NOTES AND NEWS

NOTES ON THE SO-CALLED “BLUE COLOR PHASE”
IN NORTH AMERICAN CAMBARID CRAWFISHES
(DECAPODA, ASTACOIDEA)

BY

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Recently, members of the Mississippi Natural Heritage Program provided me with a photograph and specimen of a “blue” member of Procambarus (Ortmannicus) jaculus Hobbs & Walton, 1957. This precipitated a reaction leading to this report of some of my experiences and impressions of the so-called “blue color phase” seen in some individuals in some North American populations of crawfishes.

Blue is not an unusual color in crawfishes and is common in the Nephropoidea. In the former, the color apparently results from various protein conjugations with the carotenoid astaxanthin (Fox, 1953; Goodwin, 1960). The resulting colors include greens, blues and purples, as well as the more characteristic browns; if the protein is denatured, the color is red. Black (1975) recognized at least four shades of blue in Procambarus (Ortmannicus) acutus acutus (Girard, 1852) and Momot & Gall (1971) gave an excellent summary of the reported variants known at that time plus explanations of the possible causes for the unusual individuals.

In the Cambaridae (superfamily Astacoidea) a blue ground color is normal in several, remotely related species. Among these are Procambarus (Girardiella) hagenianus (Faxon, 1884) (both subspecies), P. (G.) barbiger Fitzpatrick, 1978, P. (G.) cometes Fitzpatrick, 1978, Cambarus (Depressicambarus) cymatilis Hobbs, 1970, C. (D.) harti Hobbs, 1981, C. (Jugicambarus) gentryi Hobbs, 1970, C. (J.) monongalensis Ortmann, 1905, C. (Lacunicambarus) diogenes ludovicianus Faxon, 1885, and a strong lavender color is characteristic of Fallicambarus (Creaserinus) byersi (Hobbs, 1941). Hobbs has encountered the blue color in populations of the widely divergent genus Astacoides from Madagascar (pers. comm.). Cambarids in which blue color variants have been reported include C. (Cambarus) bartonii (Fabricius, 1798), C. (J.) carolinus (Erichson, 1846), C. (J.) dubius Faxon, 1884, Orconectes immunis (Hagen, 1870), O. virilis (Hagen, 1870), P.

Crustaceana 52 (3) 1987, E. J. Brill, Leiden
317

(Hagenides) advena (LeConte, 1856), P. (O.) acutus acutus, and P. (Scapulicambarus) clarkii (Girard, 1852). Further, blue—especially darker hues—is significant in the banding patterns which Hobbs (1958) considers a “primitive” condition in the family. In the family Astacidae (Astacoidea), such varieties are noted for Pacifastacus sp. (North America; Hand, 1954) and Astacus sp. (Europe; Lereboullet, 1851). As an example of outgroup similarity, National Geographic (1961, 119(6): 805) has a color photograph of blue juveniles of Homarus americanus; H. Milne Edwards encountered in the Massachusetts (U.S.A.) State Lobster Hatchery at Oak Bluffs.

Various explanations have been proposed to account for these color variations. There is, however, only one set of experimental data for the question, as far as I know. Black (1975) provided convincing evidence that a blue color variant in P. acutus acutus from Louisiana (U.S.A.) was the result of a recessive allele in a simple Mendelian system in which the “wild” allele had complete penetrance. Likewise, the arguments given by Momot & Gall (1971) in favor of a genetic basis for the blue variants they encountered in Michigan (U.S.A.) seem well taken, although not supported by concrete evidence such as that provided by Black. I acquired a blue female of P. acutus acutus (26 March 1977; Satsuma, Mobile County, Alabama, U.S.A.) which I sent to Dr. Black. He advised me (pers. comm., 13 October 1978) that breeding experiments proved her color resulted from the same allele as those reported by him (op. cit.).

As early as 1901, Kent suggested that environmental factors might influence the blue (and other) color. He noted that sunlight (probably by denaturing the protein in the astaxanthin complex) could elicit a red color in O. immunis, and he reported several “colors” he encountered in the species. The caption associated with the mentioned National Geographic picture (op. cit.) indicated that the hatchery personnel believed that the blue color of the lobsters, not unusual apparently, possibly resulted from the diet and/or illumination of the holding tanks.

I have no concrete data, but I have an observation which might support this thesis. In the summer of 1961, working in the laboratory of Franklin Sogandares-Bernal, my group collected a number of P. acutus acutus from sites just north of New Orleans, Louisiana, U.S.A., to serve as experimental intermediate hosts for digenetic trematodes. The animals were kept individually in small, all-glass aquaria in an open metal rack. The construction of the rack was such that light entered from all directions and its positioning was arranged so that the light was subdued and almost completely supplied by fluorescent tubes which were not kept on any specific time regime. About four weeks after capture, one of the crawfishes turned an azure blue, from a typical Louisiana acutus pattern. At the time, my feelings were that the change was due to the incident: reflected light ratio; Fingerman at the same time in a nearby laboratory was accumulating data relating this ratio to crawfish chromatophore responses. Unfortunately, shortly thereafter I moved from the