Modeling the feeding patterns of marine predators from stomach content data.

M. Morfin[a], F. Ménard[b], N. Bez[c] and M.-P. Etienne[d]

[a]Mediterranean Institute of Oceanography
Aix-Marseille University
Marseille, France
marie.morfin@univ-amu.fr

[b]UMR Ecosystèmes Marins Exploités 212
Institut de Recherche pour le Développement
Sète, France
frederic.menard@ird.fr

[c]UMR Ecosystèmes Marins Exploités 212
Institut de Recherche pour le Développement
Sète, France
nicolas.bez@ird.fr

[d]UMR Mathématiques et Informatiques Appliquées 518
INRA/Agroparistech
Paris, France
marie.etienne@agroparistech.fr

Abstract: Estimating the feeding patterns of marine top predators using stomach contents is challenging, while knowledge about the competition between predatory fish and about the interactions with their prey is important for understanding trophic pathways.

Stomach contents of fish are commonly documented to understand feeding habits, feeding preferences and consumption rates. Prey data are usually expressed in count or in weight. However simple statistical distributions poorly fit these data as they generally are zero-inflated (many empty stomachs) and over-dispersed. Here we tested several statistical hierarchical models that accounts for these two characteristics : a Zero Inflated Negative Binomial Model and other forms of the Compound Poisson models (Tweedie models).

Tweedie moddels allowed us to mimic the feeding behavior of a large pelagic fish predator (such as tuna) when hunting on prey schools: the stomach content is then considered as the sum of the preys caught in each prey school met by the predator. Indeed tunas are caught in surface schools by purse seiners, when tuna seek out schools of favoured prey aggregations. This information can be included in the model, taking benefit that two individuals caught in the same school had encountered the same prey schools. A simulation analysis has been performed to quantify the influence of this information on parameters estimation, and predator size has been included to explain the food quantity consumed in each school.

Different models are compared and applied to investigate feeding patterns of two tuna species in the context of the industrial purse seine fishery in the Indian ocean.