

Skin cancer in butterflyfish and surgeonfish on the reefs of Hawai'i

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Abstract

Understanding marine disease is increasingly important yet baseline disease data are lacking for most marine communities. In Hawaii, some species of butterflyfish have protrusive skin tumors and the endemic surgeonfish, *Ctenochaetus strigosus*, have obvious patches of skin discoloration. Little is known about reef fish disease in the Hawaiian Archipelago, so we completed visual surveys in the Main Hawaiian Islands (MHI) and Northwestern Hawaiian Islands (NWHI) to determine the distribution and prevalence of disease in surgeonfish and butterflyfish. Within the MHI, three species of butterflyfish were affected with tumors with one species, *Chaetodon multicinctus*, having the highest overall prevalence (7.5%). Affected butterflyfish were found in seven out of fifteen surveys (frequency of occurrence=46.7%) and had an overall tumor prevalence of 1.6% (n=936 fish). In contrast, within the NWHI no affected butterflyfish were found out of 20 surveys conducted at seven different atolls/islands (n=936 butterflyfish). Tumor-affected surgeonfish (*Ctenochaetus strigosus*) were found in both the main (46.7% of the surveys) and northwestern Hawaiian Islands (82.6% of the surveys). Overall disease prevalence was similar being 2.9% in the MHI (n=1778 fish) and 3.2% in the NWHI (n=1556 fish). Histology revealed the tumors to be pigment cell tumors (chromatophoromas, xanthophoromas) that were locally invasive into underlying muscle in both butterflyfish and surgeonfish. Presently, the causes of these tumors are unknown, but their clustered distribution suggests habitat may play a role.

Introduction

Coral reef ecosystems have been declining over the past few decades due to a combination of local anthropogenic stressors and global climate change with much effort concentrated on coral disease. However, understanding disease patterns in other key reef-associated organisms has the potential to provide a more comprehensive picture of overall coral reef ecosystem health. During routine coral disease surveys in Hawaii, we observed unusual skin lesions and protuberant masses in butterflyfish and surgeonfish with apparent disparate prevalence among different sites. While tumors in butterflyfish have been documented on Maui (1) little is known about their distribution elsewhere in the archipelago. **Our objectives were to further characterize this disease by 1) determining the distribution and prevalence of skin lesions in butterflyfish and surgeonfish throughout the Hawaiian archipelago and 2) systematically describe skin lesions in reef fish at the gross and microscopic level.**

Methods

- Sixty minute timed SCUBA visual surveys for all butterflyfishes (Chaetodontidae) and *Ctenochaetus strigosus* (Acanthuridae) within 5m of divers.
- MHI surveyed in 2009, NWHI surveyed 2011 (see map 1 to the left).
- Fish were included in the survey only if both sides of the individual were viewed.
- Diseased fish were recognized by the presence of skin lesions or irregular protrusions.
- Complete necropsies were done on 8 *Ch. miliaris*, 4 *Ch. multicinctus*, and 1 *Ct. strigosus* from the MHI and 72 *Ct. strigosus* from the NWHI. Representative tissues were fixed in 10% neutral buffered formalin and processed for routine histopathology (paraffin embedding, sectioning at 5 μm and staining with hematoxylin and eosin) and examined microscopically. Skin tumors were classified based on microscopic morphology (1,2)

Histopathology results

Tumors in *Ch. multicinctus* (see fish images on the left) were sessile nodular masses located mainly dorsally and less commonly laterally. In *Ch. miliaris*, tumors seemed to originate as hyperpigmentation progressing to sessile protuberant masses with ulceration in advanced stages (see fish images on the right). In *Ct. strigosus*, tumors manifested as distinct amorphous abnormally pigmented to apigmented areas on the lateral body wall. Microscopically, early lesions manifested as epidermal hyperplasia progressing to sheets of mixed pleomorphic and atypical pigment and fusiform cells within a connective tissue stroma invading epidermis, underlying dermis, and skeletal muscle. Occasional nidi of necrosis were present, metastases were not seen and both sexes seemed equally affected.

Summary

- Histopathology revealed fish skin lesions to be pigment cell tumors that were locally invasive in underlying skeletal muscle.
- Tumors were seen in 3 species of butterflyfish (*Ch. multicinctus*, *Ch. ornatissimus*, *C. quadrimaculatus*).
- Butterflyfish with tumors were observed commonly on all three MHI surveyed (Maui, Molokai, Kauai) (overall frequency of occurrence=46.7%) but not the NWHI
- Overall tumor prevalence in butterflyfish was 1.6% (n=936 fish)
- Affected *Ct. strigosus* were found commonly in both the main (46.7% of the surveys) and northwestern Hawaiian Islands (82.6% of the surveys).
- Overall disease prevalence in *Ct. strigosus* was 2.9% in the MHI (n=1778 fish) and 3.2% in the NWHI (n=1540 fish)
- Relatively high tumor prevalence in fish populations in localized areas in the main and NWHI suggests an environmental component to the disease.
- Regional (MHI vs. NWHI) differences in butterflyfish vs. surgeonfish prevalence suggest differing disease etiologies

Conclusions

This study, limited in effort and spatial scale, found fish disease in butterflyfish and *Ct. strigosus* to be fairly common. This suggests fish disease in Hawaii to be more widespread than previously considered and should be investigated further. Reef fish play an important role in maintaining coral reef ecosystem balance and understanding disease in reef fish will become increasingly important in the face of increasing anthropogenic and global stressors. Of particular concern is the relatively high prevalence of tumors in endemics suggesting increased susceptibility in this group. Precedents exist for this for introduced diseases in island ecosystems (3)

Future work

- Complete baseline surveys for fish disease throughout the Hawaiian archipelago
- Investigate underlying etiologies for species of fish where tumors are commonly seen (*Ct. strigosus*, *Ch. multicinctus*)
- Relate underlying etiologies to environmental drivers of disease

Literature Cited

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3. van Riper C, III (1991) The impact of introduced vectors and avian malaria on insular passeriform bird populations in Hawaii. Bulletin of the Society of Vector Ecology 16, 59-83.

Acknowledgements

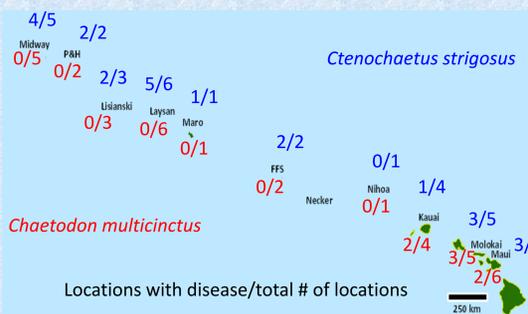
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Chaetodon multicinctus with dorsal & lateral tumors.



Ch. miliaris, observed in other studies, with tumors on base of dorsal fin.



Map 1 Survey locations and frequency of occurrence for skin cancers.

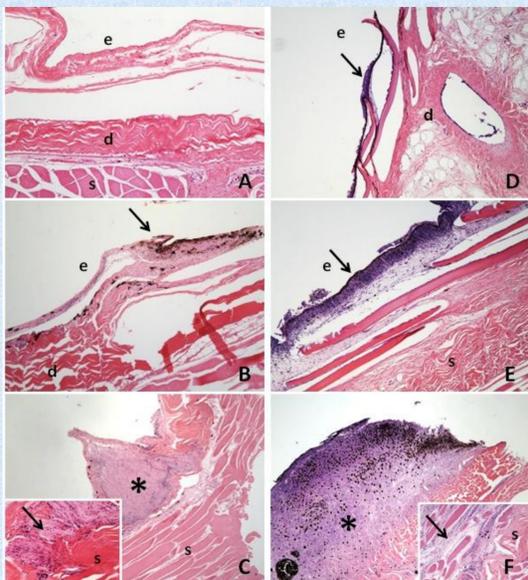


Plate 1. Histology Plate: Skin from *Chaetodon miliaris* (A-C) and *Ctenochaetus strigosus* (D-F) including normal skin (A,D), early (B,E), and advanced (C,F) lesions (pigment cell tumors). B) Early lesion. Note increased thickness of pigment cells (arrow). C) Advanced lesion. Note mass (asterisk) infiltrating dermis. Inset shows cords of haphazardly arranged fusiform cells infiltrating among skeletal muscle (black arrow) with mild inflammation (white arrow). E) Early lesion, note increased thickness of epidermal cells mixed with pigment cells (arrow). F) Advanced lesion. Note mass of mixed fusiform and pigment cells effacing epidermal architecture and infiltrating into underlying skeletal muscle (asterisk). Inset. Note sheets of mixed fusiform and pigment cells infiltrating among skeletal muscle myofibers (arrow). e=epidermis, s=skeletal muscle, d=dermis.



Ch. multicinctus with tumors on dorsal surface.



Ch. miliaris, observed in other studies, with tumors on base of dorsal fin.



Ct. strigosus with posterior third of the body covered with lesions.



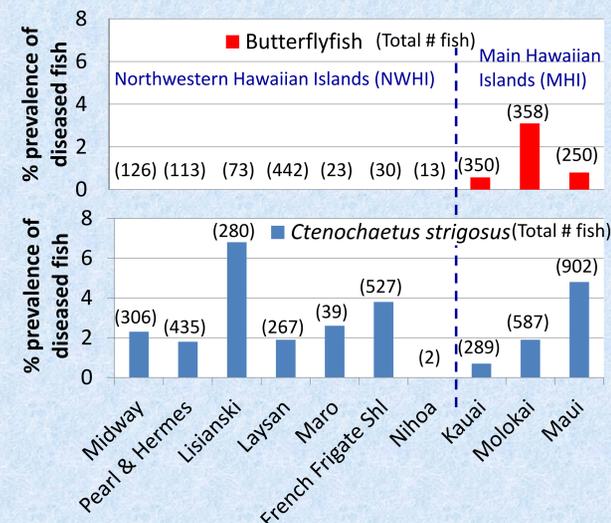
Ctenochaetus strigosus with sides covered with lesions.



Ctenochaetus strigosus with sides covered with lesions.

Species	# of fish	Frequency of occurrence	% Prevalence
<i>Ch. multicinctus</i> (MHI)	199	33.3	7.5%
<i>Ch. quadrimaculatus</i> (MHI)	42	6.7	2.4
<i>Ch. ornatissimus</i> (MHI)	135	6.7	0.74
Total <i>Chaetodon</i> spp (MHI)	936	46.7	1.6
<i>Ct. strigosus</i> (MHI)	1778	46.7	2.9
<i>Ct. strigosus</i> (NWHI)	1556	82.6	3.2
Total <i>Ct. strigosus</i>	3334	53.4	2.4

Table 1. Summary of species, sample size, occurrence & prevalence displaying skin cancer. Butterflyfish species observed during study but showing no signs of disease and included in the total # of *Chaetodon* spp. observed: *Forcipiger* sp., *Ch. auriga*, *Ch. ephippium*, *Ch. fremblii*, *Ch. kleinii* *, *Ch. lineolatus*, *Ch. lunula*, *Ch. lunulatus*, *Ch. miliaris* *, *Ch. reticulatus*, *Ch. unimaculatus*. (* observed with skin cancer at other sites not included in this study.)



Fish Survey locations

Figure 1. Percent prevalence of skin lesions across the Hawaiian Archipelago surveyed.



Left side



Right side

Both sides of an affected *Ct. strigosus*.