The article that has been scanned for on-line presentation below was originally published by the Chelonian Research Foundation (CRF) in Issue #8 of the Box Turtle Research and Conservation Newsletter (BTRCN), 1999, pages 3-7 and 19-22, edited by Heather Kalb.
The BTCRN was superseded by, and merged into, the new CRF publication, Turtle and Tortoise Newsletter beginning January 2000.
Permission to post the following article on www.ebtct.org was kindly granted to the Box Turtle Conservation Trust by Dr. Anders G. J. Rhodin, Director of CRF, in order to facilitate access to information that had been published in the supplanted box turtle newsletter.
We hope we've successfully detected and corrected any lettering corruptions created during scanning.
Note: each scanned map in the article below is oriented with NORTH to the top of the page; the "squiggly" lines seen in most maps are a tracing of the same topographical isoclines, included in the map to provide a reference for where the respective turtles are in the same habitat when comparing different maps.
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Home range establishment by translocated eastern box turtles

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The initial breeding stock for our repatriation project (Belzer, 1996) were donated turtles who had lost their homes. Therefore, our base population is a translocated assemblage. Our policy prohibits collecting animals from (or accepting ones that can be returned to their original homes in) the wild, so that our conservation …

…efforts do not destabilize surviving units among the diminishing pool of wild box turtle populations.

Translocated box turtles do not quickly establish new home ranges (Cook, 1996). Their first years in a new habitat are often characterized by lengthy, unidirectional treks (some in our project exceeded 700 m over 48 h). Homing instinct may incite these linear emigrations (Lemkau, 1970), but our individuals seldom trek toward a previous home. Thus, dispersion (Cook's term), or desertion, rather than homing, may better characterize the activity (see concluding terminology note below).

Dispersion took 25% of Cook's (1996) translocated turtles beyond the boundaries of his 579 hectare site; only 47% of the turtles established new home ranges in that large tract. In our much smaller (80 hectare) habitat at the McKeever Center (well below the 300 hectare repatriation minimum inferred by Cook), dispersion would leave very few turtles in the preserve. We therefore regularly retrieve any animals who move beyond preserve boundaries (or approach dangerous areas) until they establish a home range. All of our turtles (33 in 1998) are monitored by radiotelemetry. We anticipate that hatchlings produced by our breeding core will establish home ranges within our preserve. The translocated adults themselves, however, can engage in varying degrees of dispersion for years (perhaps more than 4 or 5 years).

What follows are simple plots of year to year movements by five of our males (Red, Patch, Guy, Giles, and Jerry). This sample enables us to begin to share our early glimpse at the process of establishing new home ranges in non-native habitat, and the varied dispersal activity that one may see among turtles in a small-habitat repatriation effort.

MAP SERIES: The location of each animal was determined about every 48 h. Arrow heads indicate the ends of movement intervals. An X at the end of a move signifies that the animal was retrieved and carried back to a more central portion of the preserve. The numerical subscripts for the X's provide some sense of sequence amid the confusion of lines. Each map

has a 100 m reference scale. A portion of the same (due north) topographical feature is traced on each map's top, for location/direction comparisons.

SERIES 1 (pg 20): Red (now in his 5th year) seems to be an animal who steadily progressed toward establishing a new home range after his translocation. After the first years of periodic retrieval, he appears to have lost his inclination to launch into linear excursions…

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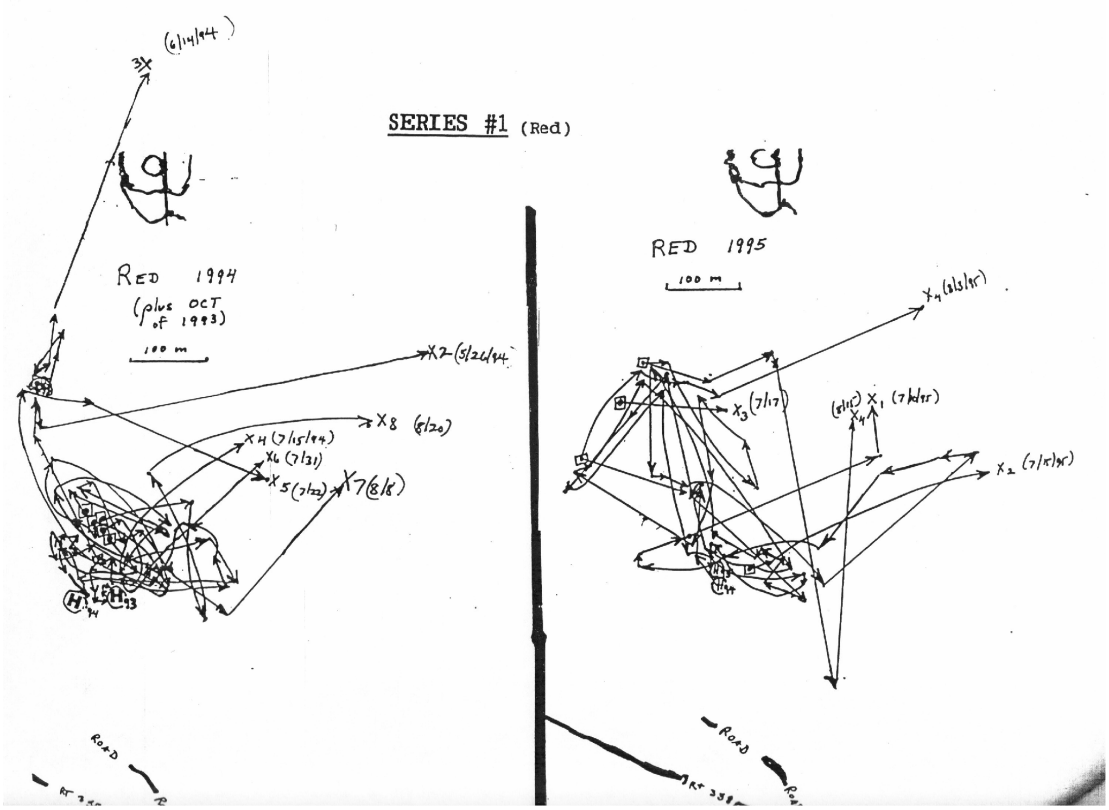
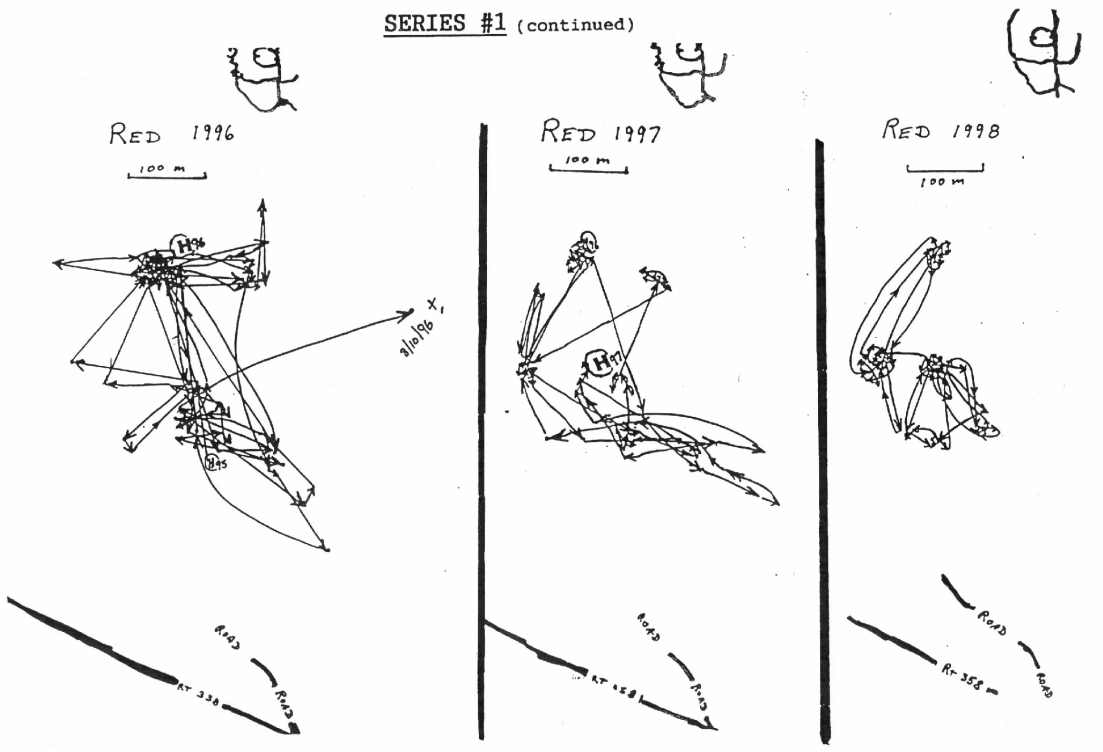
…that take him out of the preserve (note steady decline of number of map X's over 5 years; retrievals* were not needed after his third year). He increasingly developed the habit of returning to some previously used site after an excursion, and the length of his excursions became shorter. The maps indicate a progressive consolidation of habitat-use. The shift (from long, dispersed movement lines) to tangles of short lines concentrated in several areas reflects the increasing time he now spends in just a few preferred sites. Red is not known to have been a captive. (H = hibernaculum; box-enclosed dot = release site following a retrieval)

***author's August 2009 post-publication update:**

After monitoring this turtle's habitat-use for 15 years, in two different sanctuaries, we now believe that for this turtle the retrievals were probably irrelevant to his eventual habitat consolidation. We now believe that, for many box turtles, repeated retrieval and return to a sancuary's core probably has little effect on their eventual habitat-use.(e.g., see abstract at following URL) http://www.boxturtlesintrouble.org/abstracts.html



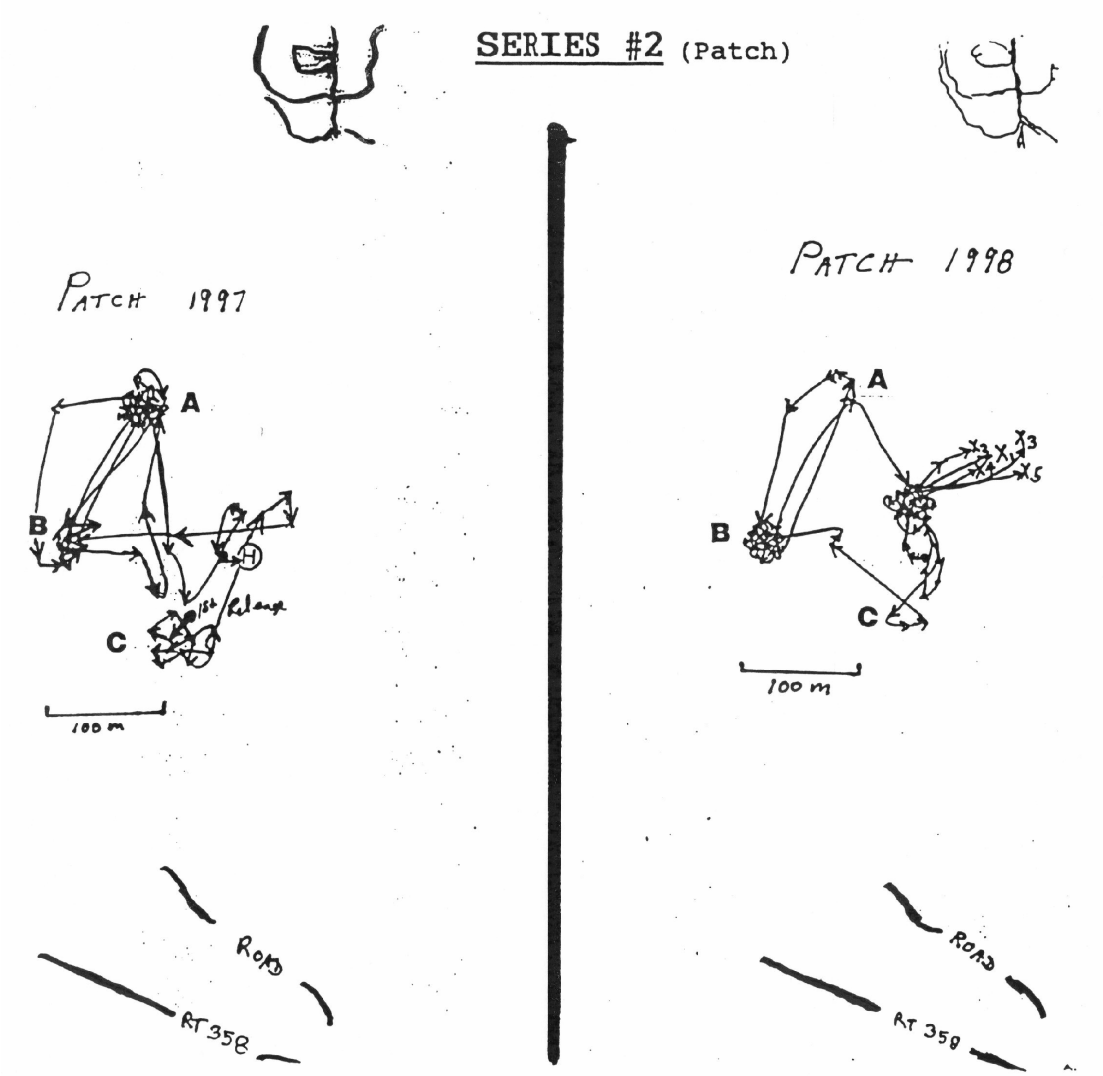


SERIES 2 (pg 20): So far as we know, Patch is a male whose only captivity was his 9-month rehabilitation from a severely fractured carapace. He seemed to begin consolidating habitat use during his very first season at the McKeever Center. He was released (28 May) in a southern zone ("C") and spent about 3 weeks there. On 17 June he moved to the northeast for a few days, next moved to a western site ("B") and spent a few days, and then went to a northern site ("A") for a few days before returning to his western site ("B"). After this tour of those four areas, his subsequent 1997 activity concentrated in two of his previous sites: September 1997 was spent mostly in the northern site "A" interspersed with several sojourns in western site "B". In late September he moved south, veered to the east and hibernated (H). All 1997 movement fell within a 250 m diameter.

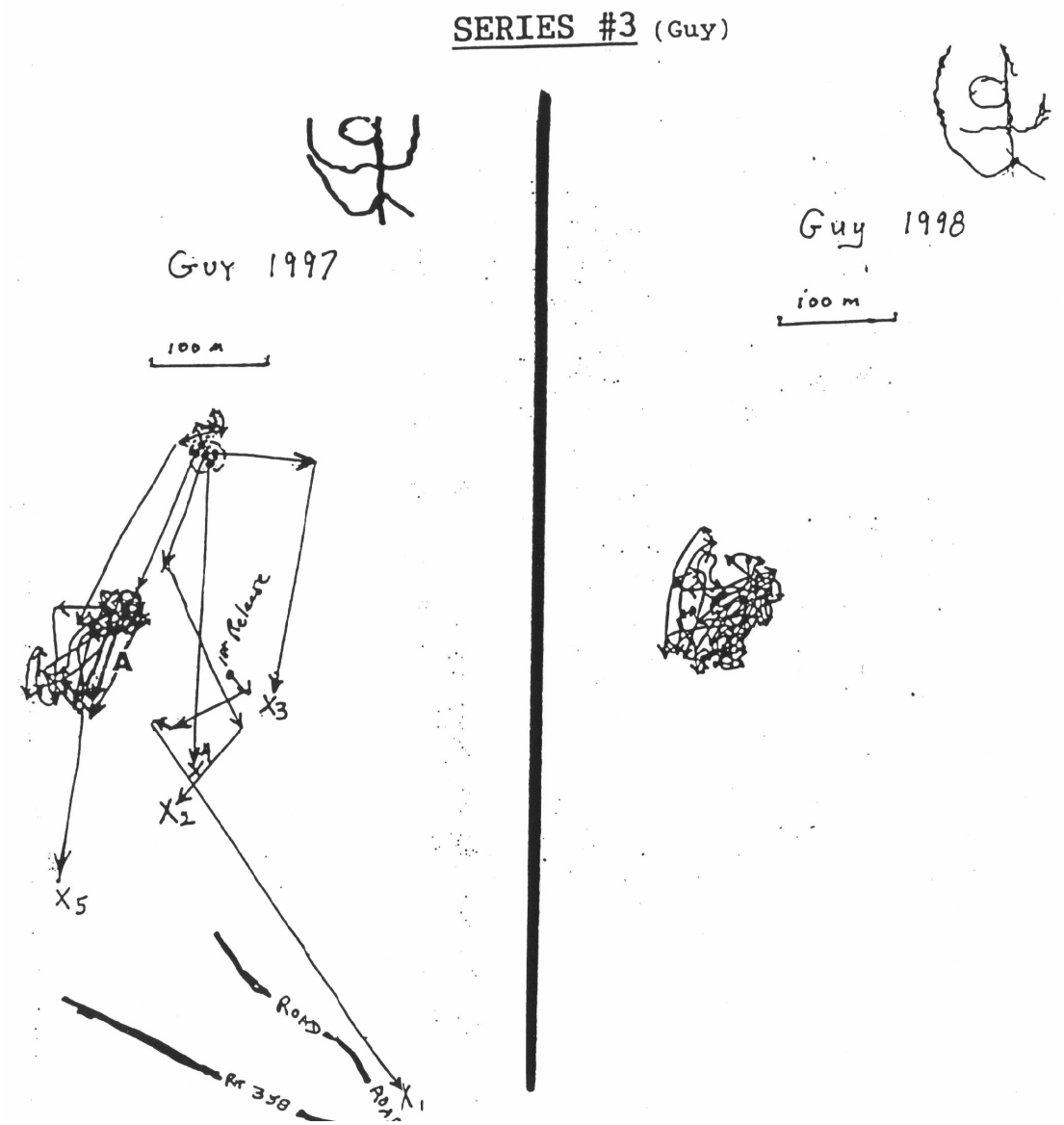
During 1998 he revisited sites (particularly the western area "B") of his first year, but developed an interest in an eastern zone (not far from his 1997 hibernaculum). That eastern area is close (75 m) to a privately mowed picnic area and pond and so excursions from that site toward the ENE bring an animal into a hazardous area. I often had to retrieve Patch during 1998, not because of lengthy excursions but because he had moved the short distance out onto the private recreation area.

Patch, a brightly colored (yellow) male, is one of our two dominant males (Red, above, is the other). Unlike many of our other turtles, Patch has yet to need retrieval because of a lengthy exodus. His confined habitat use (compared to most other of our arrivals) seems in contrast to the relatively more expansive habitat use seen among dominant males in native habitat (Davis, 1981). After small departures, Patch typically returns to some previous location. His failure to use his northern (1997) site during 1998 might be due to the periodic presence of another dominant male (Red) in that area during 1998 (cf. my article on Aggression in this issue). However, I never saw Red and Patch in that northern…

…site at the same time during 1998, so an alternative speculation on Patch's failure to use his northern site during 1998 is that the droughts of summer 1998 limited his activity.



SERIES 3 (pg 21): Guy, too, appears to be a turtle who is establishing a home range very quickly. After his first few weeks in 1997 (during which he engaged in several long flights to the south, followed by retrieval releases in a northern site) he settled into a small (approx. 140 m diameter) western zone ("A" on the map) that straddles a stream. He spent the latter part of 1997 and all of 1998 there. He periodically crosses the stream. During 1998 he ventured little more than 50 m from either bank. This area serves as Patch's (SERIES 2) "western" site. Guy had been a pet for about 5 years. Solid dots inside the dashed circle in the north constitute the area to which Guy was returned after each 1997 retrieval.



SERIES 4 (pg 21): Giles is a perplexing case. His known history does not include captivity. His first season (1994) in the preserve began (July) with two southerly flights. On all 1994 retrievals (after the first) I carried him to a central zone in the preserve ("G" on the map). Following the second retrieval during that first season, his desertions were generally northerly. He hibernated (H) near the retrieval terminus ("G").

Giles spent his second season (1995) continually fleeing to the north. He was retrieved (and returned to area "G") 11 times that season. His 1995 hibernaculum was close to that for 1994 in area "G".

During 1996 (his 3rd season) it appeared that Giles was finally beginning to settle in and develop some site fidelity. He spent two months (from 16 May to 17 July, 1996) in a small area near "G" (site of 1994 & 1995 hibernacula, and of releases after his numerous previous retrievals). But on

July 18 he moved about 170 m south and then spent the next month near a (dried) vernal pond ("D" on the map). In late August he moved still farther south and was returned (X-1 = August 21) to site "G" where he had spent the beginning of this summer. He immediately departed and moved to the far south (below "D"). Retrieval X-2 (August 23, 1996) took him back up to "G". After spending a week at "G" site, he gradually worked his way south (beyond "D"), spent the Fall and hibernated ("H") there.

Giles spent almost all of his fourth summer (1997) in that southern location ("J" on the 1997 map) near his 1996 hibernaculum. His May and June movements were short ones in a windfall area near "J". On June…

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…22,1997 he left the windfall and was moving ESE, so I returned him (X-1) the relatively short distance back to the core of his windfall meanderings ("J"). He remained in there for another week but then made a long move to the SE (out of the preserve) across two streams, at which point I retrieved him (X-2 = July 29, 1997) and took him all the way back to the northern area ("G") where he had spent most of his 1996 (3rd) season. Two days later he was back in his windfall site (approx. 300 m to the south). For the next 3 weeks he remained in that "J" area but when he made a long NE excursion I retrieved him (X-3 = August 20) and returned him to "G" site. He immediately abandoned that site toward the SE. I promptly returned him to "G" again (X-4 = August 22), but he soon departed and over several days moved back to his southern windfall area ("J") to spend the remainder of the summer and hibernate {H} down there barely 20 m from his 1996 hibernaculum.

Because so much of Giles[1]1997 activity was confined to the 150 m diameter area "J", and because he tended to return to that area after any retrievals, I believed he must have found the southern site preferable to "G" and was now establishing some site fidelity for the area. Another possibility was that he might become an animal that uses two home ranges, as Stickel (1950) had found for some T. c. *Carolina.* But early in the 1998 season (his fifth here) he launched off into renewed long (300-700m) desertions (including the longest since his arrival) much farther to the SE (taking him out of the preserve and often close to residential yards and a country road). Since he had not returned to his former northern site ("G"), I released him up there after each of the many 1998 retrievals to see if it might rekindle some fidelity for the area. After one of the retrievals, he remained there for two weeks during drought conditions (a probable manifestation of *T. c. Carolina's* propensity to minimize activity during drought, rather than any fidelity for the site) but then resumed his lengthy site desertions toward the south after a rain storm.

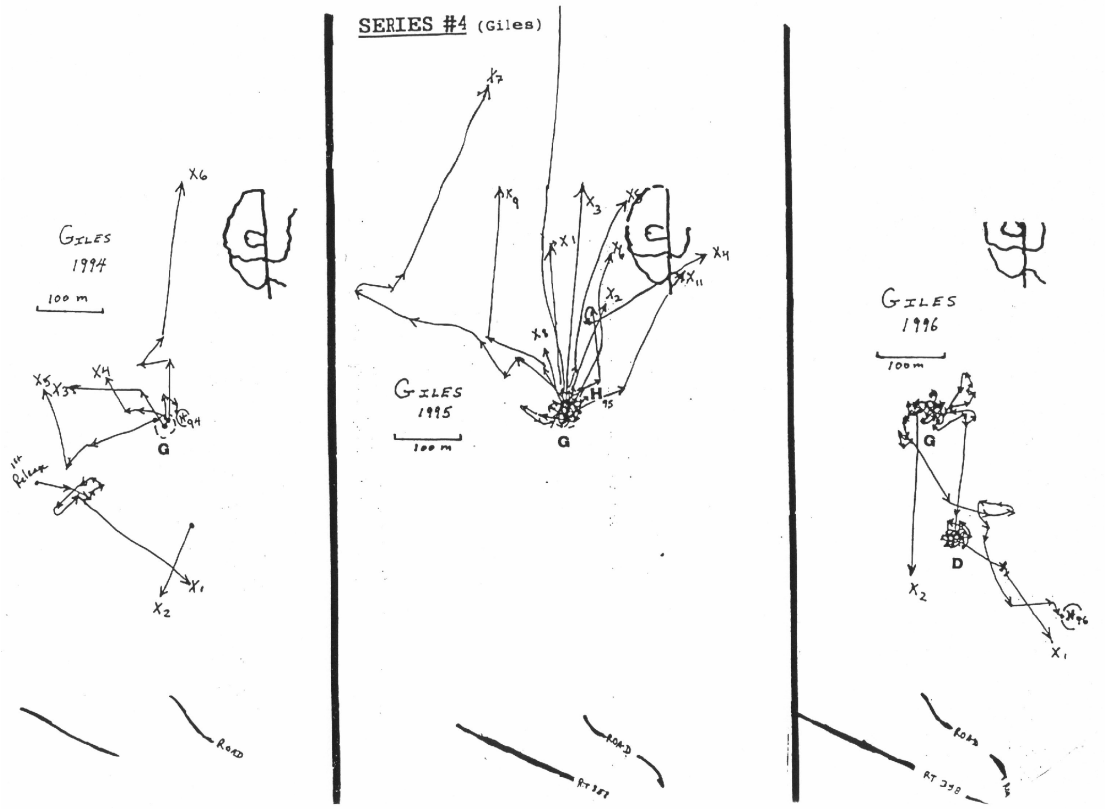
Thus, while Giles twice seemed to be settling into a home range ("G" during his third, and "J" during his fourth, season), he relapsed into desertion behavior (long linear moves) during his fifth summer. He has yet to demonstrate genuine site fidelity. This behavior by Giles suggests that translocated turtles who appear to be settling into a new habitat may revert to desertion activity, typical of a newly released turtle, even after years in the habitat.

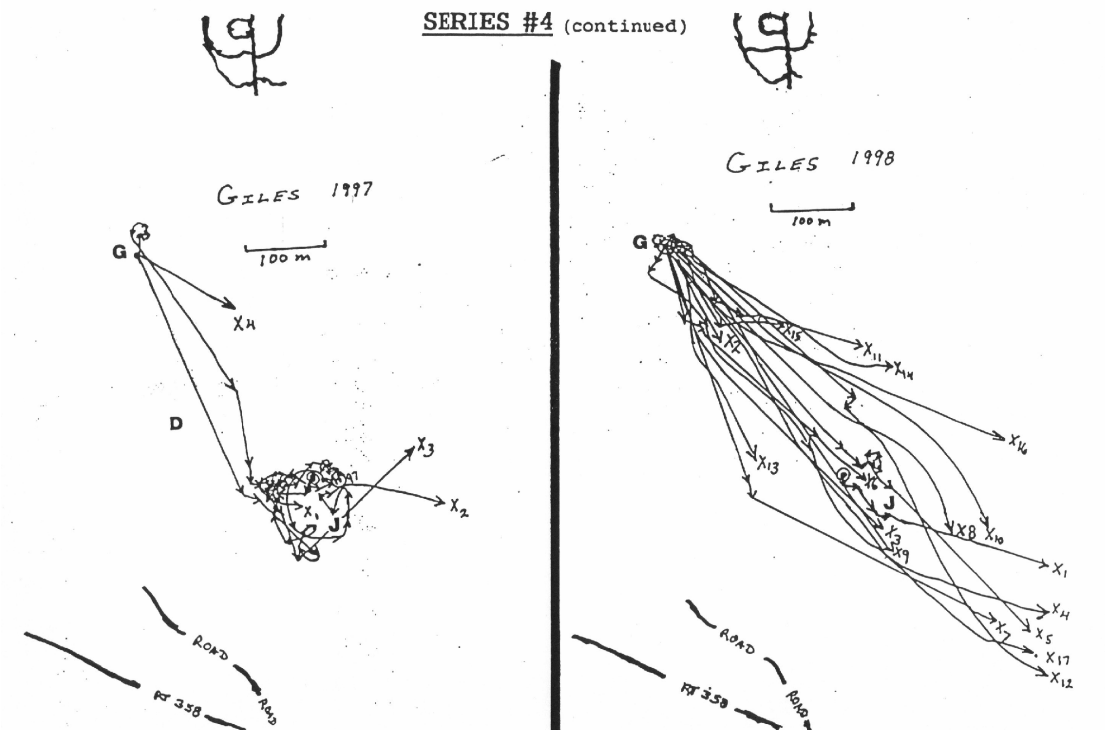
This prospect is echoed by another male who was added to the habitat late in the summer of 1996. That animal hibernated near the base of a tree in 1996. In…

…summer of 1997 he moved from his hibernaculum to an area about 300 m to the south and remained in that locale with noteworthy consistency (excepting a few excursions) most of the summer, suggesting that he might be developing site fidelity. During Fall 1997 he left his southern area and returned very close to his 1996 hibernaculum in the north; the following day he was again 300 m to the south in his summer site actively digging (as if to hibernate); the day after that he

was back in the northern site and had dug into the soil and entered hibernation only 1 m from his 1996 hibernaculum. It seemed as if his attempt to dig a hibernaculum in his summer abode didn't satisfy something and so he returned to a more proven site. I regarded this as suggestive that he was already learning characteristics of his new environment and was developing some preferences and fidelity for sites that met certain of his needs. However, during the summer of 1998, after returning to his "summer site" (300 m south of his hibernaculum), he began to abandon that southern area and flee (often 400 m before we caught up with him) even further to the south (out of the McKeever preserve and dangerously close to a road and human habitation).

Thus, the steady progression of consolidating habitat-use (and apparent site fidelity) that we see for Red (SERIES 1) during his first five seasons may not be taken as a norm. This means that studies of home range development may require 4 or 5 years (or more?) of data, beyond a season when a turtle first appears to have developed fidelity for a site, in order to assess whether a stable home range has truly been established.

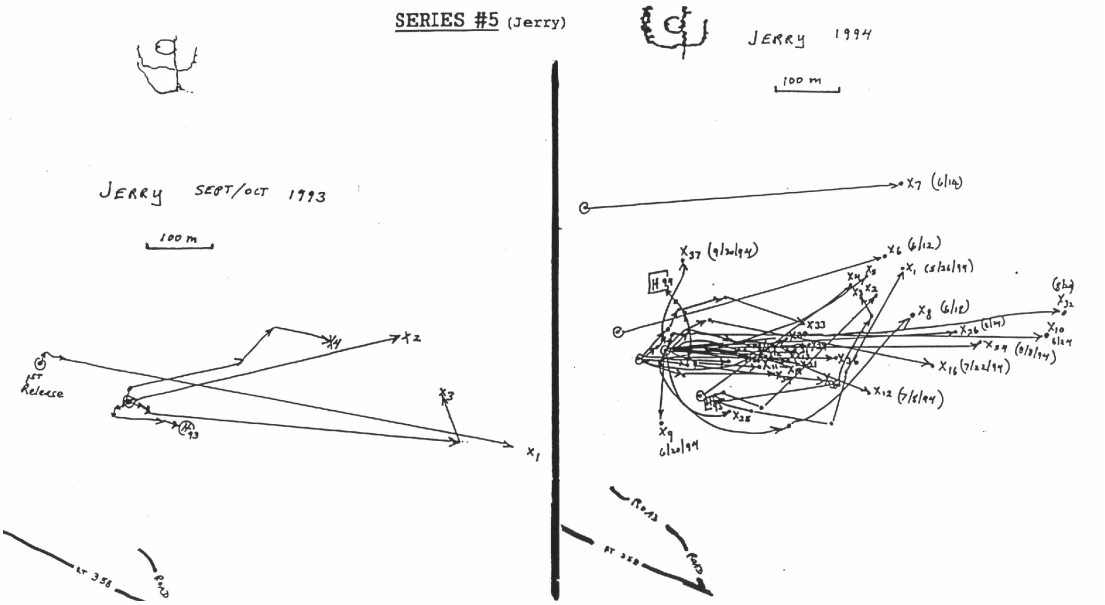




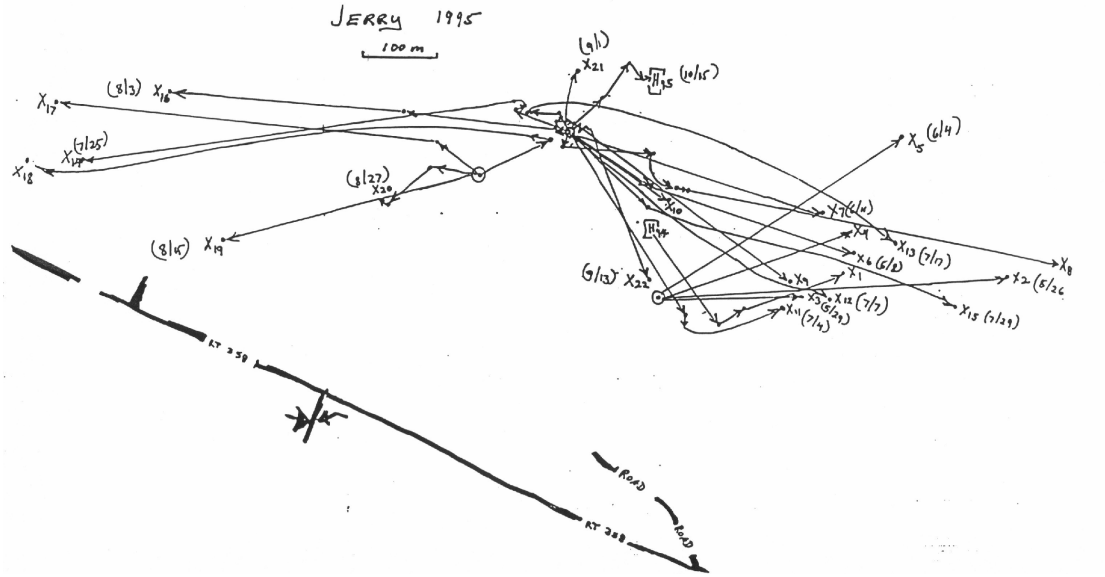
SERIES 5 (pg 22): Jerry was a male who had been in captivity at a middle school for about 5 years after being rehabilitated from near starvation during a previous captivity. He never consolidated his habitat use (note large number of map X's each year) during four years. His 4th season (the last we have data on him) was associated with some of his longest desertion moves; I had to retrieve him on almost every check that year (1996) because he covered so much ground each day (sometimes he cleared 500 m in one day).

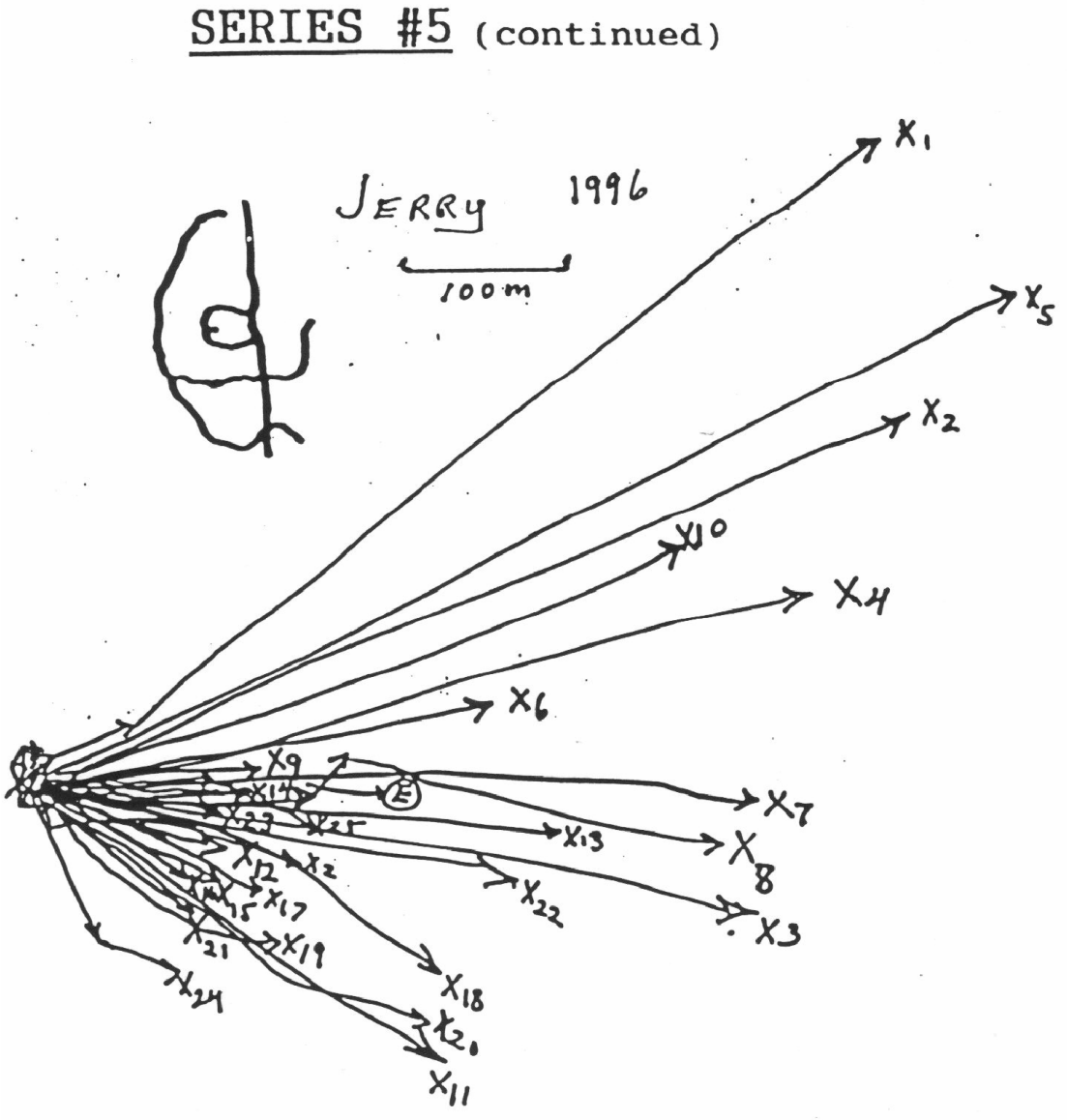
Jerry's behavior may indicate that spans approaching a decade might be necessary for some translocated turtles to establish a new home range***(*see author's Aug 2009 update above)**; or it may indicate that Jerry was a "transient" by nature (Kiester et al. 1982), retained that disposition throughout his lengthy captivity, and would never have settled into a habitat. …

SERIES #5 (Jerry)



SERIES #5 (continued)





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TERMINOLOGY NOTE: There is abundant evidence for box turtle homing ability (Lemkau, 1970; Madden, 1975; Mathis & Moore, 1988; Metcalf,1978; Posey,1979; Stickel,1989). Lemkau (1970) & Posey (1979) found that *T. c. carolina,* displaced short distances (approx. 1 km) from home, initiate long, unidirectional moves in the general direction of home. As our data accumulated, however, I abandoned using the term "homing" for the lengthy, linear moves we see for most of our newly tanslocated turtles because their directions were seldom toward the last known home. For example, Red, whose first long moves were to the north, then NE, came to us as a rescue from a wood lot being timbered about 45 km due east. Jerry, whose first 2.5 years of site desertion were almost always to the east, came to us from about 150 km to the WSW.

Two recent arrivals, one originating 150 km to the south and the other about 350 km to the southeast, persisted in making frequent excursions of 150-60Gm to the north and northeast during the entirety of

their first summer at McKeever. In fact, among our turtles, whose origins (none being near our preserve) are rather reliably known, the original dispersal bearings for only 20% were in the general direction of their previous residences.

Duration of captivity, distance from site of origin, number of different previous "homes", etc. might disrupt the expected (Lemkau, 1970; Posey, 1977) ability for accurate unidirectional homing by displaced box turtles. With our present data, I discern no associations between individual circumstances and the direction of flight in our population (e.g. animals who disperse in directions opposite from their origins include both those who were formerly in captivity and those who {so far as we know} were not). Some correlations might become apparent as many more cases of translocated turtles are observed. In any case, homing would seem to be a misleading appellation for the dispersal activity displayed by our translocated turtles.

Moreover, among some of the animals who persistently deserted our site over consecutive years, notable changes in the direction of their lengthy treks arose (e.g. see Giles, SERIES 4, above). The most remarkable example is seen for Jerry (map SERIES 5, above), a male who had been a captive (born in the wild) WSW of McKeever. Notice that for 2.5 yr he persistently fled to the east or ESE; then in late July of his 3rd season his long flights abruptly headed in the opposite direction for several weeks. During his 4th year his long desertions generally headed E, NE & SE. During one of his eastward flights (marked by "E") in July 1996, a…

…predator destroyed his rubber transmitter holder, leaving behind the transmitter and a trail of debris from the holder. We never saw Jerry again. In four years, despite the changes in direction of "flight", Jerry didn't move toward his WSW origins. Although our intervention to retrieve far ranging individuals adds a variable of unknown effect on such direction changes, it would not have affected the animals' initial dispersal directions.

See Literature Cited at the end of this newsletter.