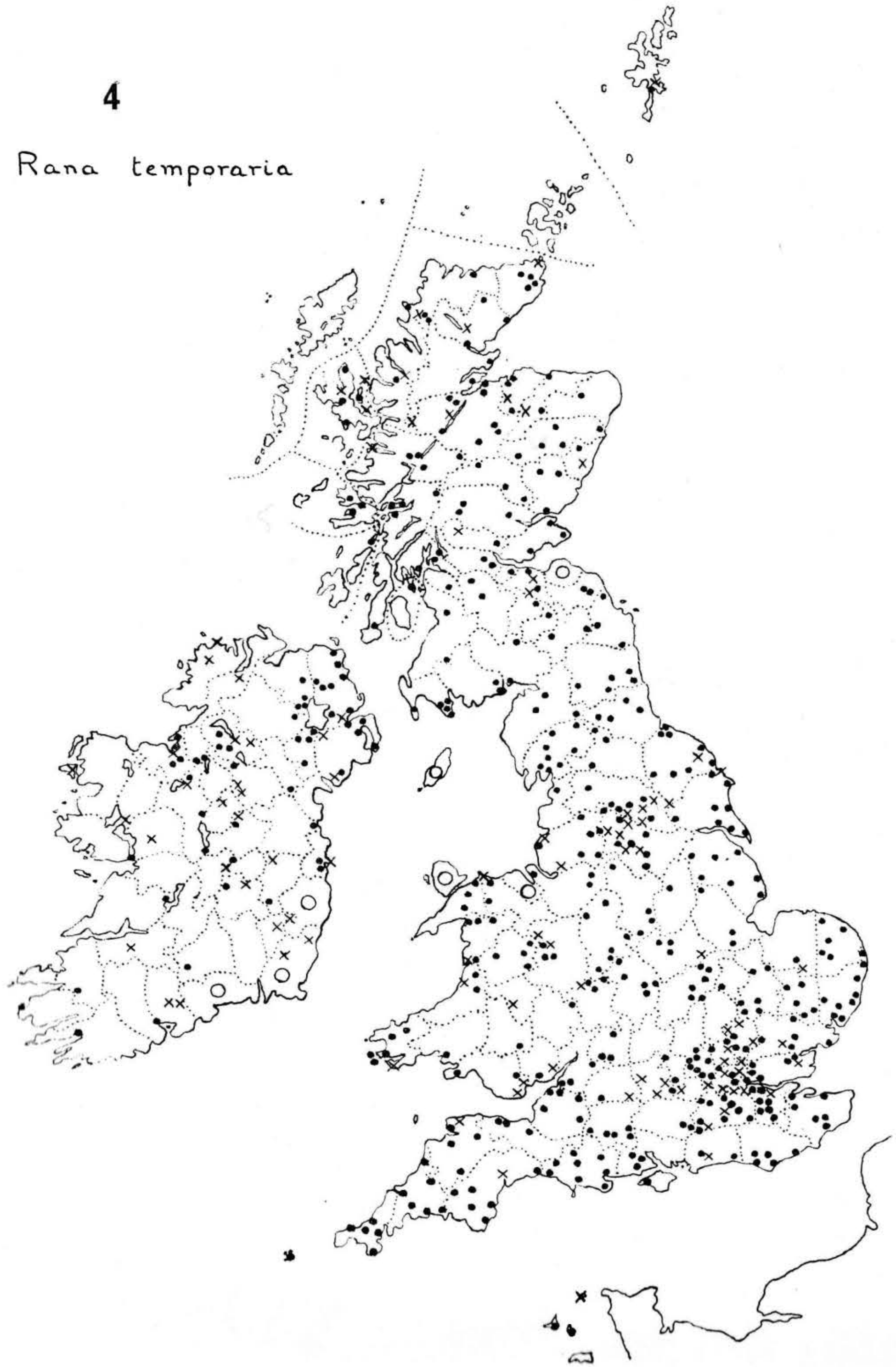


3

Bufo calamita

4

Rana temporaria



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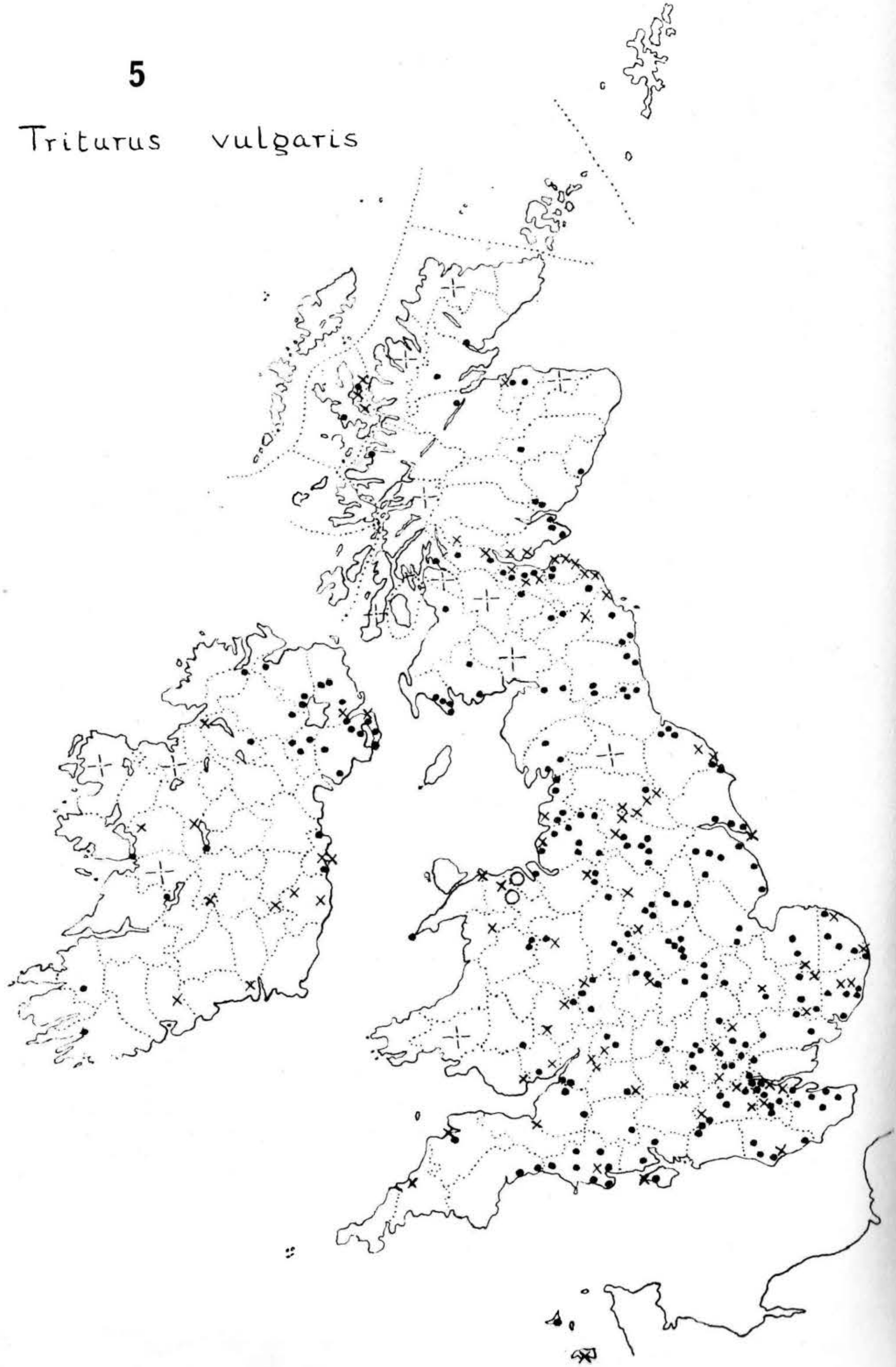
Triturus vulgaris



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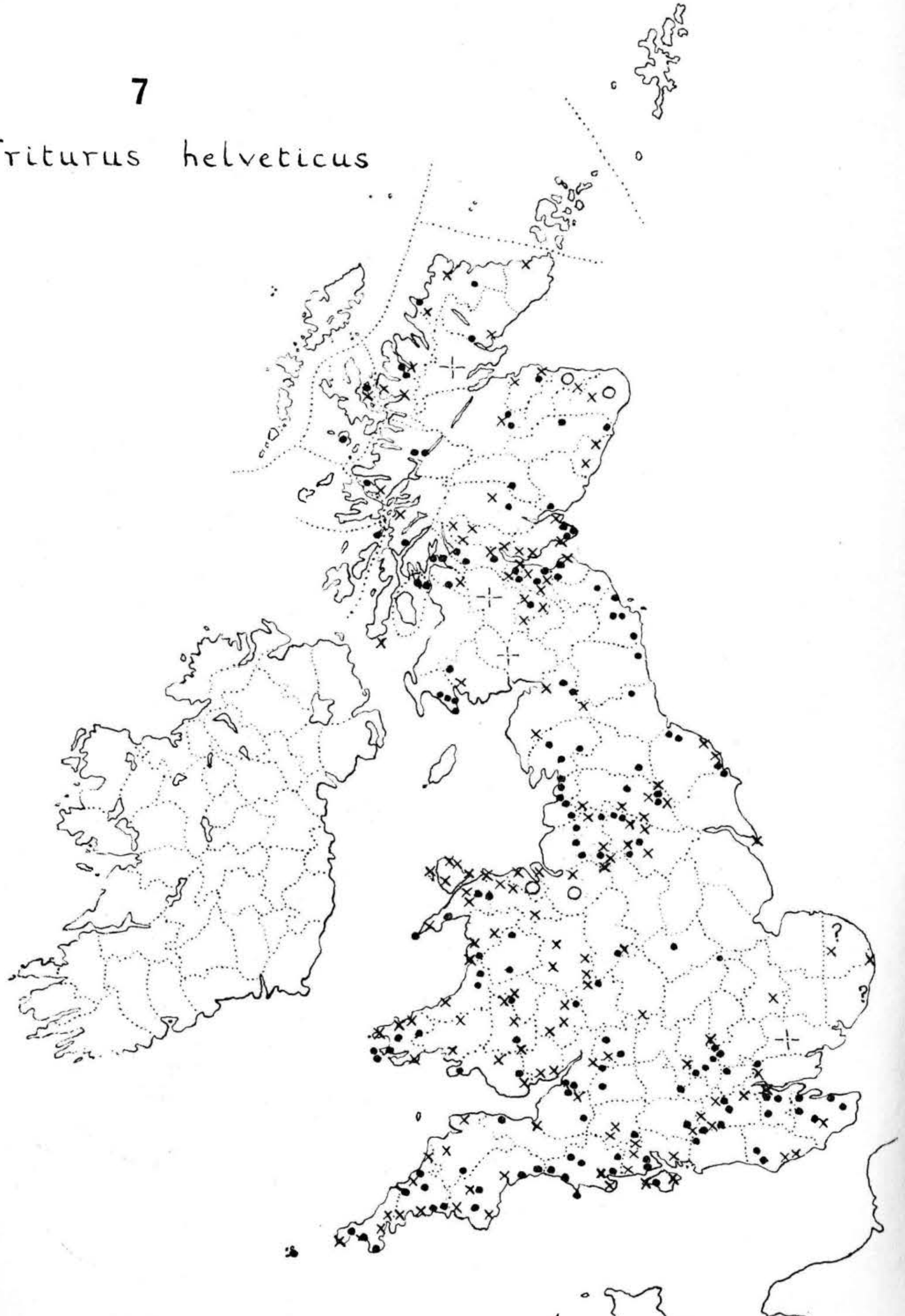
Triturus cristatus

7

Triturus helveticus



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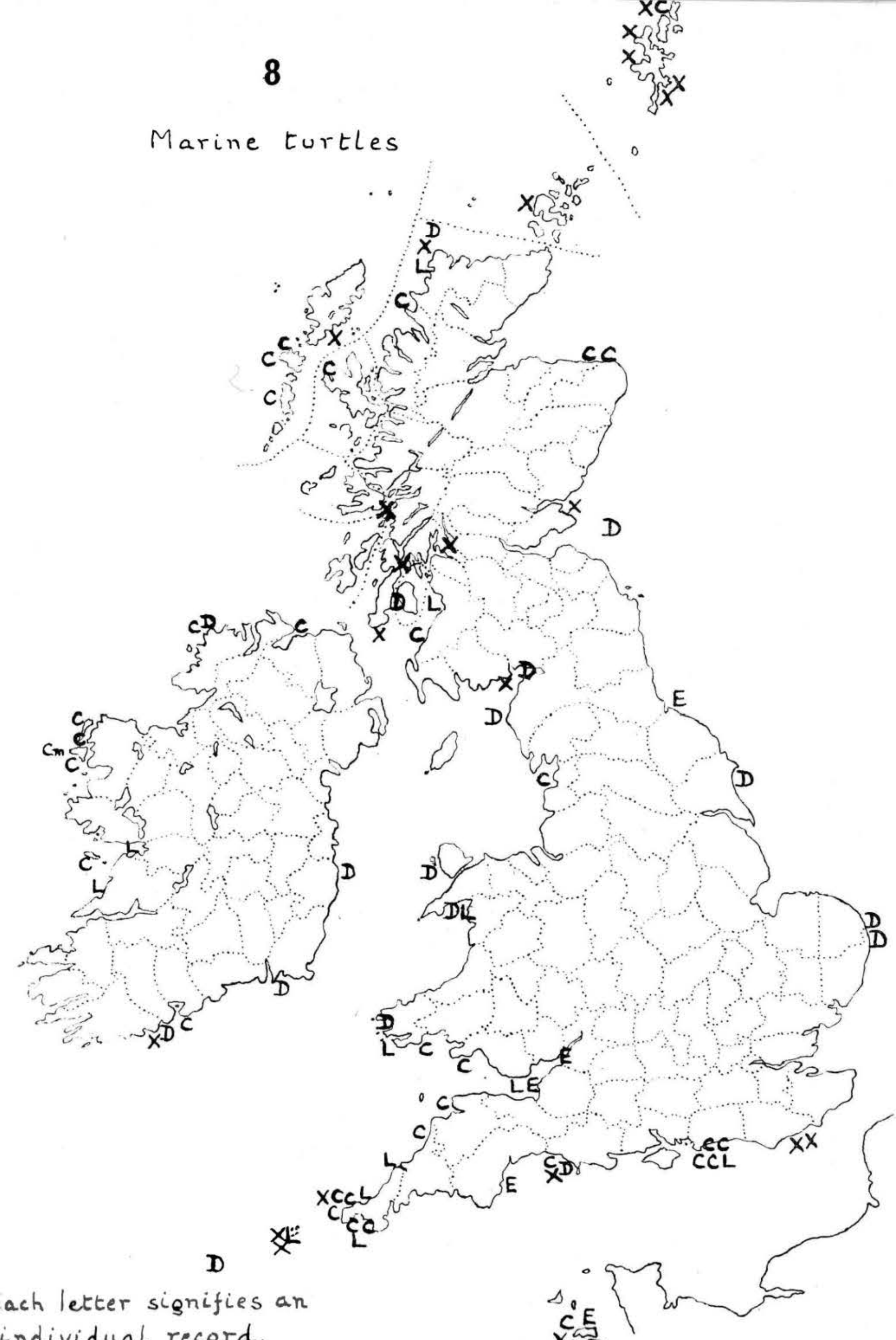
Marine turtles



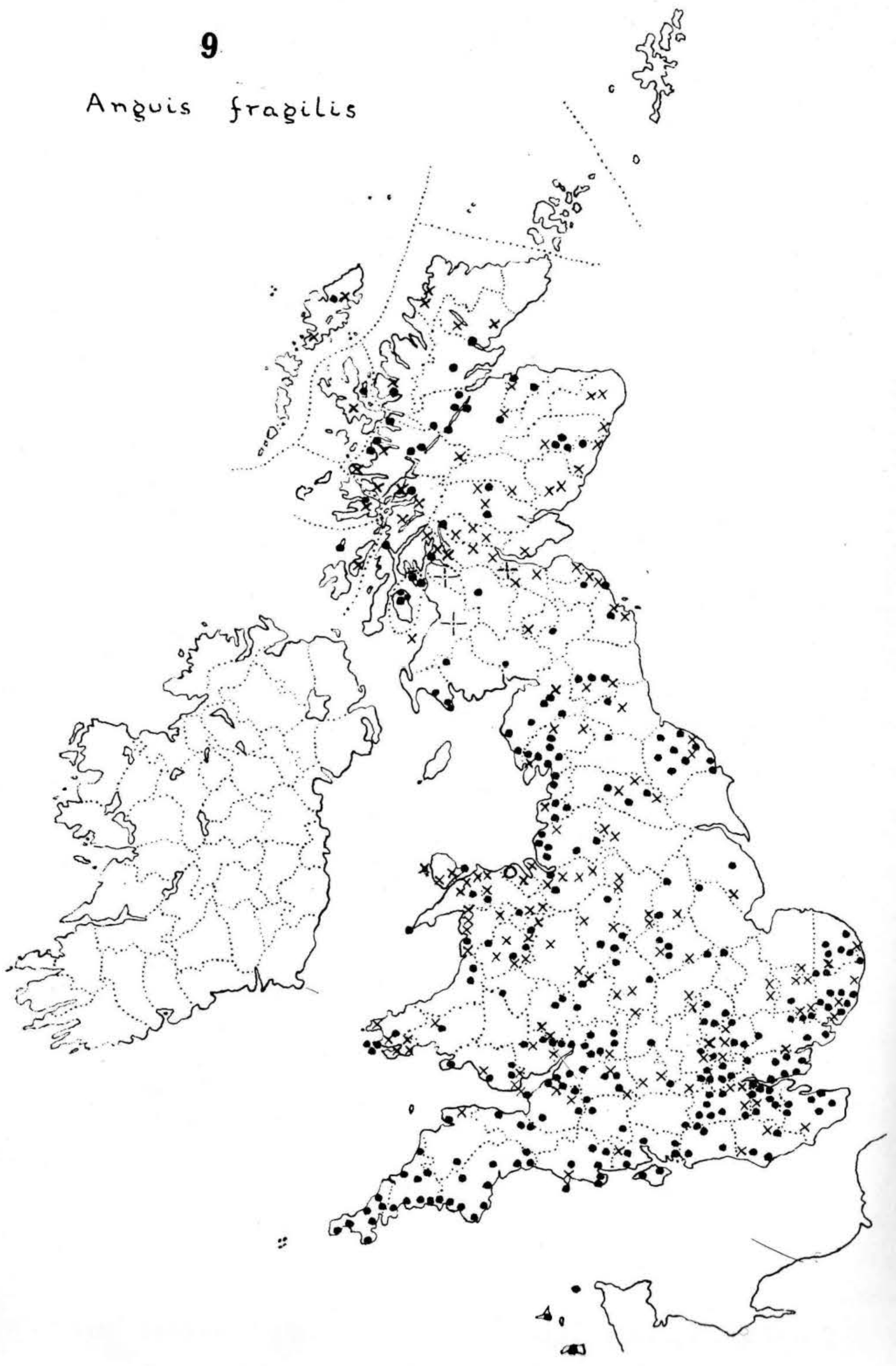
Each letter signifies an individual record.

E Eretmochelys imbricata. D Dermochelys coriacea.

C Caretta caretta. Cm Chelonia mydas.

9

Anguis fragilis



10

Lacerta vivipara

11

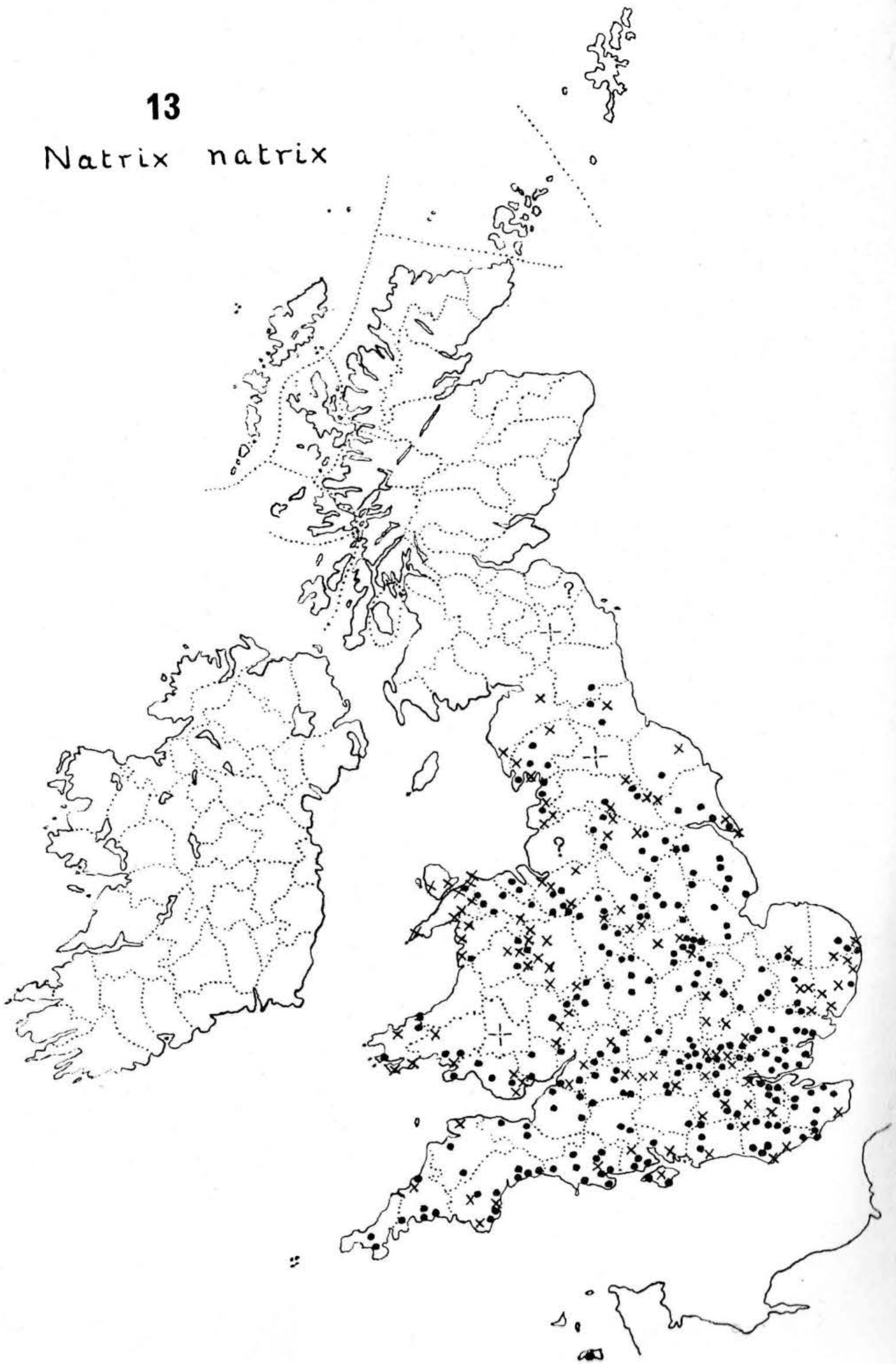
Lacerta agilis

12

Coronella austriaca

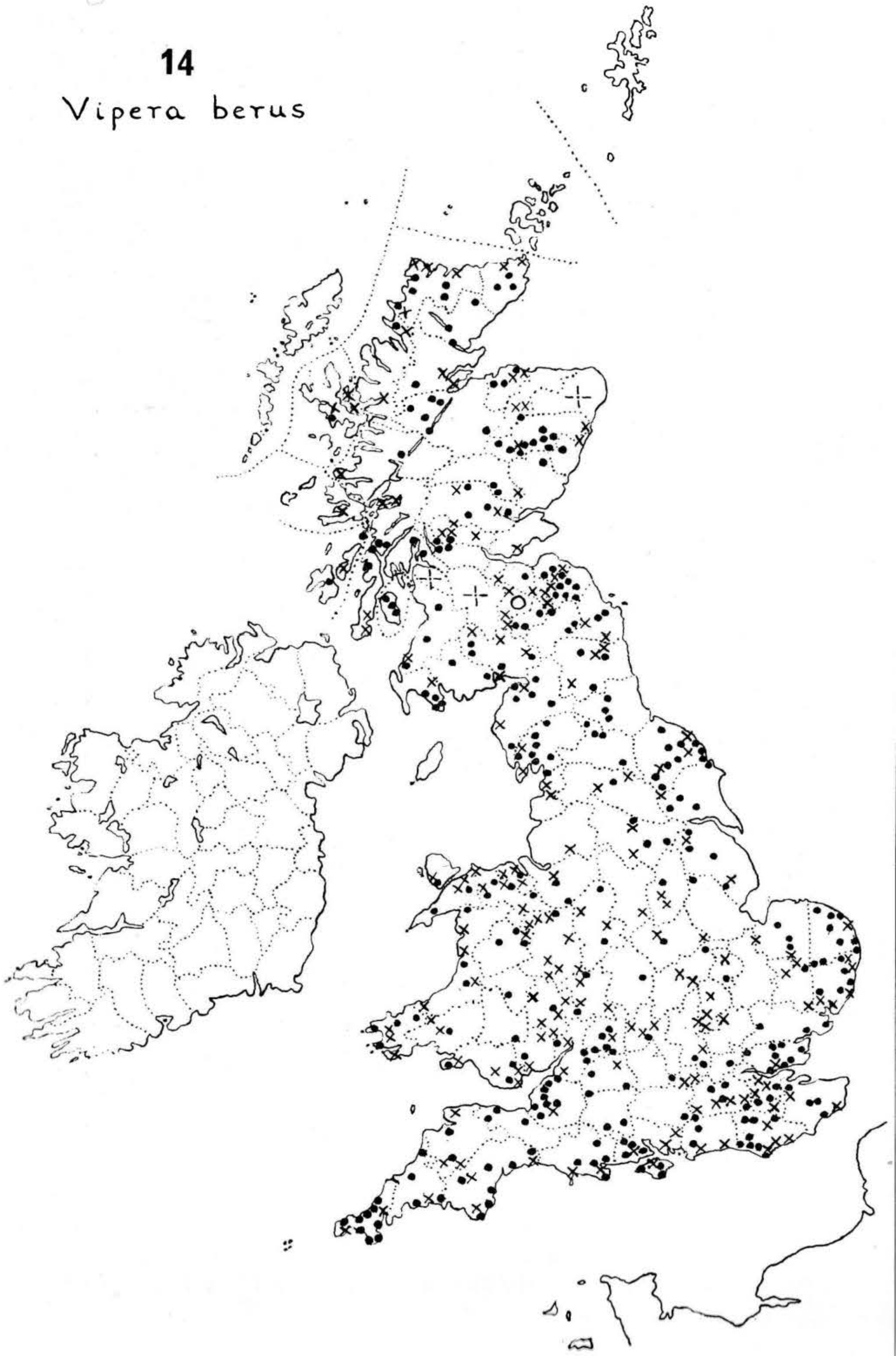
13

Natrix natrix



14

Vipera berus



HOMING BEHAVIOUR IN *RANA TEMPORARIA* LINN.

By

R. S. Oldham

Introduction.

The life of an adult frog of the species *Rana temporaria* may be divided into three phases, repeated annually, during each of which it displays a distinct behaviour pattern. In spring numbers of individuals congregate in pools where they breed. Following the breeding season, which lasts one or two weeks (Savage 1934), the population disperses and the principal activity of the summer is concerned with feeding. During autumn the frogs enter hibernation and remain in this state throughout the winter. The habitat varies from phase to phase and also varies within each phase, but in general frogs breed in water, spend the summer foraging in moist habitats on land and, as Savage (1961) has stated, hibernate either on land or under water.

Similar phases exist in the lives of other species of amphibia and during each phase there have been reports of individuals which demonstrate homing behaviour in relation to the appropriate habitat. Homing behaviour is a manifestation of fidelity to an area and refers to the ability of an individual to return to a given area once it has moved, or has been moved, from it. It is important to distinguish between homing behaviour in each of the different phases of annual activity since the physiological condition of the animal is different in each phase. In other words both the state of the animal and the nature of its habitat vary from phase to phase, so that the mechanisms involved in homing are also likely to vary.

An amphibian shows homing behaviour to a breeding site if it returns to the same site in successive years. Eibl-Eibesfeldt (1950) states that this is the case for *Bufo bufo* and Jameson (1956) provides evidence from species of *Scaphiopus, Pseudacris* and *Microhyla*. Homing behaviour is also demonstrated by animals which return to the breeding site after being artificially displaced from it (Cummings 1912, and Twitty 1959 for urodeles; Boulenger, 1912, Breder, Breder and Redmond, 1927, Nichols 1939 unpublished, Heusser 1958, Archer 1959 and Bogert 1960 for various bufonids).

As applied to the summer foraging area the term homing behaviour is somewhat nebulous, since the area and the time available for movement during summer is greater than in spring or winter. There is evidence, however, of restriction of an individual's activity to a part of the area which is potentially available to it (Martof 1953, Ryan 1953, Carpenter 1954, Pearson 1955, Brattstrom and Warren 1955, Bellis 1957, Pyburn 1958). In cases where the area of summer activity does not embrace the breeding site, individuals may home to the same foraging area each year after breeding (Martof op. cit., Pearson op. cit.). In this case homing will be more or less marked according to the distance of the summer range from the breeding site. If we consider artificial transfers of individuals to a point outside the

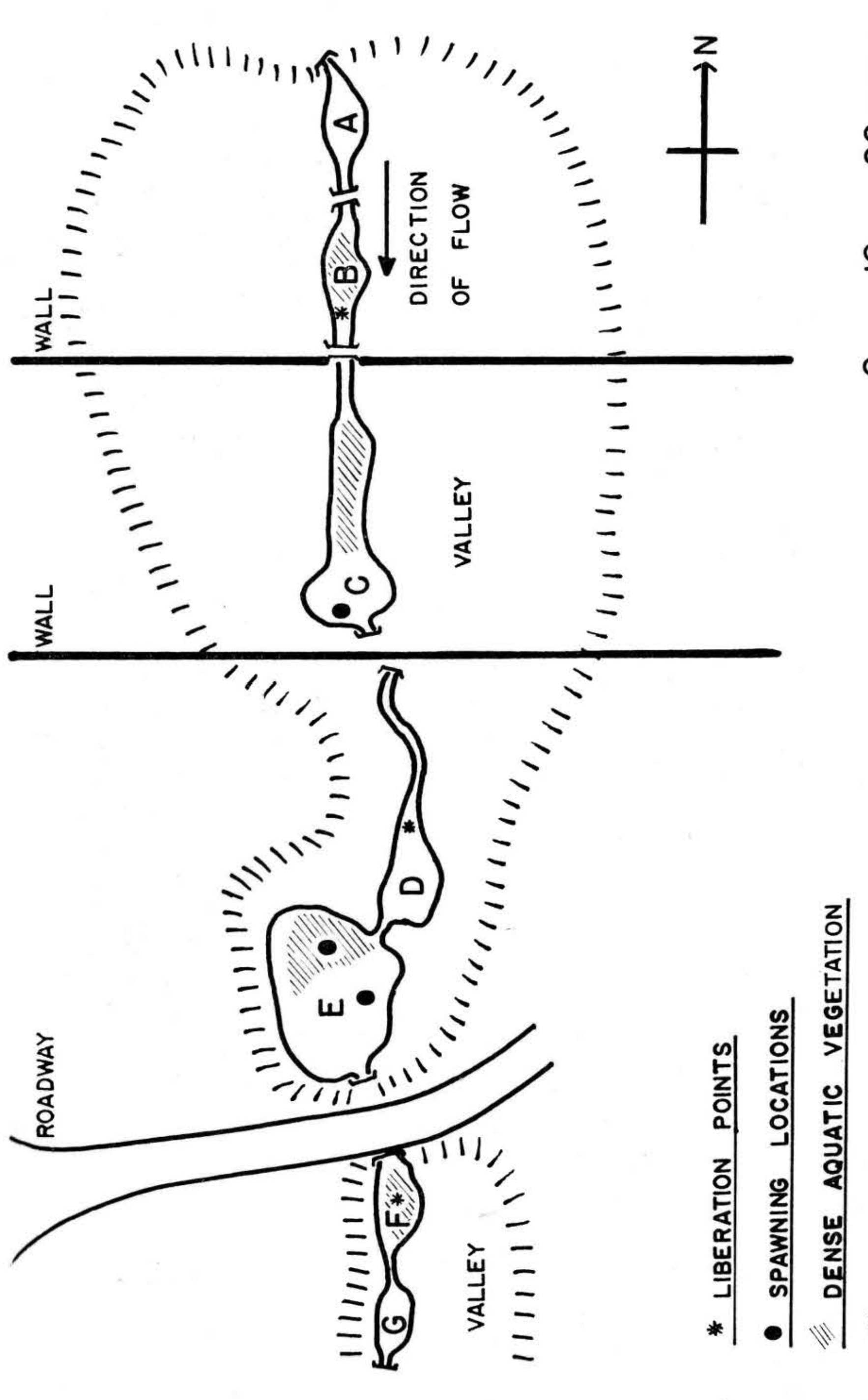


FIG. I. DIAGRAM OF THE STUDY AREA

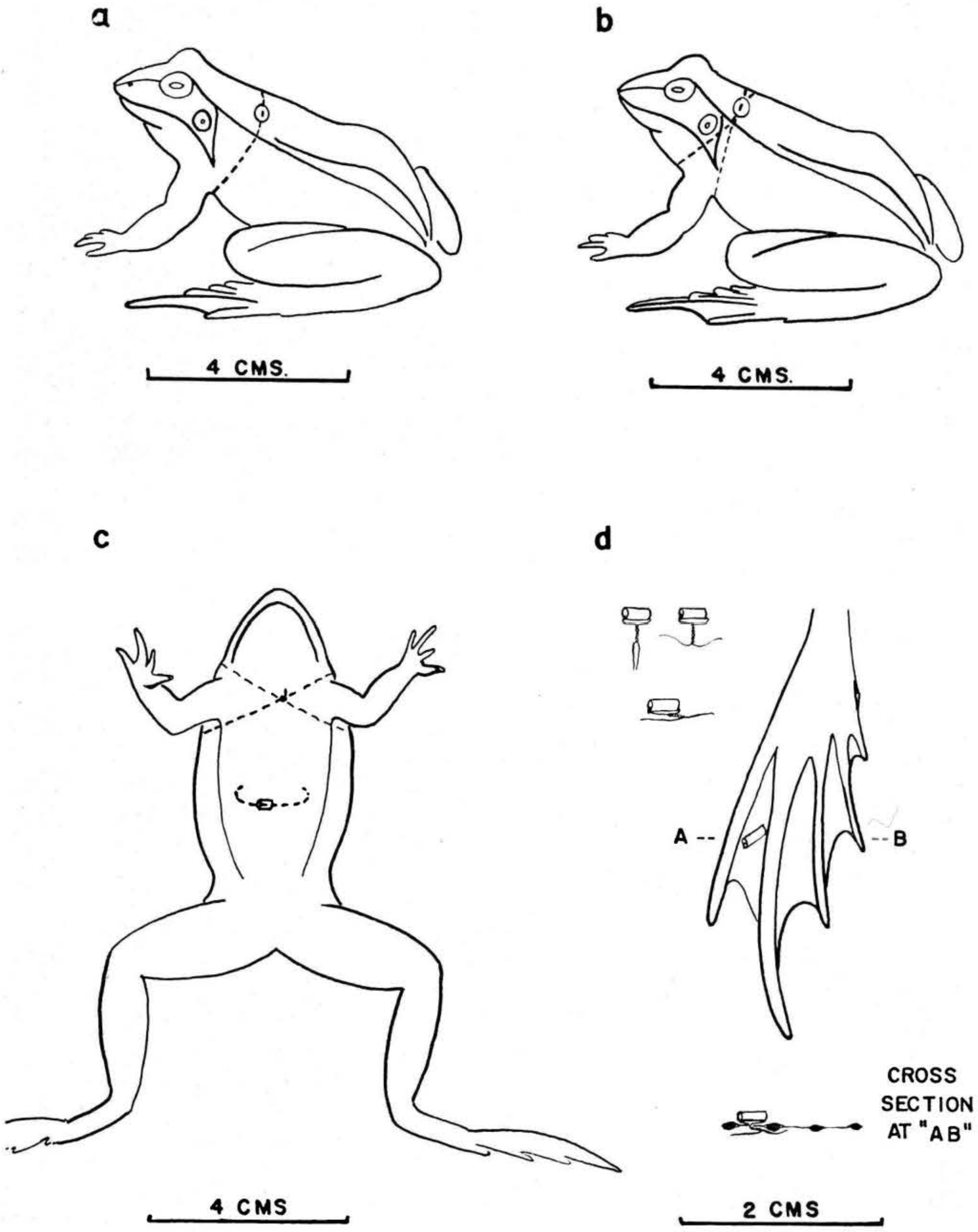


FIG. 2. EXAMPLES OF TAGGING METHODS

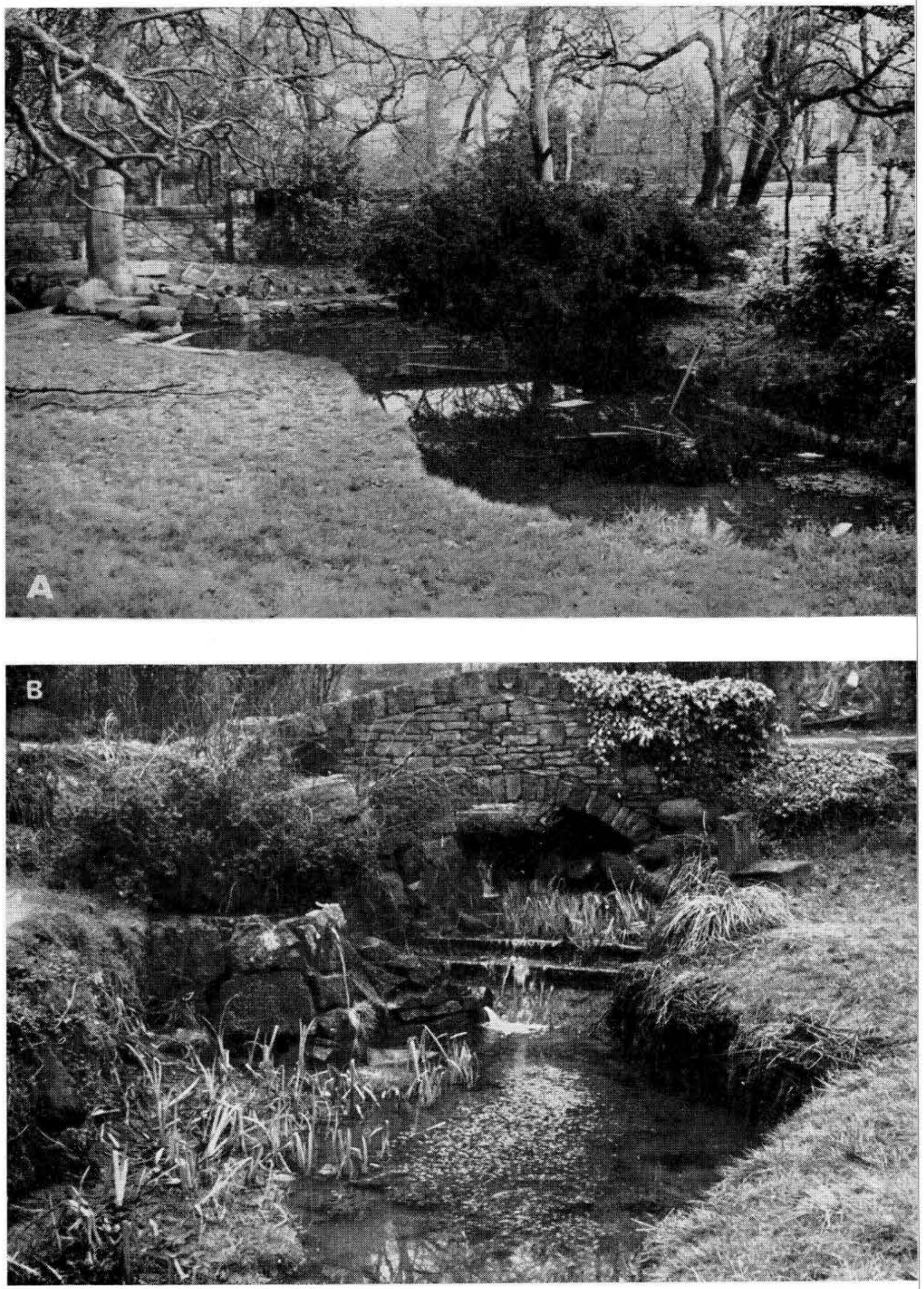


PLATE 1. Oldham.
A. Pool 'C' looking south.
B. Pool 'B' looking north.

summer range, difficulties arise because the summer range cannot clearly be defined by methods presently available. The work of Bogert (1947) suggests, however, that *Bufo terrestris* may be able to home to its summer range from an area which is unfamiliar to it.

In several cases it seems that within the overall area of summer movement there are certain preferred spots. Homing may be demonstrated in relation to these spots and has been reported by several workers (McAtee 1921, Storer 1925, Breder, Breder and Redmond 1927, Noble 1931, Raney 1940, Ingram and Raney 1943, Jordan 1954, Smith 1954, Chapman and Chapman 1958).

Movements in relation to hibernating sites have rarely been studied. Juszczyk (1951) reports instances of *Rana esculenta* returning to the same stream for hibernation year after year and Martof's (1953) work suggests that *Rana clamitans* may do likewise.

The object of the work reported below was to determine whether *Rana temporaria* demonstrates homing behaviour during one of the three phases of activity, that of breeding. Translocation experiments provide one of the simplest methods of investigation and may give insight into the mechanisms normally used by the frog in locating its breeding site.

The Study Area.

The study area in Sheffield, Yorkshire, consisted of a string of seven pools connected by a stream, situated within private grounds (fig. 1). The stream appeared from underground at the northern end of the area and disappeared about 120 yards away at the southern end. The pools all had artificial stone sides but were many years old, and most of them supported communities of aquatic plants and animals. Pools 'A' and 'G' were devoid of vertebrate life. Pool 'D' was about six feet deep and apparently devoid of plants other than algae. No frogs were ever caught in it. Pools 'B' (pl. 1B) and 'F' both contained abundant plant growth. Occasionally frogs were found in these pools but never any spawn. Frogs spawned only in Pools 'C' and 'E'. Pool 'C' (pl. 1A) was approximately 40 square yards with an average water depth of six to eight inches. It had a substrate of mud and leaves. Frogs aggregated at its southern end where they croaked and spawned. Unless actually buried in the mud frogs were readily visible in this region, plant cover being present only in the northern limb of the pool. Pool 'E' was approximately 100 square yards in area, depths varying from six inches at the northern end to four or five feet at the southern end. The substrate was composed of stone and mud with a heavy growth of plants at the northern end. At the time of the first observation, frogs aggregated, croaked and spawned on the easterly side of the pool in water which was approximately 20 inches deep. Their activity was different from that of the frogs in pool 'C'. The latter characteristically croaked and mated with their heads at the surface of the water. Those in pool 'E' apparently carried on all activity at the bottom of the pool and only on occasion would an individual rise to the surface. As a result of this behaviour the pool 'E' community was discovered two days later than the pool 'C' community. Subsequently a second distinct, spawning community became established amongst the aquatic plants at the northern end of pool 'E'. Its behaviour was similar to that of the pool 'C' community. Between pools 'B' and 'C' and between pools 'C' and 'D' there were long solid stone walls some four feet high (pl. 1A), and passing over the stream connecting pool 'E' and 'F' was a road on an embankment which left pool 'F' in a pronounced hollow of over six feet deep.

PROCEDURE.

In order to trace the movements of individual frogs a method of marking or tagging was required. Various methods were tested :

(i) Banding as used for birds. Wire bands remained in position only when tightened to such an extent that they impeded blood circulation.

(ii) Simple harness in the form of a ring of cord tied around the body immediately behind the front legs (fig. 2a). Frogs readily disengaged themselves.

(iii) Double harness consisting of two loops of nylon or cotton cord, one behind and one in front of the fore-limbs, united by knots at the back and belly (figs. 2b and 2c). Theoretically this seemed an ideal method, but in practice, with only one operator, was very difficult to employ. The knots needed to be secured precisely for if the harness was too tight it impeded the animals' progress and if too slack it was readily discarded. Similar disadvantages were found with the method described by Breder, Breder and Redmond (1927), in which a loop was fixed around the frog's waist immediately in front of the hind legs.

(iv) Fine nylon cord threaded through the skin of the frog's belly and passing through the subcutaneous space (fig. 2c). Once fixed the cord was apt either to damage the skin or to foul on objects in the water. The time involved during fixation was prohibitive.

(v) Web tags. Several types were tried. The one that proved to be most practical (fig. 2d) as regards preparation, fixation and tenacity, consisted of one or more small plastic beads of various colours, threaded on to a piece of 5-amp. fuse wire, and punched through the web of the foot. This tag in conjunction with toe clipping proved satisfactory during the period of observation, which lasted eight days.

(vi) Removal of the distal phalanx of one or more front or hind toes. Extensive use of this method was avoided owing to the possibility of infection resulting from the injury. In some cases, however, in order to increase the numbers of combinations a maximum of one toe per frog was clipped.

During the afternoon or evening from March 7th to March 15th inclusive, 1957, daily visits of from two to six hours were made to the study area. Each day as many frogs as could be captured were removed from each of pools 'C' and 'E'. During daylight the frogs would dive when the observer approached, but were still readily visible beneath the water

in pool 'C' and eastern parts of pool 'E'. In the planted part of pool 'E' the frogs would soon reappear at the surface, if the observer waited quietly, and could be removed as they appeared. During darkness collection was easier since the frogs were not disturbed by the beam from a hand lantern and could be approached readily. A net of one foot diameter on a 5 foot handle was used for collection.

In order to investigate homing behaviour the untagged frogs caught each day were tagged individually and divided into three groups arbitrarily. One group from each pool was liberated in the area of pool 'B' approximately 25 yards north of pool 'C', another in pool 'D' approximately 20 yards south of pool 'C' and the remaining group in pool 'F' approximately 20 yards south of pool 'E'. On each succeeding day all captured frogs were examined. Untagged individuals were treated as before and any with tags recorded and again removed to one of the three liberation points. An attempt was made to remove each recaptured tagged frog to a liberation point different than the one at which it was previously released. Twelve frogs were recaptured at least twice and each was released at all three liberation points. Thirty-seven frogs were recaptured at least once and each was released at two of the three points. A further eight frogs were recaptured at least once but released each time from only one point.

RESULTS.

The numbers of animals tagged and recaptured at each pool are given in Table I.

TABLE I

Numbers of frogs of each sex tagged and recaptured at each of the two pools 'C' and 'E'

Sex	Number Tagged			Number Recaptured			Percentage
	Pool C	Pool E	Total	Pool C	Pool E	Total	Recaptured
Male	42	57	99	43	20	63	63.6
Female	8	16	24	1	1	2	8.3
Total	50	73	123	34	25	59	48.0

The overall recapture frequency for females was so low that only males will be considered in the translocation experiments, the results of which are given in Table II. This table shows the total numbers of freshly caught male frogs which were tagged and removed from pools 'C' and 'E' to the three liberation points. This gives 99 frogs in six groups which are shown in the first six lines of the table. The distance each of these groups were removed and the numbers returning, in each case, to each pool are also indicated. In the last two columns of the table are given the probabilities that the pool of origin of each group did not influence its response to either pool.

TABLE II

Showing the numbers of male frogs removed from the two pools used as breeding sites ('C' and 'E') to the three liberation points. The table is arranged to show groups of frogs according to the number of times they were liberated.

Line	No. of frogs trans-located	From Pool	To libera-tion Point	Direction (North, South)	Distance in yards	No. of Returns to Pool 'C'	No. of Returns to Pool 'E'	No. not re-captured	Probability 'a'	Probability 'b'
1	18	C	B	N	25	18	0	0	<0·001	0·10
2	33	E	B	N	60	11	7	15		
3	10	C	D	S	20	3	2	5	0·57	0·75
4	15	E	D	N	15	4	4	7		
5	14	C	F	S	55	7	5	2	0·04	0·80
6	9	E	F	S	20	0	2	7		
7	29	C	B	N	25	27	1	1	<0·001	0·10
8	51	E	B	N	60	24	8	19		
9	35	C	D	S	20	15	10	10	0·18	>0·80
10	20	E	D	N	15	5	6	9		
11	29	C	F	S	55	8	10	11	0·06	>0·80
12	16	E	F	S	20	0	6	10		
13	47	C	B	N	25	43	1	3	<0·001	0·07
14	56	E	B	N	60	27	8	21		
15	45	C	D	S	20	23	10	12	0·04	0·43
16	23	E	D	N	15	5	7	11		
17	29	C	F	S	55	8	10	11	<0·04	0·50
18	18	E	F	S	20	0	7	11		
19	42	C	Both N and S to all			28	7	7	<0·001	0·43
20	57	E	three liberation points			15	13	29		
21	93	C		do.		50	21	22	<0·01	0·95
22	87	E		do.		29	20	38		
23	121	C		do.		74	21	26	<0·001	0·31
24	97	E		do.		32	22	43		

Notes on Table II.

The figures in the 'probability' column 'a' give the probability that the pool of origin of a frog did not influence its response to pool 'C'. Likewise column 'b' gives the probability that the pool of origin did not influence the response to pool 'E'.

Lines 1-6 list the translocations and recaptures of all 99 of the freshly caught males.

Lines 7-12 include these figures, but in addition list those frogs recaptured from the 99, and moved to a *different* liberation point. This gives 180 liberations.

Lines 13-18 list all liberations regardless of how many times each frog was caught or of where it was liberated, i.e. there were 218 liberations of 99 frogs. Each frog was liberated on an average of 2.2 times.

Lines 19-20 combine the figures from lines 1 to 6.

Lines 21-22 combine the figures from lines 7 to 12.

Lines 23-24 combine the figures from lines 13 to 18.

The probabilities were obtained by drawing up a two way table in order to calculate the chi-square and then referring to a table for the chi-square probability value.

Discussion.

The probability that their pool of origin was not important in determining the frogs' response to pool 'C' was less than 0.001 (Table II, lines 19 and 20). In other words there was a very strong tendency for a frog from pool 'C' to return to pool 'C' at whichever of the three points it was liberated. There was a lower tendency for a frog from pool 'E' to react in the same way to its "home" pool, but even in this case it was evident that the frogs did not choose at random. An 'E' frog was more likely to choose pool 'E' than was a 'C' frog.

When the frogs which were recaptured and moved to another liberation point were considered (Table II, lines 21-22), again the tendency for frogs to home to pool 'C' was strong. The tendency to home to pool 'E' was, however, so slight that it may be considered non-existent, and the movements which these frogs undertook could be explained purely on a random basis.

This indicates that the frogs experienced more difficulty in returning to the home pool from a second liberation point. However, where a second liberation is involved the time period is increased. As the breeding season comes to an end the animals' sexual activity declines and hence there is probably less likelihood of a successful return to a breeding pool. Lines 23 and 24 include frogs which were liberated more than once and here the probability values are as low as those from frogs liberated only once. The difference between lines 23-24 and lines 21-22 is that the former includes individuals which were released at one liberation point more than once. The discrepancy would be expected if memory were significant because those individuals having the ability to remember a route would be enabled to return more quickly. That frogs are capable of remembering the characteristics of mazes has been demonstrated on several occasions (e.g. Yerkes 1903, Buytendijk 1918).

The generally lower values in column 'b' (Table II) may be explained in two ways. One is the late date of discovery of the pool 'E' community compared with pool 'C'; the other is the difficulty experienced in capturing frogs in pool 'E' 'as compared with pool 'C'. Both these factors would lower the chances of recapturing pool 'E' frogs and in fact the recapture frequency for pool 'C' was 79% as against 56% for pool 'E'. Those 'E' frogs moved to the 'B' liberation point homed best and this is probably correlated with the fact that more frogs were moved to this point within the first two days than to the other points. The same is true for the 'C' frogs moved to the 'B' liberation point. No explanation can be offered for the low tendency to home amongst the initial 'C' frogs removed to liberation point 'D' (line 3) as compared with those removed to liberation point 'F' (line 5). The numbers of animals involved in the translocations listed in lines 3 to 6 (Table II), however, were probably too low to be reliable.

In the case of either 'C' 'or 'E' frogs returning "home" from any of the liberation points there were two routes which they might have taken, one via the stream, the other via land. By following the stream from pool 'B' in the North, for instance, an 'E' frog would first enter pool 'C' which contained an active breeding community. It must "ignore" this community, find the exit to pool 'C' and continue downstream another 35 yards to reach pool 'E'. Directed movement by land would also involve specific location of a chosen site and again it seems probable that an 'E' frog travelling from pool 'B' towards pool 'E' would fall under the "influence" of pool 'C'. This is made especially likely when the presence of the stone walls and the embankment is considered. By far the easiest route around any of these obstacles was that via the stream which flowed beneath walls and road. On at least 16 occasions frogs must have passed through, or near to, one active site in moving to the pool of their "origin".

The authors having made comparable observations have already been mentioned. Of those working with breeding animals, Cummings (1912) and Twitty (1959 and 1961) have provided the most complete reports concerning the urodeles *Molge palmata* (now *Triturus helveticus*) and *Taricha rivularis* respectively. Cummings took newts from a pool and liberated them on land five to thirty-five yards away, together with animals brought from distant pools. He concluded that they demonstrated "a small homing faculty". If we subject his results to a statistical test of the type used above we find a probability of less than 0.001 that the response of the newts to the pool was uninfluenced by their origin. This suggests that at the distances used the animals possessed a distinct homing ability. Twitty's results with *Taricha rivularis,* a riperian breeder, are still more convincing. In one experiment, in which 893 animals were used, translocations were made from two points in a stream to an intermediate point. Newts recaptured in subsequent years were almost invariably found at their original site of capture. The animals were moved between 600 and 1900 yards in this experiment. Even when moved three miles from the point of capture, in another experiment, some individuals returned in subsequent years.

The work on anurans during the breeding season all relates to the family *Bufonidae*. Heusser (1958) reports that when toads, intercepted en route to one site were transported to another, 800 metres away, some returned to the first site. Breder, Breder and Redmond (1927) removed 34 *Bufo fowleri* between 300 and 400 yards. Four were retaken at the original site of capture. The obstacles negotiated during this journey included three highways and a railway. Nichols (1939 unpublished) worked with the same species and although he used greater numbers made no distinction between breeding and non-breeding individuals. This is understandable since in the southern United States the breeding season of *Bufo fowleri* is protracted, stretching over several months, different individuals breeding at different times. He concluded that there is "the possibility of a preference of breeding ponds". Archer's (1959) observations on *Bufo regularis* are of dubious value since there was no means of identifying individuals. Boulenger (1912) provides

no figures, simply stating that "a number of pairing individuals" (*Bufo bufo bufo*) were placed midway between two ponds only one of which supported a breeding population. "All, after a little hesitation . . . took the right orientation . . .". Bogert (1960) mentions similar experiments with *Bufo compactilis* in Mexico where individuals returned to their original pools and even to specific sites within these pools. Again numbers and distances are not specified. (Heusser 1958 op cit. and Breder, Breder and Redmond 1927 op. cit.) are the only authors to report evidence of a preference for one site when others containing the same species were readily accessible. Heusser was concerned with breeding congregations of *Bufo bufo* and Breder et al. with *Rana clamitans* during the summer.

The experiments reported in this paper and those just mentioned provide information that some amphibians show a preference for certain breeding sites rather than moving at random. This leads to a consideration of mechanisms used during distant orientation. No conclusions in this respect can be drawn from the above experiments. An ample survey of the existing knowledge in this broader field is given by Bogert (1960) and more recently by Savage (1961) in a work devoted specifically to *Rana temporaria*.

It is evident that precise location of a breeding site, particularly when the breeding season is limited, is of considerable survival value. It is more difficult to understand the value of a mechanism which impels individuals to return to a particular site when other sites are available to it. However this type of fidelity ensures that, provided the characteristics of a site remain unchanged, the individual will find a suitable breeding location each year. The homing tendency has never proved to be so marked that all individuals choose their "home" site when given an alternative, and the "renegades" may provide the means of expansion into new habitats. On the whole, however, the restriction of individuals to certain breeding locations will tend to stabilize distribution and reduce competition in the population. It will also provide a partial isolating mechanism between units in the population and thus facilitate genetic differentiation.

Females at the Breeding Sites.

The overall ratio of males to females captured in the present study was 106 : 24. Such a low proportion of females seems to apply to many species (e.g. Blair 1943, Carpenter and Delzell 1951, Anderson 1954, Smith 1954, Jameson 1956, Pyburn 1958, Underhill 1960. Cunningham 1962). This disproportion is usually ascribed to the fact that the females spend less time at the breeding site than the males, and that the males, being the more conspicuous sex by virtue of their vocal performance, are more frequently observed. Whilst these two factors undoubtedly contributed to the greater numbers of males observed in the Sheffield pools, they could not entirely account for it, since the number of spawn masses totalled only 44. This is roughly double the number of observed females. A later age of maturation amongst females as reported by Smith (1954) and Anderson (1954) for *Bufo bufo* and *Microhyla carolinensis* respectively might be an additional factor resulting in the unbalanced sex ratios.

In an attempt to gain more information on the activities of the females a method of labelling spawn before it was laid was felt to be desirable. A workable method was developed which consisted of injecting a fine suspension of coloured blackboard chalk in physiological saline, through the body wall into the oviduct during or subsequent to ovulation. The particles in the suspension become mixed with the albumen during or shortly after its deposition and remain visible after oviposition. Chalk of different colours may be used, the colour being evident in the spawn clump at least 24 hours after laying. This means that it is possible to recognize spawn and to affix a mechanical tag such as beads on cotton thread, within one day of the spawn being laid. The method was unfortunately devised too late in the season for application to the above work.

SUMMARY.

1. One hundred and twenty-three frogs were taken from two pools 35 yards apart and labelled by means of a tag punched through a web of the hind foot. They were moved to one of the liberation points north, south or between the two pools.
2. Recaptured frogs were moved and liberated again, usually at a different liberation point.
3. Twenty-four of the total number of frogs were female. Only two of these were recaptured. The number of females, as indicated by spawn, was 44. The ratio of males to females captured was 106 : 24.
4. At least sixty-four per cent. of the males which were displaced by 15-60 yards from a breeding pool were recaptured at a breeding site.
5. The hypothesis that the pool of origin of a frog did not influence its response to either of the pools was tested by means of the chi-square test.
6. Frogs showed a greater tendency to return to the "home" pool than to move to another site containing active frogs despite the fact that this might be closer than the "home" pool. Sixty-five frogs showed 209 homing movements from a total of 334 recorded movements. At least 16 frogs passed a site containing breeding frogs in moving back to their original site of capture.
7. A method was developed of labelling eggs before they left the oviduct in order that spawn clumps could be identified later in the pond.

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TURTLES OF GEORGIA

By

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This paper records the results of observations made on turtles in Georgia, U.S.A., during the period July to September 1962. All these observations were made at Candler Lake, Dekalb County, except where otherwise stated. This lake is about half a mile wide and long, and is not more than about six feet deep. There is a soft muck bottom, and small, restricted areas of vegetation. A small, silt-laden tributary of the Chattahoochee River passes within a few yards of the lake at one point, but the river and the lake do not communicate. On the opposite side of the lake there is a much smaller lake, densely planted with water lilies.

Trionyx ferox. This soft-shell is not found in North Georgia, but several specimens were seen in the Okefenokee Swamp in South Georgia (Ware County). Several very large specimens were seen on exhibition in the Swamp Park (Cowhouse Island), one approaching the maximum length of the species (eighteen inches). These large turtles had very broad, pinkish heads, and very thick, fleshy lips.

Trionyx spiniferus asper. This soft-shell is found both in the lake and the river. Only one specimen was caught, a juvenile with a leathery carapace 7.8 x 7.0 cms.; after five months in captivity the length had increased to 8.9 cms. This turtle was found in the lake, sunning itself in half an inch of muddy water, and made no effort to resist capture. It fed readily on newt larvae, minced fish and meat. The carapace was brown, with a yellow margin, and several rows of black dots round the rear, the outermost one being confluent, the others becoming increasingly widely spaced. There were two prominent, confluent, dark-edged white lines on the side of the head (Pl. 2, Fig. 1). A pair of these turtles was seen in the lake on August 8th, in what might be construed as a pre-copulatory position. A small specimen, about six inches long, was seen floating about two feet behind another, about nine inches in length. The turtles dived on noticing the observer; the larger specimen reappeared after about ten seconds. This species was abundant in the river, where many were seen floating in a characteristic position, with the shell inclined at 45° to the water, and the neck extended in an S-shaped curve, with the head just above water. They were very wary, and scuttled to the bottom on noticing the slightest movement.

Pseudemys scripta. This was the most abundant species in the lake; numerous juveniles were caught, mostly while sunning in very shallow, hot, muddy water. A number of adults was seen, usually in deep water, and only one, a male (carapace 15.5 x 13.0 cms.) was caught (while basking). Several dead adults were also found. One specimen was seen eating a corncob. The Candler Lake population contains elements of both the *scripta* and *elegans* sub-species, in approximately equal amounts; pure specimens of both races were found, and all degrees of intermediates. Typical *scripta* have a yellow crescent behind the eye, a roundish, rather elevated shell, a few small black spots at the front of the plastron, a dark olive-green, black and

yellow carapace, and a yellow median head line, with a short cross-bar at the rear. Typical *elegans* have a reddish streak behind the eye, an oval, rather low shell, numerous black spots all over the plastron, a bright green, black and yellow carapace, and an often reddish, uncrossed, paramedian head line. Even the pure *scripta* from Candler Lake has fairly numerous plastral spots (Pl. 2, Fig. 2); as Carr (1952) writes: "In populations of *scripta* from areas near the range of *elegans,* which is a many-spotted form, a greater number of specimens have a greater number of plastral spots, as might be expected".

Three distinct types of melanism or pseudo-melanism seem to be developed in this turtle; the first (Pl. 2, Fig. 2) manifests itself as a jet-black flaky deposit on the laminae of the carapace and plastron, usually not infringing on the areas of new growth, and not affecting the colour of the soft parts. This type of colouration was found on turtles with shells 4 to 5 cms. in length. The second type, not seen in Candler Lake turtles, but seen in an *elegans* population in Rankin County, Mississippi, consists of a blackish colouration extending over the shell and the background colour of the head and limbs; the light stripes on the limbs are not affected. It was present on specimens from about 7 cm. length to adult size; none of these turtles was caught, and the plastral colouration could not be inspected. The third type is the well-known melanism of old males, manifesting itself as an increase in size of the plastral spots, until the plastron, and also the carapace and soft parts, are more or less uniformly dusky and unmarked.

Pseudemys floridana. Several specimens were seen in the Okefenokee Swamp; one very large specimen (Pl. 2, Fig. 3) was caught; this turtle was not measured, but had a carapace about 33 cms. long. One of the front feet was missing, probably from an encounter with one of the numerous alligators in the swamp; it was still capable of rapid walking and swimming. When caught it was engaged in eating an aquatic, moss-like plant. Although presumably referable to the typical race (*floridana*), it had the soot-black facial skin and solid submarginal blotches of the southern race (*peninsularis*).

Chrysemys picta picta. Eight painted turtles were caught in Candler Lake. This species is very wary, and very rapid in its movements; those specimens caught were secured by wading after them until they sought refuge on the bottom, and then investigating the place where they were last seen. One specimen was caught while basking, but only because it was beside a post, and could be approached from directly opposite. Numerous other specimens were seen, both basking and swimming, in the river and in the lake. A single, large, adult, abnormally sluggish and apparently unwell, was caught; it had a shell 14.5 x 10.6 cms. All specimens caught had a reddish encrustation on the plastron, which could be scraped off with the finger nail; some individuals also had black plastral markings.

Sternotherus odoratus. Four juvenile musk turtles were caught, and two dead adults (one on the bank, one in the water) were seen. The young had highly elevated, tectiform carapaces, with traces of lateral keels. One was so overgrown with moss that only the eyes and nose were free of it. The shells were thick and absolutely rigid, unlike those of baby Emydidae, which are frequently slightly flexible at the margin. The necks and limbs were extremely long and thin. They fed readily on chicken and cat meat in captivity. They were easily caught, not being very fast swimmers, but bit strongly when confined in the hand.

Kinosternon subrubrum subrubrum. Six specimens were caught, the largest, a young adult, having a carapace 7.0 x 5.5 cms. Several of these had the posterior third of the carapace overgrown with moss. One of the juveniles had a reddish plastron; those of the others were black. One had a tumour or subdermal parasite under the chin, which produced a marked swelling. Another individual, five cms. long, had five laterals on the right hand side (two corresponding to the fourth left lateral). One specimen was caught while eating a large putrifying catfish. When first caught they bit viciously, but soon became tame. The soft skin was grey, the head light in colour, with numerous black markings, which did not infringe on two or three vaguely-defined light lines on the side of the head.

Terrapene caroline carolina. Seven Common Box Turtles were found in the vicinity of Candler Lake, and a further individual was seen, under conditions not propitious to capture, near Gatlinberg, Tennessee. Even within this small series, the enormous variability of this race was evident; specimens ranged from almost unmarked yellow to almost unrelieved black. The males were characterized by their red eyes, strong, heavy build, concave plastron, thick tail base and greater tendency towards yellow spots on the head and limbs. All these generalizations, however, are subject to exceptions. The males also seemed to be less shy than the females. A copulating pair was found in long, wet grass on the edge of the lake on 27th July; when disturbed the female closed her plastral valves, catching the foot of the male in the hind one; they could not be separated until the female emerged, about half an hour later. All the turtles found were adults, with shells between 10.5 and 13.25 cms. in length.

Deirochelys reticularia reticularia. One turtle, tentatively assigned to this species and race, was seen, but not caught, in the Okefenokee Swamp.

Chelydra serpentina serpentina. This widespread species was, curiously enough, apparently absent from Candler Lake; no indications of it were found there, and no reports of its presence were heard. Two hatchling specimens, still with the umbilical scar, were seen in the Okefenokee Swamp Park, where they had been caught two days previously (on August 15th).

Macrochelys temminckii. The Alligator Snapping Turtle is absent in North Georgia, but is not rare in the Okefenokee Swamp. Although no wild specimens were seen, several large recently-caught ones were seen in the Swamp Park. A stuffed specimen, said to be the largest ever caught in the swamp, was seen; it was about four feet six inches from snout to tail tip, and weighed 107 pounds when alive. One wonders what a 200 pound individual must look like, or the 403 pound turtle mentioned by Hall and Smith (1947).

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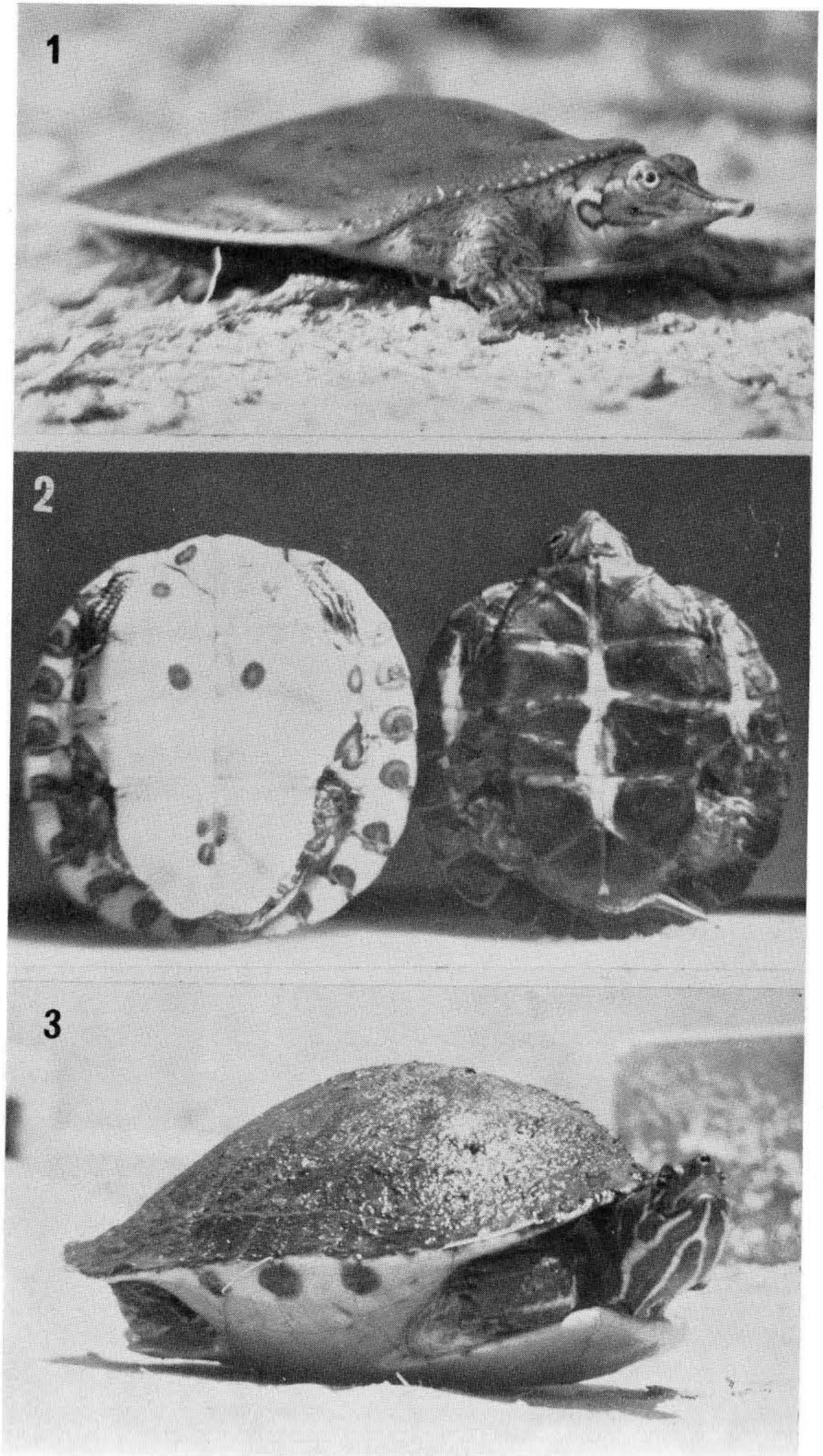

PLATE 2, Pritchard.

REPTILES IN EXPERIMENTAL EMBRYOLOGY: NOTE 2

By

LYNETTE A. HOLDER and A. D'A. BELLAIRS

In a recent number of this journel Holder and Bellairs (1962) briefly reviewed the literature in this field and described some preliminary experiments on the embryos of two viviparous species (*Lacerta vivipara* and *Anguis fragilis*) removed from the mother and cultured by the Panigel method. It is our intention to write further notes from time to time, continuing our survey of the literature and reporting current progress.

Some earlier work, not listed in our previous article, deals with the effects of injection of sex hormones on the gonads of reptile embryos. Hartley (1945) cites previous papers on the subject.

Certain recent descriptive studies may be mentioned as likely to be of interest to experimental embryologists. Darewski and Kulikowa (1961) make the striking claim that some populations of *Lacerta saxicola* in the Caucasus normally reproduce by parthenogenesis. The adults are always female, but their eggs sometimes contain monstrous male embryos with everted hemipenes.

Numerous papers by French workers on the differentiation of the sex organs and various endocrines have appeared recently, many of them in the Comptes rendus des séances de l'Académie des Sciences, Paris, and the Bulletin de la Société Zoologique de France. Hubert (1962) has also described some early development stages of *Lacerta vivipara*, and Raynaud (1962 a, b) has given an account of the fore and hind limb buds of *Anguis* embryos. These rudiments regress after a short period and lack the apical thickening or crest which is thought to play an important part in the differentiation of the limb bud in other forms.

Raynaud (1962 c, d) also describes a technique for decapitating *Anguis* embryos which are subsequently allowed to develop by his culture method. He has studied the effect of this operation (which naturally involves removal of the pituitary) on embryonic growth and on the development of the sex and other glands. In another paper Raynaud and Raynaud (1962) describe the culture on synthetic media of the embryonic neck region and lower jaw, the differentiation of the thyroid and other glands, and of the skin and skeleton.

In this laboratory further experiments involving tail amputation in cultured *Lacerta* embryos have been carried out. The addition of albumen from the unincubated hen's egg to the saline medium in the proportion of about 1 to 4 parts seems of definite value in preventing fungal infection. Previous reports of failure of the embryo to regenerate the tail have been confirmed: the power to regenerate may appear shortly before birth.

Amputation of part or the whole of a hind limb bud was successfully carried out on four specimens at Dufaure-Hubert stages 30-33 (roughly equivalent to chicks of 3½ to 4½ days). No regeneration was observed after survival periods of 18-20 days at 28°C., by which time the embryo had approached or reached the stage of hatching. This finding obviously requires confirmation on a greater number of specimens; it is of interest, however, in view of the fact that atypical structures at least can sometimes be regenerated by lizards after amputation of the limbs (see Vorontsova and Liosner, 1960).

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TREETOAD STUDIES: CORRECTION

By

JOE GORMAN

Reasonably, Roger Conant, author of A Field Guide to Reptiles and Amphibians (Houghton Mifflin, Boston, 1958), asked for the specimens of "Hyla ocularis" which I reported in this journal (Vol. 3, No. 2, 38-9, 1962). I sent four specimens on 8th January, 1963. He writes (20th April): "Dr. [Philip W.] Smith and I had an opportunity to examine them together last week, and we believe that the frogs are not *ocularis,* but instead are members of the *Pseudacris triseriata* x *feriarum* complex."

The error is mine, and I thank Mr. Conant for the correction. I apologise to the readers of this journal, its editors, and Mr. Regan, S.J. for involving them. Ecological judgments must be based on careful systematics.

Two points of the article are worth repeating the ecological construction of the coastal plain of eastern North America (since my publication I found it so considered in Lobeck, A. K., Physiographic Provinces of North America (Geographical Press, Hammond, Maplewood, N.J., 1950)), and a possible re-direction of attention to the definition of "Pseudacris" (cf. Noble, G. K., Biology of the Amphibia (McGraw-Hill, New York 36, 1931 : reprinted, Dover, New York 14, 1954), pp. 510-1).

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LITTER RECORDS FOR COMMON LIZARD AND SLOW-WORM

By

LYNETTE A. HOLDER AND A. D'A. BELLAIRS

Minimum and maximum figures for litter sizes, either of young born, or (marked with *) of probably fertile eggs recovered from the oviducts of specimens killed for study are given by the following authors.

Lacerta vivipara	min. 4—max. 10 (5-8 usual); Smith, 1954, p. 197 (U.K.)
	5-12; Panigel, 1956, p. 575 (France)
Anguis fragilis	7-19*; Rollinat, 1934, p. 218 (France)
	4-19 (6-12 usual); Smith, 1954, p. 176 (U.K.)
	max. 21*; Raynaud, 1962, p. 184 (France)

Among the specimens used for embryological research by us during 1962/63, a common lizard from southern England contained 14 living eggs in the oviducts, 7 on each side with one additional, infertile egg on the right. A slow-worm from Dorset contained 21 living oviducal eggs, 10 on the left and 11 on the right. These are maximum figures; we found a minimum of 3 for *Lacerta* and 5 for *Anguis.*

M. Johnson and E. Hazelwood (personal communication) report a slow-worm taken near Scarborough which gave birth to 22 living young in the Bellevue Museum, Halifax, Yorks. 14 were born in their membranes on October 2, 1962, and 8 more were found on October 9, together with 6 more eggs which did not hatch. 2 of the latter seemed infertile, but the remainder contained embryos 30 to 70 mm. long. This total of 26 fertile eggs is perhaps the greatest recorded, at least in this country.

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REVIEWS

SNAKES OF SOUTHERN AFRICA: by VIVIAN F. M. FITZSIMONS. Macdonald, London, 1962. 423 pp., 74 colour-plates, 43 monochrome photographs, 260 line-drawings, 77 range maps. Price £7 10s.

To quote from the foreword, "Dr. FitzSimons was destined to write this book", and certainly very few other herpetologists could have attempted it. The amount of information packed into its 400-odd pages is quite remarkable.

The first 50 pages give general information, under a number of headings, on snakes as a whole, and should provide interesting and informative reading for any zoologist. The rest of the book deals specifically with the snakes of Southern Africa, which is taken to be that part of Africa lying south of a line drawn from the Zambesi River in the east to the Kunene River in the west. Each of the 138 species and subspecies in this area is described in great detail, its range defined with lists of recorded localities, and adequate taxonomical information given to explain existing classifications in relation to previous references. In most cases, under the heading "Field Notes", useful information is supplied about habits and habitat, and the only possible disappointment any herpetologist could experience with this book is that these notes, excellent as they are, have not been further expanded.

The colour-plates, by the well-known animal artist, the late Rev. P. Smit, are works of art as well as accurate representations of the species concerned. Most of the line-drawings are by the author and show the head-scalations of nearly all the species described. The range maps do not describe the boundaries of the range, but plot recorded localities. In this way, they give a fair idea of comparative population densities as well as the general area in which the species is found, but in many cases it is necessary to guess how far the range might extend beyond the localities plotted; in the case of those species extending into Northern Africa they cover only that part of the range lying in Southern Africa. To compensate for this, a general description of the overall range is in each case included in the text.

The final chapters comprise a gazetteer of nearly 1,700 place-names, a bibliography of over 70 items, and indices of scientific and vernacular names (the latter covering names in common use in English, Afrikaans and various African dialects).

I have no hesitation in advising anyone interested in snakes to buy this book, if they can afford it. I wish I could.

J. W. Steward.

SNAKES: by H. W. Parker. Robert Hale Ltd., London, 1963. 191 pp. 16 plates and 11 text-figures. Price 21s.

Those who are interested in snakes as animals must often have wished for some authoritative but not too technical account, where the emphasis is on information rather than glossy illustration. Dr. Parker, who was for many years in charge of the amphibians and reptiles at the British Museum (Natural History), has written what seems virtually the ideal book. Rather more than half of it deals in a masterly fashion with various aspects of ophidian life, and incorporates the results of much recent research on such problems as how snakes move, and catch and eat their prey, and on reproduction and embryonic development. The difficult subject of snake venoms, on which there is a vast, scattered and indigestible literature, is well covered.

It is difficult to find anything to criticise in this book. The author does state in an appendix that the use of antivenin in snake-bite treatment may be followed by allergic reactions. Possibly a stronger note of warning might have been sounded against the indiscriminate use of this measure after the

bite of snakes which are only moderately poisonous, such as the adder (*Vipera berus*). As the reviewer can state from personal experience, the effects of such treatment may be worse than the bite! The traditional first-aid remedies of tourniquet and incision also have their dangers if applied by unskilful hands.

The second part of the book surveys the various groups of snakes such as the colubrids, the highly poisonous elapids and vipers, and the boas and other primitive forms. Dr. Parker is particularly informative about some of the interesting but more obscure groups such as the Dipsadinae or Thirst-snakes (the bite of one species was supposed to engender thirst), which feed on snails. The mechanism by which the snake uses its long lower jaw like a winkle-pin to extract the mollusc from its shell is well described.

The last chapter is devoted to the somewhat ambivalent relationship between snakes and man, the animals being alternatively revered, dreaded or exploited for their skins or food-value, according to the inclinations of the various human communities. There are useful appendices listing the antivenins available, and the popular and scientific names of many kinds of snakes. The book is well illustrated by photographs and simple but very adequate line drawings, and contains a short bibliography. The publishers of this excellent work are to be congratulated on its modest price.

A. d'A. Bellairs.

KRANKHEITEN DER REPTILIEN: by H. H. Reichenbach-Klinke (with contribution by E. Elkan). Gustav Fischer, Stuttgart. 1963. 142 pp., 105 illustrations. Price DM 34.

This useful handbook follows the author's previous volume on diseases of Amphibia. Much of it is devoted to the diseases caused by protozoan and metazoan parasites; bacterial disease is dealt with very briefly. The sections on non-parasitic diseases and tumours are also short. There is a striking photograph of a lizard severely afflicted with the curious skin excrescences which are so familiar to vivarium keepers; the condition may be associated with mite infestation. Anomalies and regenerative phenomena also receive rather summary treatment and some readers might wish that rather more space had been allotted to these interesting topics. The full bibliographies are, however, of great value. Despite what seems to be a slightly unbalanced treatment of the various conditions, this book is a most welcome contribution to a field of knowledge in which very few attempts at synthesis have been made.

THE CURIOUS WORLD OF SNAKES: by Alfred Leutscher. (Illustrated by Barrie Driscoll.) The Bodley Head, London. 1963. 32 pp. Price 13s. 6d.

A book for young people with pleasant illustrations and text.

DJUREN I FARG [ANIMALS IN COLOUR] : by KAI CURRY-LINDAHL. (Illustrated by K. A. Tinggaard.) Almquist and Wiksell, Stockholm. 1963. 196 pp.

An attractively illustrated handbook of the Swedish mammals, reptiles and amphibians.

A. D'A. BELLAIRS.

A STUDY OF REPTILES AND AMPHIBIANS, INCLUDING THEIR CARE AS PETS : by A. LEUTSCHER. Blandford Press. 1963. 10s. 6d.

This book is intended to serve as an introduction to reptiles and amphibians, and the facts it relates cover this very well. After a brief background which includes details of evolution and classification, the various groups are considered in turn. The last two chapters deal with the hobby of herpetology and the concluding one gives suggestions for experiments and fieldwork. Some of Gesner's drawings of reptiles and amphibians are used, and the illustrations are rather variable in quality.

J.F.D.F.

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