

**ONTOGENETIC COLOR CHANGE IN
ISCHNURA KELLICOTTI WILLIAMSON FEMALES
(ZYGOPTERA: COENAGRIONIDAE)**

J.V. ROBINSON and W.H. JORDAN

Department of Biology, University of Texas at Arlington,
Box 19498, Arlington, TX 76019-0498, United States

Received June 10, 1995 / Reviewed and Accepted August 18, 1995

I. kellicotti has been classified as a sp. with dichromatic females. By marking orange females it is demonstrated that they change color ontogenetically into the blue form. Orange and blue females were dissected and all blue forms contained mature eggs, but no orange females held eggs. Blue females averaged 28.3 mg, while orange individuals averaged 20.8 mg. It is concluded that there is no evidence that this sp. has dichromatic females.

INTRODUCTION

Complex intraspecific color variations are well known in female ischnuran damselflies. Populations containing dichromatic females have been documented for many species (e.g. *I. elegans*, PARR & PALMER, 1971; HINNEKINT, 1987; – *I. damula*, JOHNSON, 1975; – *I. graellsii*, CORDERO, 1990a, 1990b). Other ischnuran species are categorized as having monochromatic females displaying ontogenetic changes in coloration (e.g. *I. perparva*, KENNEDY, 1915). Still others develop age related pruinescence of such intensity that their underlying colors are obscured (e.g. *I. verticalis*, GRIEVE, 1937). Taxonomic guides often assign ischnuran species to such categories without providing supporting documentation regarding how such assignments have been determined.

Ischnura kellicotti Williamson is described as a species containing dichromatic females (NEEDHAM & HEYWOOD, 1929; JOHNSON & WESTFALL, 1970; JOHNSON, 1972). No published data exist for potentially falsifying the alternative hypothesis that these color forms represent ontogenetic stages. We consider such data in this research.

METHODS AND RESULTS

Thirty one orange females were collected and marked on their wings with indelible ink during a 3 day period, 22-24 June 1991, at Veteran's Park Pond in Tarrant Co., Texas USA (ROBINSON, 1983). On day 2, one of these females was resighted with the blue coloration of the andromorph form. Another individual sighted on that day was in a state of color transition; blue replaced orange everywhere except on her legs (cf. DUNKLE, 1990). On day 3 another "heteromorph" was sighted as an "andromorph".

Twenty two females were captured, weighed, and dissected to determine the presence of mature eggs. Blue females ($\bar{X} = 28.3$ mg) weighed significantly more ($F = 33.97$, $P < 0.0001$) than orange females ($\bar{X} = 20.8$ mg). This weight differential corresponds to the presence of mature eggs in the blue form. All 10 blue females contained mature eggs, but none of the 12 orange females carried eggs. The Fisher Exact Test indicates that this difference is significant ($P < 0.0001$).

DISCUSSION

Ischnura kellicotti females show age-related color change. This color change appears to be associated with the attainment of reproductive maturity. No evidence exists that this species contains dichromatic females.

Like many ischnurans, *I. kellicotti* males and females are commonly found together at ponds without accompanying mating activity. The few copulations we observed occurred early in the morning. When copulating pairs were netted, the female was usually of the intermediate color form (i.e., with orange legs). It is not clear whether male recognition of female receptiveness is related to female coloration or whether the female modifies her behavior. FINCKE (1987) reports that *I. verticalis* females become more receptive to males as they approach reproductive maturity. This is accompanied by color change and less frequent copulation refusal displays in *I. verticalis*. *I. kellicotti* females do not utilize an active copulation refusal display to nearby males and yet they are rarely harassed. Interestingly, males and both blue and orange females adopt a resting posture on lily pads (DUNKLE, 1990) in which their abdomen parallels the leaf except for the last few segments which curl down such that segment 10 touches the lily pad. This normal posture is quite similar to the downward abdomen bending display many ischnuran females use to refuse copulations. This posture potentially represents a "constant" refusal display that may be modified only at times of receptivity.

The evolutionary maintenance of dichromatisms in damselfly females has interested many researchers (TILLYARD 1905, JOHNSON 1975, ROBERTSON 1985, HINNEKINT 1987, CORDERO 1990a, FORBES 1990). Considerable effort can be expended testing the hypotheses generated from this interest. Yet, selective pressures that maintain dichromatism within a population need not correspond to those

maintaining age related color change. It is of particular importance that the form of color variation be verified before a species is used as a study system to test such hypotheses.

It is unclear whether the coloration systems of other ischnuran species have been misclassified. A candidate for misclassification is *I. heterosticta*. TILLYARD (1905) describes the andromorphic form as having an abdomen almost as thin as that of the male and the heteromorph possessing a much stouter abdomen. He postulates that the andromorph might be mimicking the male which constitutes an unsatisfactory meal for predators. Alternatively, the thinner "andromorph" may simply represent individuals without eggs, similar to the orange *I. kellicotti*.

REFERENCES

- CORDERO, A., 1990a. The adaptive significance of the prolonged copulations of the damselfly, *Ischnura graellsii* (Odonata: Coenagrionidae). *Anim. Behav.* 40: 43-48.
- CORDERO, A., 1990b. The inheritance of female polymorphism in the damselfly *Ischnura graellsii* (Rambur) (Odonata: Coenagrionidae). *Heredity* 64: 341-346.
- DUNKLE, S.W., 1990. *Damselflies of Florida, Bermuda and the Bahamas*. Scient. Publishers, Gainesville, FL-Washington, DC. [Nature Guide No. 3].
- FINCKE, O.M., 1987. Female monogamy in the damselfly *Ischnura verticalis* Say (Zygoptera: Coenagrionidae). *Odonatologica* 16: 129-143.
- FORBES, M.R.L., 1990. Female morphs of the damselfly *Enallagma boreale* Selys (Odonata: Coenagrionidae): a benefit for androchromatypies. *Can. J. Zool.* 69: 1969-1970.
- GRIEVE, E.G., 1937. Studies of the biology of the damselfly *Ischnura verticalis* Say, with notes on certain parasites. *Entomologica am.* 17: 121-153.
- HINNEKINT, B.O.N., 1987. Population dynamics of *Ischnura e. elegans* (Vander Linden) (Insecta: Odonata) with special reference to morphological colour changes, female polymorphism, multiannual cycles and their influence on behaviour. *Hydrobiologia* 146: 3-31.
- JOHNSON, C., 1972. The damselflies (Zygoptera) of Texas. *Bull. Fla St. Mus. (Biol. Sci.)* 16: 55-128.
- JOHNSON, C., 1975. Polymorphism and natural selection in ischnuran damselflies. *Evol. Theor.* 1: 81-90.
- JOHNSON, C. & M.J. WESTFALL, 1970. Diagnostic keys and notes on the damselflies (Zygoptera) of Florida. *Bull. Fla St. Mus.* 15: 45-89.
- KENNEDY, C.H., 1915. Notes on the life history and ecology of the dragonflies (Odonata) of Washington and Oregon. *Proc. U.S. natn. Mus.* 49: 259-345.
- NEEDHAM, J.G. & H.B. HEYWOOD, 1929. *A handbook of the dragonflies of North America*. Thomas, Springfield.
- PARR, M.J. & M. PALMER, 1971. The sex ratios, mating frequencies and mating expectancies of three coenagriids (Odonata: Zygoptera) in Northern England. *Ent. scand.* 2: 191-204.
- ROBERTSON, H.M., 1985. Female dimorphism and mating behaviour in damselfly, *Ischnura ramburi*: females mimicking males. *Anim. Behav.* 33: 805-809.
- ROBINSON, J.V., 1983. Effects of water mite parasitism on the demographics of an adult population of *Ischnura posita* (Hagen) (Odonata: Coenagrionidae). *Am. Midl. Nat.* 109: 169-174.
- TILLYARD, R.J., 1905. On dimorphism in the female of *Ischnura heterosticta*, Burm. *Proc. Linn. Soc. N.S. Wales* 30: 302-306.