

**Trophic interactions among abundant members
of the fish fauna in a permanently-open and a
seasonally-open estuary in south-western Australia**

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Submitted by

Thea Elisabeth Linke

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Declaration

I declare that the information contained in this thesis is the result of my own research unless otherwise cited, and has as its main content work which has not previously been submitted for a degree at any university.

Thea Elisabeth Linke

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Abbreviations

ANOSIM	analysis of similarities
ANOVA	analysis of variance
C	carbon
DW	dry weight
DHA	docosahexaenoic acid
EPA	eicosapentaenoic acid
FA	fatty acid
FAL	fatty alcohol
FAME	fatty acid methyl ester
FATM	fatty acid trophic marker
GC-MS	gas-chromatography mass-spectrometer
GF/C	glass fibre filter
IR-MS	isotope-ratio mass-spectrometer
KCl	potassium chloride
n	number of individuals
N	nitrogen
nMDS	non-metric multidimensional scaling ordination
PERMANOVA	permutational analysis of variance
PERMDISP	permutational analysis of multivariate dispersions
PTFE	polytetrafluoroethylene
PUFA	polyunsaturated fatty acid
SD	standard deviation
SIMPER	similarities percentages
sPOM	sedimentary particulate organic material
tFA	total fatty acid
TL	total length
tSV	total seston volume
V	volume

Abstract

Three complementary, quantitative approaches, *i.e.* gut content analyses, stable isotope analyses ($\delta^{15}\text{N}$; $\delta^{13}\text{C}$) and fatty acid composition, were employed to investigate the extent to which the diets of four abundant species of teleost occupying different feeding niches, *i.e.* *Leptatherina wallacei* (pelagic feeder), *Acanthopagrus butcheri* (benthopelagic feeder), *Pseudogobius olorum* and *Favonigobius punctatus* (benthic feeders) differed within and among species and within species on temporal and spatial scales in a permanently-open (the Swan-Canning estuary) and a seasonally-open estuary (Wilson Inlet) in south-western Australia. The stable isotope analyses and analyses of fatty acid composition were used to elucidate the origin of energy and the possible pathways of nutrient transfer from potential prey items to these four species of fish.

Multivariate methods (non-metric multidimensional scaling ordination and associated tests, such as PERMANOVA, ANOSIM and SIMPER) were used to detect any significant differences in the dietary and biochemical compositions of the fish. Stomach content data for each species demonstrated size-related changes in diet and that the dietary compositions of each species varied among estuaries. Each species was classed as opportunistic and omnivorous, consuming fauna as well as flora, but to differing extents. *Leptatherina wallacei* fed in the water column as well as on the benthos, while *P. olorum* almost exclusively consumed benthic prey.

The baseline $\delta^{15}\text{N}$ values of primary producers were higher, in general, in the Swan-Canning estuary than in Wilson Inlet, and the $\delta^{15}\text{N}$ values in the former system were also higher in each prey and fish species. This fact provided evidence to suggest that anthropogenically introduced nitrogen was present at the system level. The $\delta^{13}\text{C}$ values showed a higher influence of terrestrially derived carbon and a lesser influence of marine derived carbon in the diet of each prey and fish species in the Swan-Canning estuary than in the aquatic macrophyte fuelled (*Ruppia megacarpa*) Wilson Inlet. The docosahexaenoic : eicosapentaenoic (DHA:EPA) fatty acid ratio was highest in the pelagic feeder (*L. wallacei*), lowest in the benthic feeder (*P. olorum*) and intermediate in the benthopelagic feeder (*A. butcheri*) in both the Upper Swan River and Wilson Inlet,

and it was higher in pelagic (*e.g.* seston, calanoid and cyclopoid copepods, mysids) than in benthic (*e.g.* annelids, molluscs, harpacticoid copepods) prey in both estuaries, indicating that *L. wallacei* fed, to a certain extent, on pelagic prey, while *P. olorum* fed on benthic prey. Therefore, the DHA:EPA ratio may provide a useful indicator of the respective feeding niches occupied by estuarine fish species.

The findings from these studies suggest that (1) the food resources are partitioned within and among species and among estuaries, (2) both terrestrial and aquatic sources of organic material support food chains in two estuaries, (3) the DHA:EPA ratio can be a useful indicator of feeding mode and (4) the food resources and the pathways of material transfer from primary producers to consumers differ among these species.

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