California Fish and Game 99(4):237-239; 2013

Orange coloration in a black-and-yellow rockfish (*Sebastes chrysomelas*) from central California

Kevin O. Lewand, John R. Hyde, Vince P. Buonaccorsi, and Robert N. Lea

Monterey Bay Aquarium, 886 Cannery Row, Monterey, CA 93940, USA (KOL)

Southwest Fisheries Science Center,8604 La Jolla Shores Drive, La Jolla, CA 92037-1508, USA (JRH)

Von Liebig Science Center, 601 17th Street, Huntingdon, PA 16652, USA (VPB)

California Department of Fish and Game (retired), 20 Lower Ragsdale Drive, Monterey, CA 93940, USA and *California Academy of Sciences, 55 Music Concourse Drive, Golden Gate Park, San Francisco, CA 94118, USA (RNL)*

**Correspondent: klewand@mbayaq.org*

Key words: abnormal coloration, black-and-yellow rockfish, *Sebastes chrysomelas*

In November 2010 an orange colored rockfish (*Sebastes* sp.) was caught by hook and line off Avila Beach, San Luis Obispo County, California (35º 14' N, 120º 64' W) at a depth of 6 m near the Point San Luis Lighthouse. The fish initially was not identifiable with any of the shallow-water rockfishes, yet had the general conformation of a member of the *Pteropodus* rockfish complex. Through analysis of morphological characters the specimen was determined to be either a black-and-yellow rockfish (*S. chrysomelas*) or gopher rockfish (*S. carnatus*). Both are considered as shallow-water species with gopher rockfish generally found deeper than black-and-yellow rockfish (Larson 1980, Love et al. 2002) and we initially assumed that the orange colored rockfish was a black-and-yellow rockfish. Within aquarium conditions, the fish demonstrated behavioral characteristics similar to those of both black-and-yellow rockfish and gopher rockfish by hiding in cracks in rocks covered with invertebrates such as California hydrocoral (*Stylaster californicus*), strawberry anemone (*Corynactis californica*), sponges (Porifera), and algae (Figure 1). As coloration is the primary character used to separate these species, we incorporated genetic techniques to confirm identification.

To date, no orange black-and-yellow rockfish or gopher rockfish have been reported. Xanthic coloration has been observed off the California coast in what likely was one of those two species (Medlin 2012), but was not confirmed as the fish was not landed. Additionally, xanthism has been reported in other rockfish species, including the China rockfish (*S. nebulosus*; Ueber 1989) and grass rockfish (*S. rastrelliger*; Cripe 1998).

Figure 1.—Orange colored black-and-yellow rockfish on display at Monterey Bay Aquarium. The fish has been continuously maintained and on exhibit from November 2010 to date (January 2014).

Morphological, morphometric, and meristic characteristics, following Phillips (1957), aided in placing the specimen within the *Pteropodus* clade and into the black-and yellow and gopher rockfish complex. The relevant characteristics are as follows: total length 305 mm; standard length 255 mm; head length 97.5 mm; orbital width 21.6 mm; interorbital width 13.5 mm; longest dorsal spine 34.1 mm; dorsal fin XIII,12; anal fin III, 6; pectoral fin L 9/17, R 9/17; interorbital space concave; cranial spines upright and strong; caudal fin rounded; anal fin rounded. The counts and measurements were taken while the fish was under anesthesia.

To genetically identify the specimen, DNA was extracted from a piece of fin tissue using a Chelex-based boiling method (Hyde et al. 2005). The mitochondrial cytochrome b gene was amplified and sequenced using methods described by Hyde and Vetter (2007). The resultant sequence was compared to reference sequences in order to determine species identity. The sequence indicated that the fish in question was either a gopher rockfish or black-and-yellow rockfish. These spec ies are not reciprocally monophyletic at mitochondrial loci, and examination of the highly divergent nuclear DNA locus *Sch*-18 was necessary. The *Sch*-18 locus was amplified and digested with the restriction enzyme *Alu*I, using methods described by Buonaccorsi et al. (2011). The resultant genotype was homozygous for black-and-yellow rockfish diagnostic alleles, providing an unambiguous species identification.

Sebastes rockfishes are known for their high evolutionary diversity, and are considered a marine species flock (Johns and Avise 1998, Love et al. 2002). The occurrence of visually striking within-species color polymorphisms, such as that described herein, may affect mate selection and, therefore, could have evolutionary implications (Gray and McKinnon 2007). For example, if two subgroups of black-and-yellow rockfish were in the process of ecological divergence, a genetic color polymorphism that arose within one subgroup could result in assortative mating, reduce gene flow between populations, and facilitate divergence.

Acknowledgments

We thank Peter Nelson who caught the fish and donated it to the Monterey Bay Aquarium for the public to view. Additionally, we gratefully acknowledge an anonymous reviewer who pointed out a number of editorial inconsistencies and lapses in the original draft.

Literature Cited

Buonaccorsi, V. P., S. R. Narum, K. A. Karkoska, S. Gregory, T. Deptola, and A. B. Weimer. 2011. Characterization of a genomic divergence island between black-and-yellow and gopher *Sebastes* rockfishes. Molecular Ecology 20:2603-2618.

Cripe, D. 1998. Occurrence of xanthic grass rockfish, *Sebastes rastrelliger.* California Fish and Game 84:100-101.

Hyde, J. R., and R. D. Vetter. 2007. The origin, evolution, and diversification of rockfishes of the genus Sebastes (Cuvier). Molecular Phylogenetics and Evolution 44:490-811.

Hyde, J. R., E. Lynn, R. Humphreys Jr., M. Musyl, A. P. West, and R. Vetter. 2005. Shipboard identification of fish eggs and larvae by multiplex PCR, and description of eggs of blue marlin, shortbill spearfish, and wahoo. Marine Ecology Progress Series 286:269-277.

Johns, G. C., and J. C. Avise. 1998. Tests for ancient species flocks based on molecular pylogenetic appraisals of *Sebastes* rockfishes and other marine fishes. Evolution 52:1135-1146.

Larson, R. J. 1980. Competition, habitat selection, and the bathymetric segregation of two rockfish species. Ecological Monographs 50:221-239.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press, Berkeley and Los Angeles, USA.

Medlin, S. 2012. The faces of REEF: member spotlight, Carl Gwinn [Internet]. Reef Environmental Education Foundation [Accessed 15 December 2013]. Available from: http://www.reef.org/enews/articles/faces-reef-member-spotlight-carl-gwinn

Miller, D. J., and R. N. Lea. 1972. Guide to the coastal marine fishes of California. Fish Bulletin 157. California Department of Fish and Game, Sacramento, USA.

Phillips, J. B. 1957. A review of the rockfishes of California (Family Scorpaenidae). Fish Bulletin 104. California Department of Fish and Game, Sacramento, USA.

Ueber, E. 1989. Xanthic, gigantic, China rockfish. California Fish and Game 75:47-48.

Received 30 January 2013
Accepted 30 December 2013
Associate Editor was N. Kogut