Functional Diversity (Rao's Q)

May 4, 2016

From script "functional_diversity_metrics.R" in pfx-groundfish repository.

Rao's (1982) quadratic entropy represents the mean difference between 2 randomly selected species (with replacement):

$$FD_Q = \sum_{i=1}^{S-1} \sum_{j=i+1}^{S} d_{ij} p_i p_i$$

S = species richness

p_i = relative abundance of the ith species

d_{ij} = difference between the ith and j^{th} species:

(a) For analyses using only quantitave traits, distance matrix is a species-species Euclidean distance matrix.

(b) For analyses using mixed quantitative and categorical traits, trait values are standardized by the range of values (Gower's standardization (1971)), and distance matrix is a Gower dissimilarity matrix (distances are calculated separately for quantitative and categorical traits, then distance is calculated as the mean trait difference weighted by the number of traits belonging to quantitative vs categorical trait types).

I've used log-transformed functional trait values as per Botta-Dukat (2005).

1. Shallow areas

(a) Using only quantitative traits (max length, max age, max depth, depth coefficient (mean) from Ole's positive model, trophic position; traits are not correlated). **Red = oiled area.**
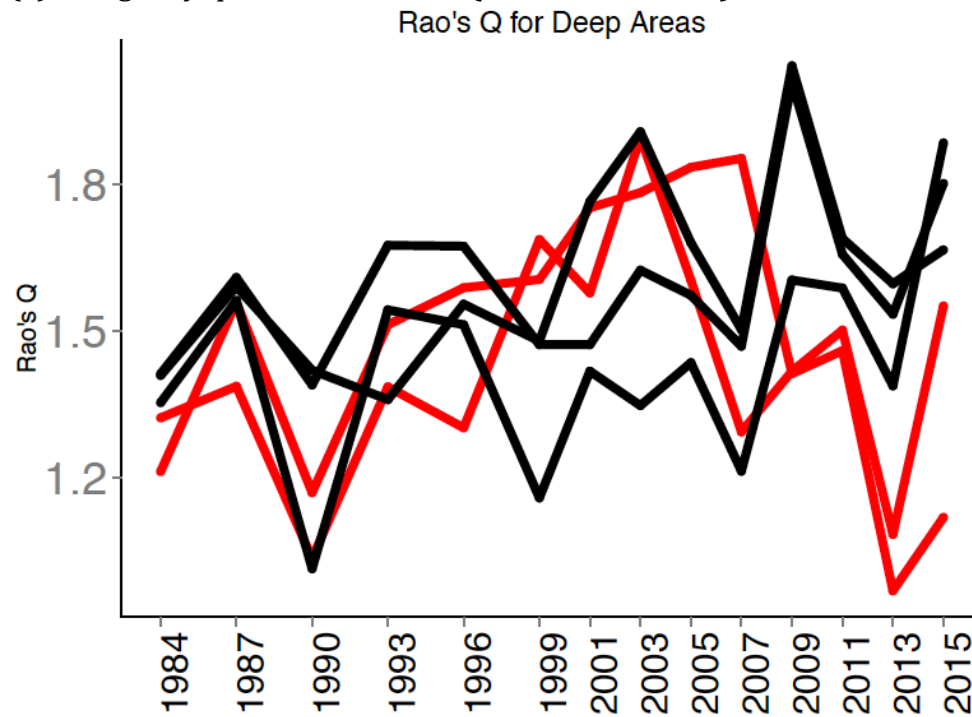

Rao's Q for Shallow Areas
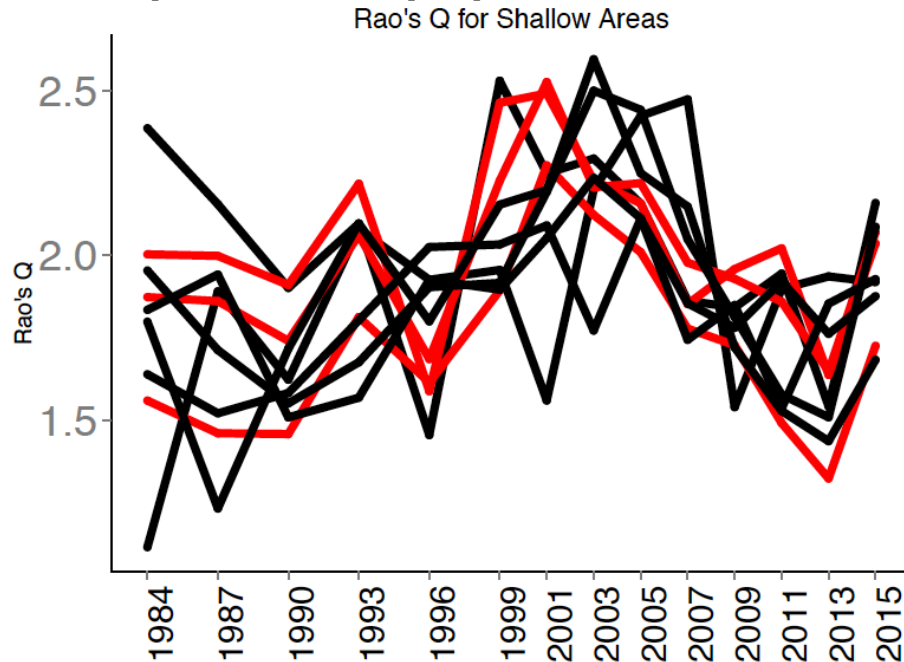
(b) Using quantitative traits and one categorical trait (diet items, ie invert vs. fish vs. generalist, and benthic vs. pelagic). Note small range of Rao's Q values.

Rao's Q for Shallow Areas 1–9
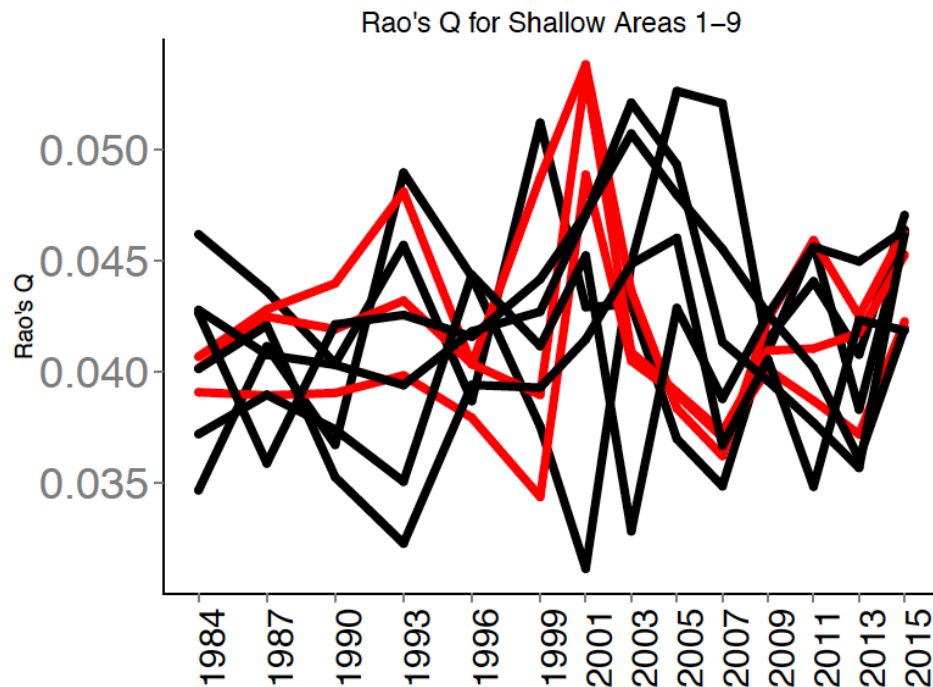
2. Deep areas
(a) Using only quantitative traits: **(Red = oiled area)**

Rao's Q for Deep Areas

(b) Using quantitative and categorical traits. Note small range of Rao's Q values.

Rao's Q for Deep Areas