BULLETIN OF MARINE SCIENCE, 65(2): 587–591, 1999

NOTES

OCCURRENCE OF A UNIQUE COLOR MORPH IN THE SMOOTH TRUNKFISH (*LACTOPHRYS TRIQUETER* L.) AT THE FLOWER GARDEN BANKS AND STETSON BANK, NORTHWEST GULF OF MEXICO

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The Flower Garden Banks National Marine Sanctuary consists of three isolated banks located on the outer continental shelf of the northwest Gulf of Mexico: the East Flower Garden Bank (EFG), the West Flower Garden Bank (WFG) and Stetson Bank (SB). All three banks have an approximate minimum depth of 20 m. The EFG and WFG (collectively referred to as the FGB) are 175 km SSE of Galveston, Texas, and support coral reef communities (Bright et al., 1984). The banks are topographic expressions of seafloor uplift caused by vertically migrating salt originating from a Jurassic evaporite deposit 15 km below the seafloor (Rezak et al., 1985). Stetson Bank is 112 km SSE of Galveston, Texas, and is an outcrop of consolidated sedimentary rock (sandstone, siltstone and claystone) thrust upward by an underlying salt dome (Bright and Pequegnat, 1974). Benthic cover at SB is primarily sponges, algae and fire coral (*Millepora alcicornis* Linnaeus). All three banks support tropical reef fish assemblages (Bright and Pequegnat, 1974; Boland et al., 1983; Rezak et al., 1985; Dennis and Bright, 1988; Pattengill et al., 1997). The nearest coral reefs to these isolated banks are over 600 km to the south in the Gulf of Campeche.

In September 1994, a unique gold color phase of what was presumed to be the smooth trunkfish (*Lactophrys triqueter* Linnaeus) was documented at the EFG. The following June, golden *L. triqueter* individuals were sighted at the WFG and SB. Roving diver (Schmitt et al., 1993) survey data over 3 yrs showed fluctuations in the presence and sighting frequency of the golden individuals (Table 1) but averaged 7.8%, where sighting frequency is the proportion of survey dives when a fish was sighted. Overall, the golden form of *L. triqueter* was occasionally observed and uncommon and the normal colored form was frequently observed but not abundant. When sighted, one to three golden individuals were seen during a 40-min dive. Sighting frequency and average number of individuals seen during a dive was greatest at SB. The average sighting frequencies of normal colored individuals at the EFG, WFG and SB during the same period were 87.3, 94.9 and 78.0%, respectively. The average number of normal colored *L. triqueter* seen during a 40-min dive was five at the EFG and WFG and nine at SB.

The fish were uniformly bright gold with a body pattern of blue spots (Fig. 1). The fins were mostly dark brown to black. The indistinct honeycomb markings at the mid-body, which are present on normal colored *L. triqueter*, were also visible. The golden individuals were in the same size range as normal colored individuals. The two color morphs were frequently observed together and there were no obvious differences in behavior. In addition, there did not appear to be an age basis for the color difference as roughly equal frequencies of gold morphs were seen in small (young) and large (old) individuals.

Members of the western Atlantic Ostraciidae are not sexually dichromatic. Previous work on color change in two western Atlantic species, trunkfish (*L. trigonus* Linnaeus)

Table 1. Percent sighting frequency (%SF) of "golden" smooth trunkfish during six survey cruises to the FGB and SB. Observations were made during roving diver visual surveys. The number of surveys (N) completed during each cruise is given.

	EFG		WFG		SB	
Survey Date	N	%SF	N	%SF	N	%SF
Sept. 1994	12	8.3	18	0	20	0
May–June 1995	23	8.7	23	13.0	20	25.0
Sept.–Oct. 1995	26	3.9	24	0	29	6.3
May–June 1996	20	0	22	0	21	19.1
Aug.–Oct. 1996	30	0	28	7.1	16	6.3
May–June 1997	21	9.5	21	14.3	21	23.8

and honeycomb cowfish (*L. polygonia* Poey), documented color change with increasing size (Tyler 1965; Tyler 1967). The color patterns of several species are known to be highly variable, but there are no reports of xanthic individuals.

In August 1997, a golden individual was collected with a hand-held net from Buoy site 4 of the WFG (27°52′29.4″N, 93°49′04.1″W) at a depth of approximately 22 m. The individual was preserved in 10% formalin and was deposited at the Texas Cooperative Wildlife Collection (#TCWC 8912.01) in College Station, Texas. The individual had a total length (TL) of 95 mm, a relatively small size compared to most observed on the banks. The specimen was identified as *L. triqueter* and there were no obvious morphological distinctions besides the color (J. McEachran, Texas A&M Univ., pers. comm.).

Fishes have several types of pigment cells, including melanophores (black or brown), xanthophores (gold) and iridiphores (reflective). Fishes can change color by slowly adding or loosing chromatophores or by aggregating or concentrating pigments within individual chromatophores. Fishes that are amelanic lack melanophores allowing the underlying xanthophores to be unmasked (Webber et al., 1973), a condition known as xanthochromism. These contain E-carotene and canthaxanthin and import a golden color (Webber et al., 1973). It has been suggested that xanthophores may even be over-produced in the absence of melanophores or other pigment cells (Angus and Blanchard, 1991).

Color change and color morphs in fish species can result for a variety of reasons. These include reversible color changes controlled by the nervous system and permanent color patterns that result from genetic mutations. Sexually dimorphic coloration and behaviorally modified changes in color are common and relatively well understood (DeMartini and Donaldson, 1996). What is less understood are color changes or color morphs seemingly unrelated to factors like reproduction or level of maturation (Domeier, 1994; DeMartini and Donaldson, 1996).

The appearance of a golden morph in fishes is not uncommon. The Midas cichlid (*Cichlasoma citrinellum* Gunther) is a well-known example in tropical fresh water systems (Dickman et al., 1990). All *C. citrinellum* begin life fully pigmented. At various ages some individuals become amelanic and turn gold. The amelanism is permanent and the polychromatic cichlids assortively mate (McKaye, 1980). The difference between the normal and golden morphs is genetically based (Barlow, 1976) and the incidence of polychromatism in Nicaraguan lakes appears stable at around 8% of the adult population (Dickman et al., 1990).

Figure 1. A "golden" smooth trunkfish (*Lactophrys triqueter*) at the Flower Garden Banks.

Golden phases in reef fish are also relatively common, especially in Hawaii and the Red Sea. Species that have golden phases include guineafowl puffer (*Arothron meleagris* Bloch and Schneider) (Randall, 1995), trumpetfish (*Aulostomus chinensis* Linnaeus) (Randall, 1996), leaf scorpionfish (*Taenionotus triacanthus* Lacepede) (Eschmeyer and Randall, 1975), leopard grouper (*Mycteroperca rosacea* Streets) (Heemstra and Randall, 1993), Pacific chub (*Kyphosus bigibbus* Lacepede) (Randall, 1996), seaweed blenny (*Parablennius marmoreus* Poey) (Causey, 1969), coney grouper (*Cephalopholis fulva* Linnaeus) (Heemstra and Randall, 1993), goatfish (*Parupeneus cyclostomus* Lacepede) (Smith and Heemstra, 1986), and giant kelpfish (*Heterostichus rostratus* Girard) (Stepien, 1985). Reversible color change has been documented in *A. chinensis* (Randall, 1996), *T. triacanthus* (Eschmeyer and Randall, 1975), *P. marmoreus* (Causey, 1969), and *H. rostratus* (Stepien, 1985). For the remainder of the species listed, it is unknown whether the color is due to a genetic mutation affecting the production of pigments or if it is under nervous system control.

Based on our observations, the gold color in *L. triqueter* observed at the FGB and SB appears to be permanent and is probably the result of a single gene recessive mutation (see Dunham and Childers, 1980). Because the occurrence of a golden phase of *L. triqueter* is not known in other areas of the northwest Gulf of Mexico or elsewhere, this mutation appears to have occurred locally and subsequently spread throughout the relatively isolated gene pool of the FGB and SB.

Acknowledgements

The author would like to thank B. Semmens and L. Akins for collecting the specimen and J. McEachran and K. Vaughan from the TCWC for identifying and cataloging the specimen. The specimen was collected under FGBNMS permit FGBNMS-10-97. Appreciation is also extended to all those who responded to my request for information on the Fish-Ecology and Coral Reef List Serves. Funding and support for field time was provided by Reef Environmental Education Foundation, the Gulf of Mexico Foundation, Rinn Boats, Texaco Exploration and Production, Seaspace, the Texas A&M University Women's Faculty Network and the International Women's Fishing Association. T. Sebastian graciously provided the picture of the golden smooth trunkfish.

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Date Submitted: July 17, 1998. Date Accepted: January 19, 1999.

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