Odonatologica 12(2): 167-172 *June 1, 1983*

THE DEMOGRAPHICS AND HABITAT UTILIZATION OF ADULT *ARGIA SEDULA* (HAGEN) AS DETERMINED BY MARK-RECAPTURE ANALYSIS (ZYGOPTERA: COENAGRIONIDAE)

J.V. ROBINSON[1], J.E. DICKERSON[2] and D.R. BIBLE[3]

[1]Department of Biology, The University of Texas at Arlington, Arlington, Texas 76019, United States

[2]Entomology Department, University of California, Davis, California 95616, United States

[3]Biology Department, Syracuse University, Syracuse, New York 13210, United States

Received October 20, 1982 / Accepted January 18, 1983

Adult *A.sedula* individuals were marked and recaptured daily throughout a one month period. Males had a daily survivorship of 0.79 and averaged 4.43 days between their first and last capture. Multiple matings by males can parsimoniously be considered a random event. A temporal shift in perching structure usage away from emergent *Sagittaria* toward algal mats is documented. This shift occurred as the *Sagittaria* became more dense.

INTRODUCTION

Argia sedula (Hagen) is a nearctic zygopteran which ranges from Canada to Mexico, and is widespread in Texas (NEEDHAM & HEYWOOD, 1929; JOHNSON, 1972). It is often found along the banks of slow moving streams and ditches (WILLIAMSON, 1900; WALKER, 1953) where males station themselves awaiting the arrival of mature females. The species is sexually dimorphic; males are blue and black in general appearance while females have rusty coloration. Despite a moderate amount of research existing concerning the demographics (BORROR, 1934; BICK & BICK, 1965a; GARRISON, 1978) and reproductive behavior (BICK & BICK, 1965a, 1965b, 1982) of congenerics, little such information exists for this species (BICK & BICK, 1980). We here present the results of a mark-recapture study of imaginal *A. sedula* which primarily focuses on mature males.

STUDY SITE

A 220 m linear section of Trading House Creek, which traverses the campus of The University of Texas at Arlington in an east-west direction, was used for this research. This section has a maximum width of 9.2 m and minimum width of 5.6 m and is completely lined on both sides and bottom by cement paving which has been silted over. It is subdivided into two nearly equal portions by a walkway. One of these main sectors is essentially free of emergent vegetation while the other has a patch of *Sagittaria platyphylla* which grew in size and density throughout the study. Algal mats sporadically occur throughout the site. A 0.6 m horizontal cement border lines the northern edge of the creek. This border was marked off into 44 adjacent 5 m sectors which were used to obtain data regarding the spatial distribution of *A. sedula;* sectors 1-22 were located west of the walkway while the remaining sectors were on the eastern side. Sectors 16-20 were characterized as being the only region having emergent vegetation, albeit sparse, at the start of the project. Both the north and south ends of this site are bordered by heavily shaded regions within which *A. sedula* was uncommon. The open environment provided by this portion of the creek thus constituted a relatively discrete habitat for this species.

Other zygopterans collected at this site during this study were *A. tibialis, A. fumipennis, A. plana, Enallagma basidens, E. signatum, E. civile, E. exsulans, Anomalagrion hastatum, Ischnura posita* and *Telebasis salva.* During the initial stages of the project *A. sedula* was the most common species but, based on our subjective opinion, it was surpassed in abundance by several species as the research continued.

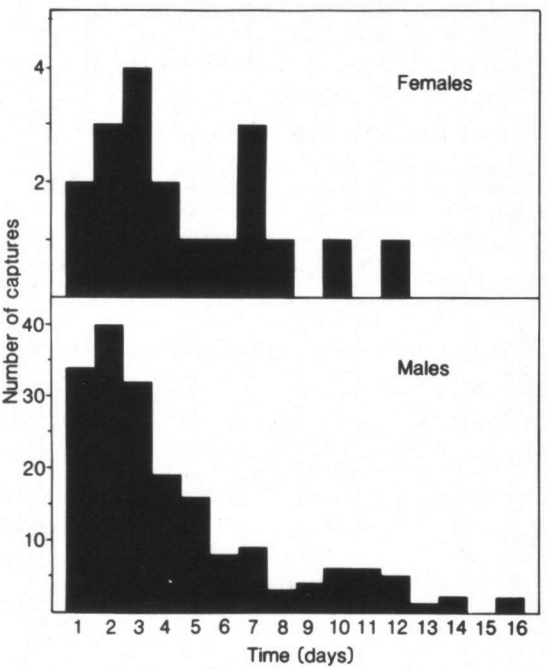

Fig. 1 The time interval between the first and last capture for recaptured males and females.

METHODS

Mature *Argia sedula* were collected daily from 21 May 1982 to 18 June 1982. Heavy rains on 31 May and 19 June reduced their activity sufficiently to prevent any captures on these dates. Individuals were uniquely marked with indelible ink on their wings and then immediately released in the same sector in which they had been captured. The individual's sex, the sector of its capture and the type of structure it used to perch were recorded for each capture. It was also noted whether or not

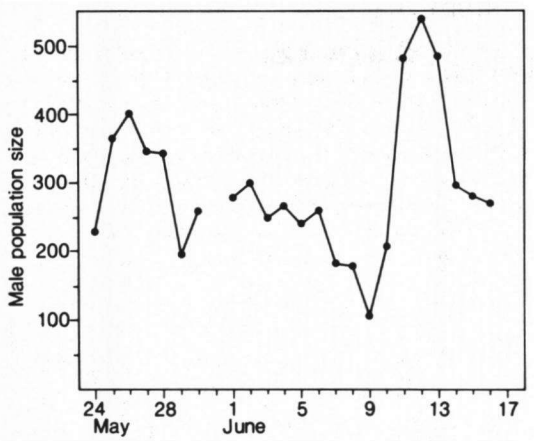

Fig. 2 Three day moving averages of estimated male population size.

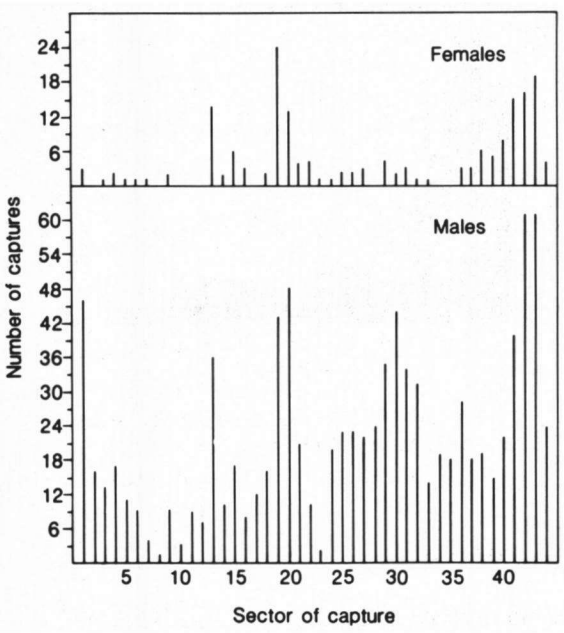

Fig. 3 The spatial pattern of habitat usage by males and females broken down into 5 m segments.

the individual was part of a tandem pair.

The capture-recapture data were analyzed using the Jolly-Seber stochastic methodology (JOLLY, 1965; SOUTHWOOD, 1978). Since 80% of the initially marked individuals were males, the data presented regarding population size and daily survivorship are confined to this sex. This prevents confounding our conclusions with potential differences in the life histories of the two sexes, yet still provides a large sample size for analysis.

RESULTS AND DISCUSSION

A total of 733 individuals (584 males) were initially captured and marked during this study. One hundred eighty five of these males were subsequently recaptured, as were 19 females. The time interval between first and last capture for recaptured individuals averaged 4.43 days for males and 4.70 days for females (Fig. 1). These values are within the range previously reported for other zygopterans (e.g. *Pyrrhosoma nymphula* 6.7 d (CORBET, 1952); *Lestes australis* males 9.9 d, females 9.2 d (BICK & BICK, 1961); *Enallagma civile* males 3.5 d, females 3.1 d (BICK & BICK, 1963); *E. praevarum* males

Table I

The numbers of times individual males were captured while they were in tandem contrasted with expected values derived from a Poisson distribution (mean = 0.182)

Number of tandem captures of individual males	Observed frequency	Expected frequency
0	805	798.1
1	136	145.8
2	19	13.3
3	1	0.8

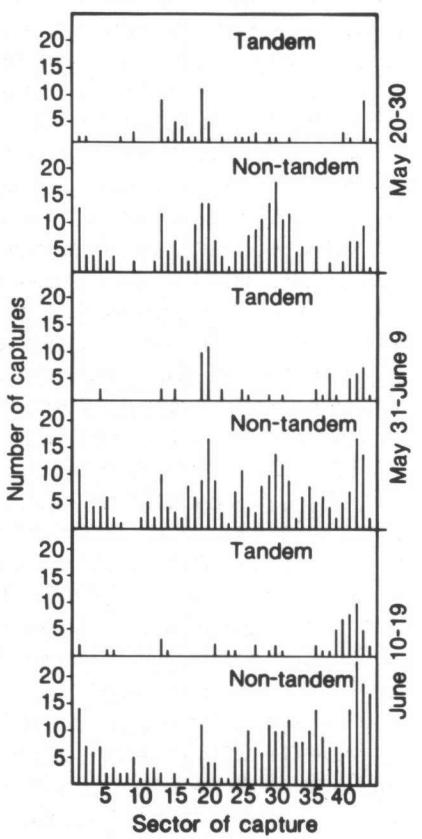

Fig. 4 The spatial pattern of habitat usage by tandem and non-tandem males during the first, second and third ten days of the study.

5.0 d, females 5.5 d (JOHNSON, 1964); *Argia apicalis* males 8.4 d, females 7.0 d (BICK & BICK, 1965). The estimated male population size through time is depicted in Figure 2. The average daily probability of survivorship for males was 0.79.

Of all male captures 18.2% occurred during their tandem pairing with females. There was a statistically greater (a 2x2 contingency analysis, $0.01 < P < 0.05$) fraction of unmarked males captured in tandem (20.3%) than recaptured males so engaged (17.6%). This plausibly reflects an age effect in individual fitness since recaptured individuals are on average, presumed to be older than initially captured males. While this difference is statistically significant its practical importance is moot due to the closeness of these values. The number of times particular males were captured while engaged in reproductive activity is presented in Table I. These data were used to test the null hypothesis that males randomly obtained access to females by comparing the actual frequency distribution of pairings per male with expected values obtained from a Poisson statistical

distribution having a mean of 0.182. The closeness of observed and expected values strongly supports the hypothesis of random mating for males (Tab. I).

The spatial use of the site by males and females is depicted in Figure 3. A temporal shift in habitat use is indicated in Figure 4 where the capture location of non-tandem and tandem males is shown during the early, middle and late stages of the study. The most prominent feature of this shift is away from the *Sagittaria* dominated sectors toward the eastern edge of the site which had a higher density of floating algal mats. This preference shift away from *Sagittaria* toward algal mats is emphasized by the change in perching structures utilized (Fig. 5). Note that even though reproductive activity appeared to correspond with general peaks in the locations of males, other sectors also had comparable usage. We believe that these sectors constitute the acceptable portions of this habitat while the low usage areas either reflect undesirable regions or regions more difficult to sample. Sectors 1-11 constitute that portion of the creek which is most narrow and also partially shaded. Individuals might have avoided capture by relocating to the opposite bank more easily in this region than the other sectors which were all approximately 9 m wide. Sectors 33 and 34 are situated immediately under a footbridge which cast a midday shadow upon them while sector 23 corresponds to the walkway mentioned in the description of the study site. *A. sedula* activity was observed to be closely correlated with bright sun hence shaded regions would presumably often be avoided. Foot traffic over the walkway might likewise serve as a deterrent to high densities.

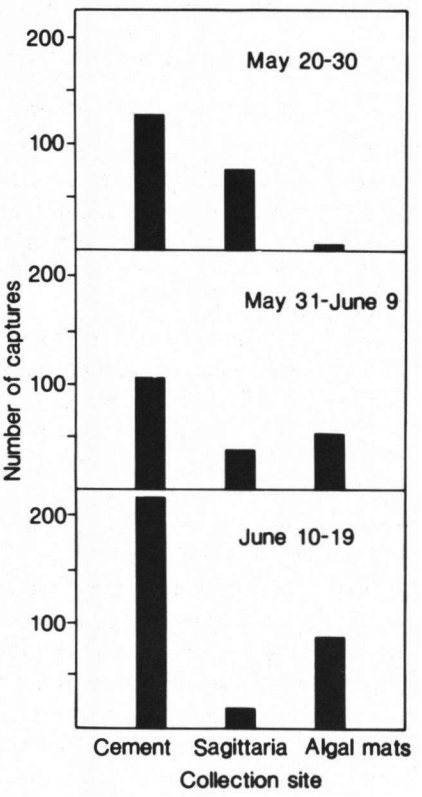

Fig. 5 Perching structure type usage during the first, second and third ten days of the study.

The high densities of non-tandem males in regions without tandem pairs suggest that these males either do not recognize advantageous locations for obtaining females or that females arrive at the aquatic site randomly, are joined by a male, and then move in tandem to a desirable site for reproductive activity.

ACKNOWLEDGEMENTS

We thank Mr. KEITH KENNEDY for executing the drawings for this paper. This work was supported by NSF grant DEB-8010919 to JVR and by a Texas Utilities Generating Co. grant to DRB.

REFERENCES

BICK, G.H. & J.C. BICK, 1961. An adult population of Lestes disjunctus australis Walker (Odonata: Lestidae). *SWest. Nat.* 6: 111-137.

BICK, G.H. & J.C. BICK, 1963. Behavior and population structure of Enallagma civile (Hagen) (Odonata: Coenagrionidae). *SWest. Nat.* 8: 57-84.

BICK, G.H. & J.C. BICK, 1965a. Demography and behavior of the damselfly, Argia apicalis (Say) (Zygoptera: Coenagriidae). *Ecology* 46: 461-472.

BICK, G.H. & J.C. BICK, 1965b. Color variation and significance of color in reproduction in the damselfly Argia apicalis (Say) (Zygoptera: Coenagriidae). *Can. Ent.* 97: 32-41.

BICK, G.H. & J.C. BICK, 1980. A bibliography of reproductive behavior of Zygoptera of Canada and conterminous United States. *Odonatologica* 9: 5-18.

BICK, J.C. & G.H. BICK, 1982. Behavior of adults of dark-winged and clear-winged subspecies of Argia fumipennis (Burmeister) (Zygoptera: Coenagrionidae). *Odonatologica* 11: 99-107.

BORROR, D.J., 1934. Ecological studies of Argia moesta Hagen (Odonata: Coenagrionidae) by means of marking. *Ohio J. Sci.* 34: 97-108.

CORBET, P.S., 1952. An adult population study of Pyrrhosoma nymphula (Sulzer): (Odonata: Coenagrionidae). *J. Anim. Ecol.* 21: 206-222.

GARRISON, R.W., 1978. A mark-recapture study of imaginal Enallagma cyathigerum (Charpentier) and Argia vivida Hagen (Zygoptera: Coenagrionidae). *Odonatologica* 7: 223-236.

JOHNSON, C., 1964. Mating expectancies and sex ratio in the damselfly, Enallagma praevarum (Odonata: Coenagrionidae). *SWest. Nat.* 9: 297-304.

JOHNSON, C., 1972. The damselflies (Zygoptera) of Texas. *Bull. Fla St. Mus.* 16: 55-128.

JOLLY, G.M., 1965. Explicit estimates from capture-recapture data with both death and immigration - stochastic model. *Biometrika* 52: 225-247.

NEEDHAM J.G. & H.B. HEYWOOD, 1929. *A handbook of the dragonflies of North America.* Thomas, Springfield.

SOUTHWOOD, T.R.E., 1978. *Ecological methods with particular reference to the study of insect populations.* Chapman & Hall, London.

WALKER, E.M., 1953. *The Odonata of Canada and Alaska,* Vol. 1. Univ. Toronto Press, Toronto.

WILLIAMSON, E.B., 1900. The dragonflies of Indiana. *Rep. Indiana St. Geol.* 24: 229-333.