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BREEDING PHENOLOGY OF CURLEW

Analysis of Nest Record Cards from the British Trust for Ornithology Nest Record Scheme

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CONTENTS

1. SUMMARY

1.1 The Nest Record Cards contained a fair representation of Curlew records from all parts of the country, habitats and altitudes.

1.2 Median laying date was 1st May, the majority of clutches were of 4 eggs (77%) and overall 63% of nests fail before hatching.

1.3 Overall, average laying dates tended to become later in the 1960s and 1970s and then become earlier through the 1980s.

1.4 Nest failure rates rose and then fell through the 1960s and 1970s in agricultural habitats.

1.5 Laying dates tended to be earlier at low altitudes than at high altitudes. Clutch sizes were relatively large at medium altitudes and nest failure rates tended to decline in recent years at low altitudes.

1.6 Clutches tended to be larger in Wales than in the midlands and south of England.

2. INTRODUCTION

Internationally important populations of Curlew breed and winter in Britain. The bulk of the breeding population is associated with the upland fringe, although substantial numbers breed in Breckland and lowland wet grassland sites such as the Somerset Levels. Whilst the lowland population has undoubtedly undergone a severe contraction in range, the upland population may be increasing in both range and density. English Nature attaches High Priority to the conservation of Curlew in England. Despite this importance, there are no published detailed studies of the breeding biology of Curlew in Britain. Recent studies (which have yet to report) have concentrated on Orkney, where habitat use appears to be markedly different from that elsewhere in the species' range.

English Nature issued a contract for minor works towards this study of the Curlew nest record cards of the British Trust for Ornithology. This contract is part of an English Nature research programme investigating aspects of the breeding biology of this species. It is expected that the results of the analysis will be included with field observations of Curlew in a scientific publication to be jointly authored by Dr A F Brown (English Nature) and the BTO.

3. METHODS

Analysis was based on British Trust for Ornithology Nest Record Cards (NRCs). These cards provide details of (a) the location of the nest and (b) the contents of the nest on each visit by NRC contributors. From these data it is possible to compute estimates of breeding parameter variables such as first egg date, clutch size and hatching success. Computation of these variables uses reasonable estimates of, for example egg-laying interval and maximum and minimum incubation periods obtained from the literature (Baillie 1988).

In this study we investigated first egg date, clutch size and nest loss during incubation. In the case of the Curlew, contributors to the scheme were rarely able to follow the fate of chicks after hatching and so samples sizes of records which would allow chick survival and fledging success to be estimated are insufficient for analysis. Failure rates were calculated using Mayfield's (1961, 1975) method and standard errors calculated after Johnson (1979).

Records were divided by region, altitude, habitat, and period. Regional divisions were based on UK Meteorological office regions. These were amalgamated into four broad regions to avoid the sample from being too finely subdivided. These categories were: (a) Scotland, (b) Northern England, (c) Wales and (d) The Midlands & South England. Four altitudinal zones were defined. These were (a) 0 - 100m asl, (b) 101 - 200m asl, (c) 201 - 300m asl and (d) >300m asl. Habitat was divided into four major groups. These were (a) Agricultural, (b) Moorland, (c) Wet and Coastal Habitats (such as water meadow and salt marsh) and (d) Others. While all these habitats have obvious sub-divisions, for example heather moor and bog versus grass moor, or pastoral farmland versus arable farmland, the majority of cards within these groups report unspecified moorland or farmland. Those in the "Others" group contained a mixture from most habitats recorded under the scheme not falling into the other three broad categories and so does not form a group of allied habitats. Most, however represented rarely used habitat with relatively small samples and so further subdivision was not warranted.

Statistical analyses were undertaken using SAS programs (SAS 1985). Comparisons within each set of divisions given above were made using Kruskal-Wallis One-way analysis of variance. Mean yearly values for nest failure rates were analysed for trends with time by fitting both linear and quadratic regressions, weighting by sample size. Trends in laying date and clutch size were analysed using the whole dataset.

4. RESULTS

4.1 General Information

The oldest NRCs available for this analysis date from 1947. Prior to 1965 the yearly intake averaged about 30 cards, after that time it increased to about 60 per annum (Table 1). The distribution of NRCs largely reflects the distribution of the Curlew in the UK except there were disproportionately more than would be expected from the Midlands and South of England: Northern England 39.5%, Scotland 34.9%, Wales 13.1% Midlands and Southern England 12.5%. Not surprisingly the most frequently recorded habitats were the moorland and agricultural land categories: Agricultural 39.2%, Moorland 36.7%, Wetlands and Coastal 3.9%, Others 20.1%. Of those habitats amalgamated into the Others category no individual habitat contributed more than 1% to the total. The geographical distribution of records from different habitats were not evenly distributed between regions ($\chi^2_9=85.31$, $P<0.01$ (category "Others" excluded)) (Table 2). Partitioning indicated that returns from Scotland contained a disproportionately large number of records from moorland while those from Wales contained a large number of records from coastal habitats. The geographical distribution of records from different altitude classes was also disproportionately distributed ($\chi^2_9=203.21$, $P<0.01$) (Table 3). Partitioning indicated that this did not reflect the expected altitudinal differences between the various regions: high altitude records were over represented from Wales and the Midlands and South of England while low altitude records were over represented in records from Scotland and the North of England. Similarly habitats were not evenly distributed between altitude classes ($\chi^2_6=195.67$, $P<0.01$) (Table 4) with moorland records over represented from high altitudes and agricultural habitats being over represented at low altitude.

4.2 Laying Dates

The overall Median first egg date was 1st.May (IQR 26th April - 11th May). The were no significant differences between first egg date between habitats (Kruskal-Wallis one-way ANOVA, $H=2.86$,$P=0.41$) (Figure 1), or regions (Kruskal-Wallis one-way ANOVA, $H=6.32$,$P=0.09$) (Figure 2) however significant differences were found in first egg dates between altitude classes (Kruskal-Wallis one-way ANOVA, $H=9.79$, $P=0.02$) (Figure 3). A multiple comparisons test (Siegal & Castellan 1989) indicated that first egg date was significantly earlier at low altitudes (Median=29th April, IQR=25th April-8th May) than it was at high altitudes (Median=6th May, IQR=29th April to 20th May). While there was no significant linear trend in the mean first egg date over the time period 1947 to 1992 (one-way ANOVA, $F_{1,214}=0.015$, $P=0.90$) when a quadratic curve was fitted to the data there was a significant relationship between first egg date and year ($F_{2,214}=9.92$, $P<0.0001$) (Figure 4). This indicated first egg dates became progressively later during the late 1960s but has been getting progressively earlier since the early 1980s. When this was repeated by region the same trend was only apparent for northern England, and when repeated by altitude class was only apparent at low altitudes. No such trend was apparent on a by habitat basis for any of the habitat classes.

4.3 Clutch Size

Reliable estimates of clutch size were available for 841 nesting attempts. The majority of these were clutches of 4 eggs (77%) with a substantial number of 3 egg clutches. The remaining 6% included 41 clutches of 2 eggs, 4 of 5 eggs and 3 of 6 eggs. While there

were no significant difference in clutch size between habitats (Kruskal-Wallis one-way ANOVA, H=4.63,P=0.20) (Table 5), there were significant differences in clutch size between regions (Kruskal-Wallis one-way ANOVA, H=12.46,P=0.0060) (Table 6) and between altitude classes (Kruskal-Wallis one-way ANOVA, H=8.08,P=0.0443) (Table 7). A multiple comparisons test indicated that clutches tended to be larger in Wales than in the midlands and south of England but failed to identify where differences between altitude classes occurred. Looking solely at mean rank scores for altitude classes suggested clutches tended to be larger in the medium altitude class (201 - 300m asl) than at other altitudes. No trends in clutch size over the time period 1947 to 1992 were identified.

4.4 Nest-failure rate

Details of mean daily failure rates together with proportion of nests failing over the period from first egg date to hatching (taken as 33 days based on 1-2 day egg interval and 29 day incubation period) derived from these data are given in Table 8. When mean daily failure rates were looked at on a by-habitat basis no significant linear trends were detected for any habitat. A significant quadratic relationship was found for breeding attempts in agricultural habitats only, with mean daily failure rates increasing during the 1960's and decreasing during the 1980's (Figure 5). No significant differences were found in mean daily failure rates between habitats. The only significant trend found when looking at mean daily failure rates on a by-altitude-class basis was a linear trend for breeding attempts at altitudes up to 100 metres indicating a decline in failure rate over the period 1947-1992 (Figure 6). The plots suggest a similar picture to that from agricultural habitats, except that samples from earlier years were insufficient to produce a significant quadratic regression. No significant differences were found in mean daily failure rates between altitude classes. No significant trends were found when looking at mean daily failure rate on a by-region basis. No significant differences were found in mean daily failure rates between regions.

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Table 1 **Intake of records for the period 1947 - 1992.**

Period	Records
1947-60	414 (18.7%)
1961-65	169 (7.6%)
1966-70	296 (13.4%)
1971-75	266 (12.0%)
1976-80	316 (14.3%)
1981-85	257 (11.6%)
1986-92	495 (22.4%)

Table 2 **Records by Region and Habitat (n, column %, row %).**

Habitat	Scotland	Northern England	Central & Southern England	Wales
Agricultural	224 (29.0%) (25.8%)	405 (46.3%) (46.7%)	138 (50.0%) (15.9%)	101 (34.7%) (11.6%)
Moorland	329 (42.6%) (40.8%)	309 (35.4%) (38.0%)	88 (31.9%) (10.8%)	87 (29.9%) (10.7%)
Wet Habitats	22 (2.9%) (25.3%)	27 (3.1%) (31.0%)	8 (2.9%) (9.2%)	30 (10.3%) (34.5%)
Other	197 (25.5%) (44.3%)	133 (15.2%) (29.9%)	42 (15.2%) (9.4%)	73 (25.1%) (16.4%)

Table 3 **Records by Region and Altitude (n, column %, row %).**

Altitude (metres)	Scotland	Northern England	Central & Southern England	Wales
0-100	273 (46.0%) (51.2%)	157 (25.0%) (29.5%)	52 (28.4%) (9.8%)	51 (25.8%) (9.6%)
101-200	169 (28.4%) (43.9%)	165 (26.3%) (42.9%)	31 (16.9%) (8.1%)	20 (10.1%) (5.2%)
201-300	94 (15.8%) (32.2%)	126 (20.1%) (43.2%)	14 (7.7%) (4.8%)	58 (29.3%) (19.9%)
>300	58 (9.8%) (14.8%)	179 (28.6%) (45.7%)	86 (47.0%) (21.9%)	69 (34.9%) (17.6%)

Table 4 **Records by Habitat and Altitude (n, column %, row %).**

Altitude (metres)	Agricultural	Moorland	Wet Habitats	Other
0-100	208 (34.3%) (39.0%)	111 (18.4%) (20.8%)	26 (55.3%) (4.9%)	188 (54.3%) (35.3%)
101-200	215 (35.5%) (55.8%)	108 (17.9%) (28.1%)	11 (23.4%) (2.9%)	51 (14.7%) (13.3%)
201-300	107 (17.7%) (36.6%)	116 (19.2%) (39.7%)	6 (12.8%) (2.0%)	63 (18.3%) (21.6%)
>300	76 (12.5%) (19.4%)	268 (44.4%) (68.4%)	4 (8.5%) (1.0%)	44 (12.7%) (11.2%)

Table 5 Clutch Size by Habitat.

Clutch Size	Agricultural	Moorland	Wet Habitats	Others
<=2	21	14	1	5
3	62	40	3	40
4	279	174	34	161
>=5	4	0	1	2
Average	3.73	3.70	3.92	3.77

Table 6 Clutch Size by Region.

Clutch Size	Scotland	Northern England	Central & Southern England	Wales
<=2	11	21	1	1
3	43	60	43	13
4	217	276	217	81
>=5	0	6	0	1
Average	3.76	3.74	3.59	3.86

Table 7 Clutch Size by Altitude.

Clutch Size	0-100m	101-200m	201-300m	>300m
<=2	13	4	3	12
3	40	19	23	19
4	196	125	84	89
>=5	0	4	0	0
Average	3.74	3.86	3.73	3.64

Table 8 **Mean Daily Nest Failure Rates (calculated on yearly means) and Proportion of Nests Failing Prior to Hatching**

(i) By Habitat Breakdown

Habitat	Agricultural	Moorland	Wet Habitats
Mean Daily Failure Rate (S.E.)	0.0253 (0.0011)	0.0217 (0.0019)	0.0651 (0.0036)
Average Proportion of Nests Failing Prior to Hatching	57.1%	51.5%	89.2%

(ii) By Altitude Class Breakdown

Altitude Class (metres asl)	0-100	101-200	201-300	>300
Mean Daily Failure Rate (S.E.)	0.0257 (0.0133)	0.0383 (0.0028)	0.0392 (0.0016)	0.0284 (0.0017)
Average Proportion of Nests Failing Prior to Hatching	57.6%	72.4%	73.3%	61.4%

(iii) By Region Breakdown

Region	Scotland	Northern England	Central & Southern England	Wales
Mean Daily Failure Rate (S.E.)	0.0225 (0.0014)	0.0294 (0.0014)	0.0359 (0.0021)	0.0414 (0.0027)
Average Proportion of Nests Failing Prior to Hatching	52.2%	62.6%	70.1%	75.2%

Overall Mean Failure Rate = 0.0296 (0.0009)

Overall Proportion Failing Prior to Hatching 62.9%

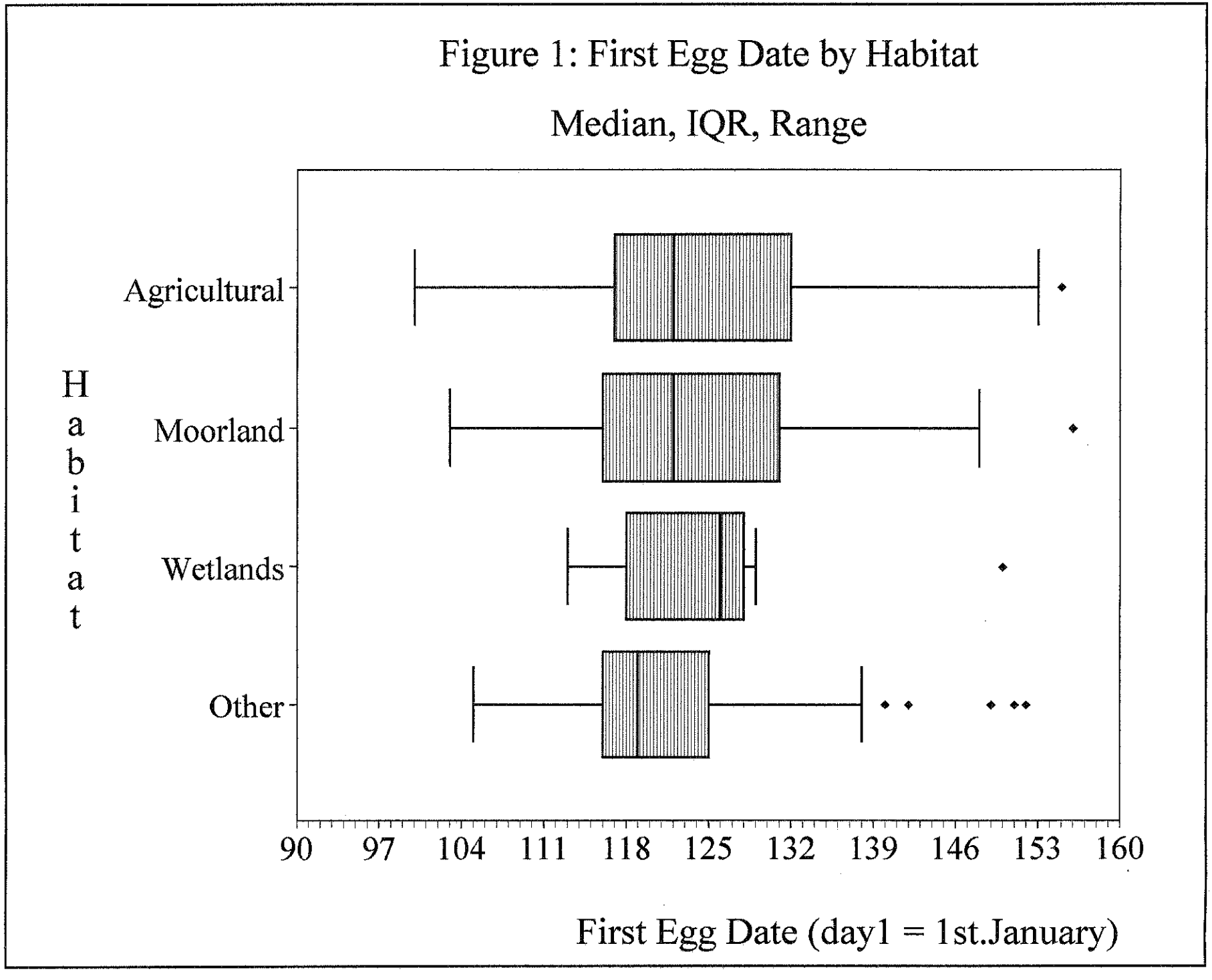
Figure 1: First Egg Date by Habitat
Median, IQR, Range
Habitat
Agricultural
Moorland
Wetlands
Other
90
97
104
111
118
125
132
139
146
153
160
First Egg Date (day1 = 1st.January)

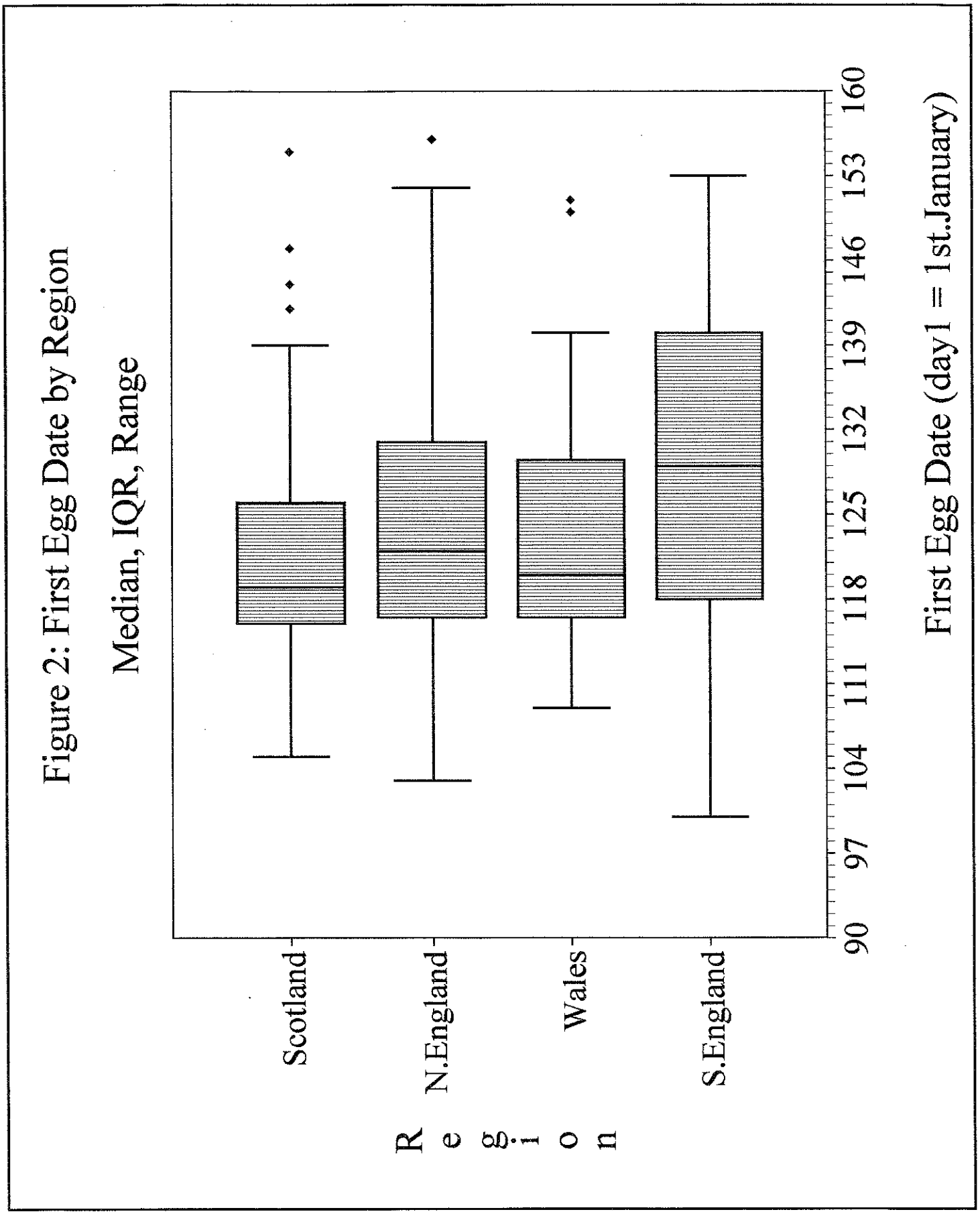
Figure 2: First Egg Date by Region
Median, IQR, Range
Scotland
N.England
Wales
S.England
Region
90
97
104
111
118
125
132
139
146
153
160
First Egg Date (day1 = 1st.January)

Figure 3: First Egg Date by Altitude

Median, IQR, Range

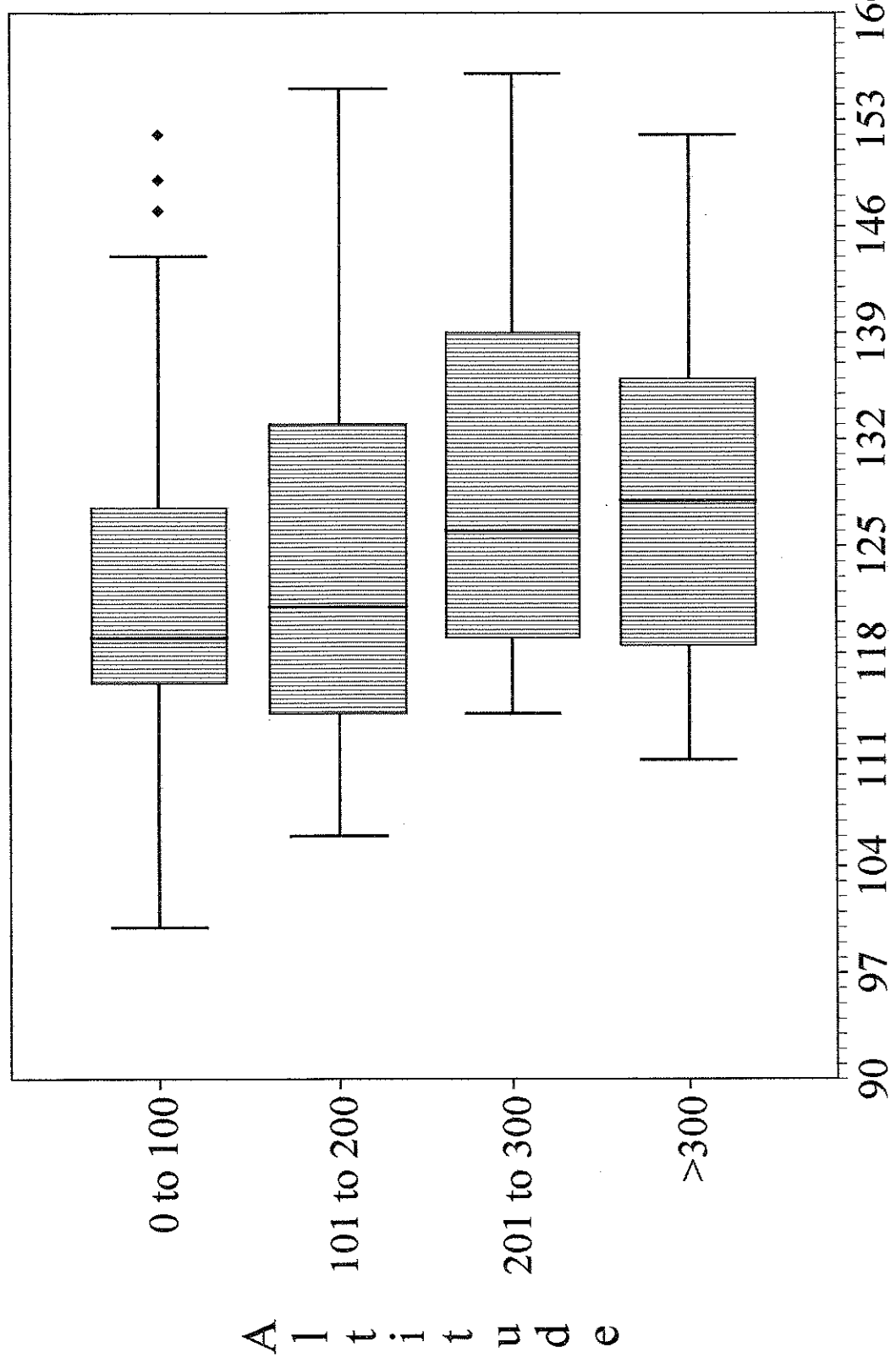

Figure 4: Mean First Egg Date by Year

(Individual points represent annual means)

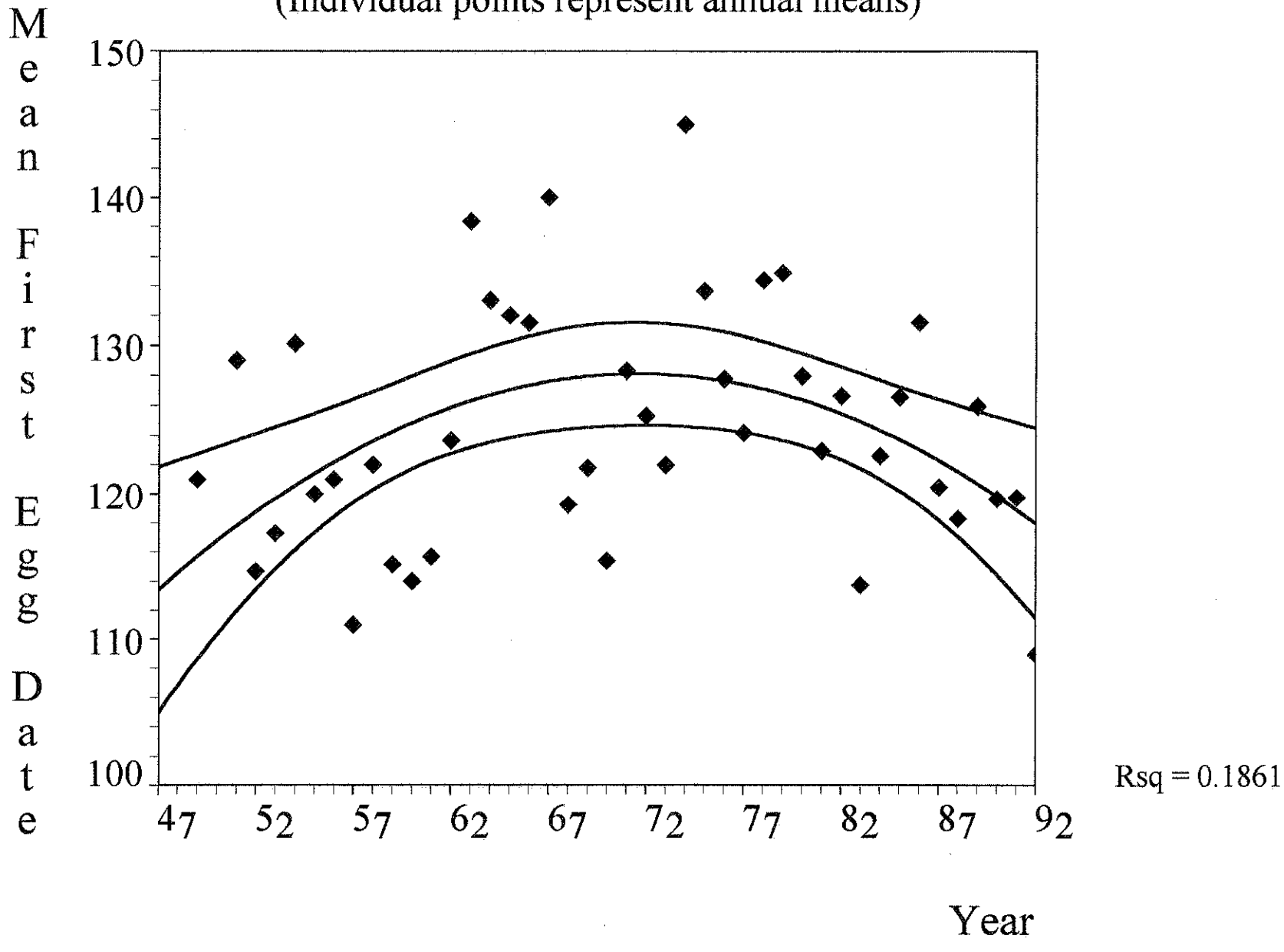

Figure 5: Mean Daily Failure Rates in Agricultural Habitats

(Individual points represent annual means)

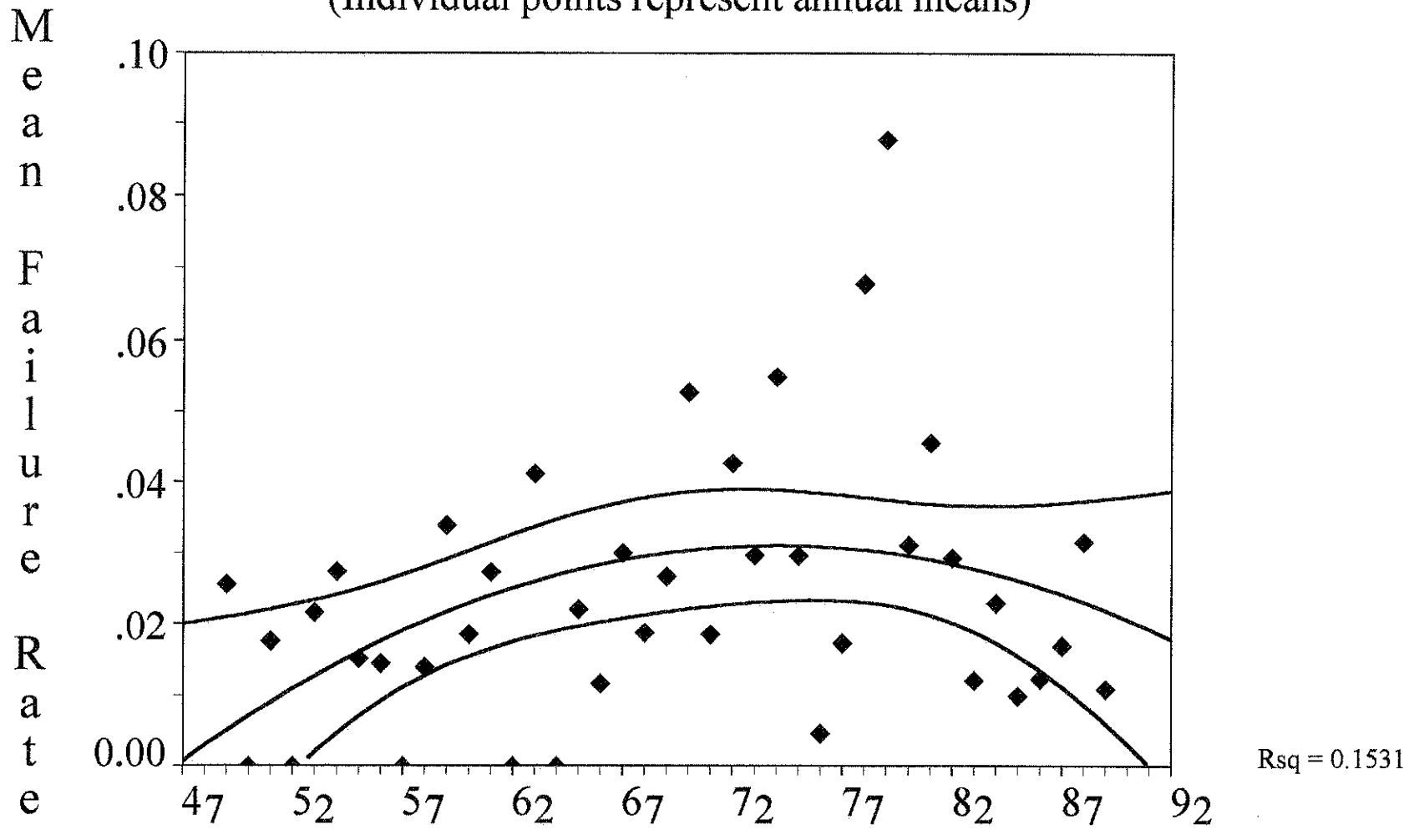

Figure 6: Mean Daily Failure Rates at Low Altitude

(Individual points represent annual means)