Discriminating stocks of common dentex (Dentex dentex) around Corsica island (NW Mediterranean) using two otolith shape classification methods

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The otoliths grow over the entire life time of a fish. Both genetic and environment factors contribute to the variation observed in growth rate and shape of otoliths while it is thought that these are controlled by the protein synthesis and growth of fish. The main objective of this work was to study the growth of sagittal otoliths in Atlantic bluefin tuna and examine the changes of otolith shape in relation to fish size. The hypothesis that otolith size or shape variables are directly related to fish age is also considered, with the aim of providing strictly objective measurements that could be used as valuable criterion to estimate age of Atlantic bluefin tuna. Otolith morphological characteristics were studied in specimens ranging in fork length from 8.5 to 278 cm and from 20 days to 21 years in age. Four morphometric variables - whole otolith length, width, area and perimeter - were measured using image analysis techniques and three shape indices - circularity, E value and rectangularity - were calculated for each pair of sagittal otoliths. The absolute and relative growth of otoliths was determined. Mean otolith lengths at age were predicted from the otolith growth equations. Statistically significant relationships were observed between all otolith variables tested and the age or length of fish. Among the variables, otolith area was the one that showed the highest correlation with fish length (R^2=0.983, Ao=0.141FL1.136) followed by otolith length (R2=0.978, Lo=0.541FL0.654) whereas the otolith circularity exhibited the lowest correlation. Remarkable changes in otolith shape indexes were observed during the early stages of bluefin tuna ontogeny.

Abstract reference: WSShape_Baudouin_07

Discriminating stocks of common dentex (*Dentex dentex*) around Corsica Island (NW Mediterranean) using two otolith shape classification methods

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The common dentex *Dentex dentex* (Linnaeus, 1758) is a Mediterranean and near Atlantic coastal top predator fish. This species is of great economic importance for both artisanal (small-scale coastal fisheries) and recreational fishing. The common dentex is also the only sparid fish classified by the International Union for the Conservation of Nature (IUCN) as "Vulnerable" in the Red List of Threatened Species in the Mediterranean Sea. Despite its ecological and economic importance, data on the stock structure of this species are still very scarce. The aim of this study was to determine the spatial structure of common dentex around Corsica Island using otolith shape. The shape analysis has often been successfully applied using shape index and elliptic Fourier analysis. In this study we also used geometric morphometrics, a less common method that appears slightly more efficient for visualization purpose and can therefore be used as a usefull complementary method for studying otoliths shape variations. For this purpose 95 otoliths were collected from four different zones around Corsica. First, multiple regressions were applied to test the influence of endogenic variables (size, weight and gender). It appears that these variables contribute significantly to otolith shape variations, as well as the geographic location. Canonical analysis shows a spatial pattern, particularly for the region of Ajaccio which is well-segregated. However the sample region explained only 0.5% of the total shape variation, emphasizing that other environmental factors may affect otolith shape

variations among individuals. The use of the two complementary methods (*i.e.* Fourier series and geometric morphometrics) is discussed. Nevertheless, these first results support the use of otoliths shape as a tool for understanding spatial population structure of this species.

Abstract reference: WSShape_Worsøe Clausen_08

Image Acquisition – do's, don'ts, and important things to remember

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Otolith shape analysis is a widely used technique for e.g. species- or stock identification and separation. There are several steps in shape analysis which each are equally important for the validity, ease and efficiency of the result from any analyses of otolith shape as they all potentially can bias the perception of the actual otolith shape. Here we demonstrate how the image acquisition process can introduce artefacts if not carefully considered prior to any analysis of otolith shape. The steps involved in acquiring standardised images for otolith shape analysis are demonstrated with particular focus on contour acquisition by light microscope of the whole otolith and sulcus acusticus (internal side) shapes of otoliths. Potential caveats in relation to the physical otolith will be identified (e.g. anatomical position, side asymmetries, crystallizations anomalies, broken tips, otolith rotation in relation to curvature) as well as important factors to consider in relation to the image acquisition set-up (e.g. light settings, background and medium) and approaches to dealing with this error will be outlined. Additionally a demonstration of methods for capture of internal otolith shape will be made along with guidance as to how to identify the optimal structures for analysis. The session will be a combination of presentations and live demonstration of image acquisition and image digital processing illustrating a series of issues to take into consideration when acquiring photos of otoliths. The aim is for participants to leave with an outline of what to include when setting up a procedure for otolith shape acquisition minimising the potential bias of image artefacts on the following otolith shape descriptor extractions.

Abstract reference: WSShape_Brophy_09

Obtaining numerical shape descriptors from otolith images.

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Otolith shape analysis is a relatively inexpensive technique that can be readily applied using widely available microscopy and digital imaging equipment coupled with freely available software tools. Rigorous application of the technique to questions of stock structure requires that shape descriptors are independent of size and are not subject to artefacts of image acquisition. A conceptual explanation of commonly used shape descriptors (basic shape indices, elliptical fourier