Fixed pieces of smallmouth bass skin and muscle from Susquehanna River fish having grossly visible skin abnormalities were submitted to the Histology Lab at the U.S. Geological National Fish Health Research Laboratory, Leetown Science Center in May 2012. These included raised, mucoid lesions (Figure 1) collected 3/27/12 between York Haven and Safe Harbor Dams and melanistic areas (Figure 3) from two fish collected 4/24/12 around Hoover Island.

Microscopically, these raised pale, mucoid-appearing areas are the result of increased thickness of the epidermis (Figure 2A). In some areas, folding of the basement membrane is evident (Figure 2B).

Figure 1. Smallmouth bass with numerous small, slightly raised, mucoid-appearing lesions on the body surface and fins (arrows).
Normal epidermis has columnar epithelial cells closest to the basement membrane, with more flattened (squamous) epithelial cells closer to the body surface. Mucous cells are also common in normal epidermis (Figure 2C). The raised areas are composed of proliferating epithelial cells often pleomorphic and arranged in swirls (Figure 2D).

Figure 2. Microscopic appearance of papillomas observed on smallmouth bass from the Susquehanna River. A. Raised area (a) in proximity to normal epidermis (arrow). B. Raised area (a) with papillomatous folding of the dermis (b). C. Higher magnification of normal epidermis with columnar epithelial cells (a) arising at the basement membrane (arrowhead). Mucous cells (arrows) are present. D. Higher magnification of raised pale areas. Cells are not arranged normally and often appear in swirls (a). E.
Normal epidermis with columnar epithelial cells (arrows) close to the basement membrane and mucous cells (a). In the dermis are densely packed, melanin-containing cells (b). Epithelial cells within the papilloma are pleomorphic, arranged in abnormal patterns, and have a highly vacuolated cytoplasm.

These lesions are papillomas and have been described in a variety of fish species. In some instances viral particles have been observed in similar lesions using electron microscopy (Anders and Möller, 1985; Lee and Whitfield 1992; Quackenbush et al. 2001). In other cases, investigators have tried to culture and/or visualize viruses using electron microscopy and have not found any indication of a viral etiology. There are a number of reports of increased prevalence of these types of papillomas at site impacted by industrial and/or sewage effluent (Korkea-aho et al. 2006; 2008), increased by exposure to androgens (Kortnet et al. 2003) and they, together with numerous other indicators, are used by ICES (International Council for the Exploration of the Sea) as an indicator of environmental condition (Bucke et al. 1996). Further work, such as molecular analyses for viruses, in situ hybridization for neoplasia markers and chemical analyses for contaminant concentrations in skin would need to be done to determine cause.

The black (melanistic) areas are found on the body surface, fins and jaws (Figure 3). In most cases these are not raised (Figure 3A), but some appeared to be slightly raised (Figure 3B).

Figure 3. Smallmouth bass with melanistic areas on the body surface and lips. A. The majority of these black areas are not raised (white arrows). B. Some appear to be slightly raised (black arrows). C. Melanistic area on the upper lip.
In normal bass skin the melanin-containing cells are present in the dermis (Figure 4A and C). In the melanistic areas of skin the melanin-containing cells appear to have migrated from the dermis to the epidermis and proliferated (Figure 4B). Figure 4A demonstrates the difference between normal and melanistic areas on the same fish. In some areas (Figure 4B) there appears to be an accumulation of these cells near the skin surface. In other areas this is not as apparent, but rather the epidermis is thickened and there are inflammatory cells in the dermis (Figure 4D) when compared to normal skin (Figure 4C). The melanin-containing cells in normal skin are small, generally somewhat elongated cells, densely packed with melanin (Figure 4E). The melanin-containing cells within the melanistic spots are pleomorphic, often stellate and melanin is less densely packed (Figure 4F). These areas are hyperpigmented areas within the epidermis and do not have the histologic appearance of melanomas (Okihiro et al. 1993; Gimenez-Conti et al. 2001). However, in some areas the cells are pleomorphic and abnormal (Figure 4F).

Melanocytes or melanophores are cells which synthesize melanin, present in membrane-bound melanosomes. Other epithelial cells may engulf melanosomes. Melanocytes can extend pseudopodia and disperse melanosomes, which allows fish to change color. These processes are under control of hormones. Melanin-concentrating hormone induces aggregates of melanosomes in the skin, while α-melanocyte stimulating hormone and epinephrine are responsible for pigment dispersion (Kawauchi and Baker 2004). Proopiomelanocortin is a gene important in the production melanocyte stimulating hormones. Expression of this gene is also important in the stress response (Karsi et al. 2005). UV-exposed, or “suntanned” red seabream were reported to have an increased number of melanocytes in the epidermis when compared to those in shaded tanks (Adachi et al. 2006). Increased UV radiation, chemicals associated with oxidative damage as well as chemicals affecting hormonal regulation of melanocytes could all contribute to the production of these melanistic areas.
Figure 4. A. Section with a melanistic area on one side (a) with melanin-containing cells within the epidermis. The area of normal skin (b) has melanin-containing cells in the dermis. B. Section of a melanistic spot with slightly thickened epidermis and accumulations of melanin-containing cells near the surface of the epidermis. C. Normal skin (a) with melanin-containing cells (arrows) in the dermis. D. Section of a melanistic area (a) with the melanin-containing cells in epidermis and inflammation (arrow) in the dermis. E. Higher magnification of normal skin illustrating cells densely packed with melanin in the dermis. F. Higher magnification of epidermis within a melanistic area illustrating stellate melanin containing cells.
References


