Supplementary materials

Table 1: Main characteristics of the datasets for the 2011-2012 season.

Data	**Source**	**Variable**	**Description**
AIS positions	(1)	mmsi	Ship unique identification number
		name	Ship name
		type	Ship type
		lat	Latitude
		lon	Longitude
		timestamp	Position time stamp
		sog	Speed over ground (kn)
		cog	Course over ground
		rot	Rate of turn
Landings	(2)	date	Date
		name	Ship name
		specie	Name of the specie
		weight	Catch weight (kg)
Auction prices	(2)	date	Date
		price	Daily auction price (€/kg)
		specie	Name of the specie
Fishing calendar	(3)	date	Date authorized for fishing
		hours	Hours authorized for fishing (starting and ending)
		métier	Name of the fishing métier authorized
Ships	(2)	licence	Name of the fishing licence
		name	Ship name
		owner	Ship owner

The data (AIS positions, Landings, Auction prices, Fishing calendar and Fishing-licensed ships) sources include (1) the Naval Academy Research Institute, (2) the local fishermen committee and (3) the regional fishermen committee.

Descriptive statistics of the complementary data are shown in Table 2. Total fishing trip duration ranged from approximately 6 hours for warty venus dredging to 8 hours for variegated scallops dredging, but involved approximately 1 hour and 45 minutes of fishing regardless of the métier. This time span is related to dredge-fishing regulations for the Bay of Brest, which limits active dredging to 2 hours in any one day. In total, 1,408 GPS positions were collected during warty venus dredging and 1,041 GPS positions were collected during variegated scallop dredging. The median time interval between each collected position was approximately 15 seconds (with an interquartile range of 5 seconds) for each métier. We assumed that the difference between the median time interval between recorded AIS positions (30 seconds) compared to GPS positions (15 seconds) was negligible because they correspond to similar orders of high frequency magnitudes.

Table 2: Summary of GPS data collection.

Descriptive statistics	**Warty venus**	**Variegated scallops**
Total positions (n)	1408	1041
Fishing positions (n)	490	438
Total duration (h : min)	5 : 51	7 : 54
Fishing duration (h : min)	1 : 45	1 : 47
Median time interval (s)	14	16
IQR time interval (s)	5	5

GPS data were collected with on-board observers for two fishing trips corresponding to warty venus and variegated scallop dredging.

Table 3: Classification of mono- and multi-species landings by dredge métiers, related AIS positions and daily fishing trips available in the raw AIS database.

		Great scallop	**Warty venus**	**Variegated scallop**
Landings	Mono-species	1819	511	107
	Multi-species	56	310	54
	Total	1875	821	161
AIS	Positions	81273	2394	21
	Fishing trips	951	164	10

Table 4: Evaluation of the method.

Descriptors	**Summary statistics**	**Vessels**	
		Wv	Vs
Fishing positions	Positions (n)	1407	1037
	Bad Steaming (%)	5	3
	Good Steaming (%)	61	55
	Bad Fishing (%)	4	10
	Good Fishing (%)	30	32
	Overall accuracy (A)	0.91	0.87
	Kappa (K)	0.80	0.73
Fishing grounds	Warren's similarity index (I)	0.95	0.94
Fishing intensity	Warren's similarity index (I)	0.96	0.92

Summary statistics concerning the ability to differentiate between fishing and non-fishing activities (Fishing positions) and comparisons between observed and estimated distributions of the continuous descriptors (Fishing grounds and Fishing intensity).

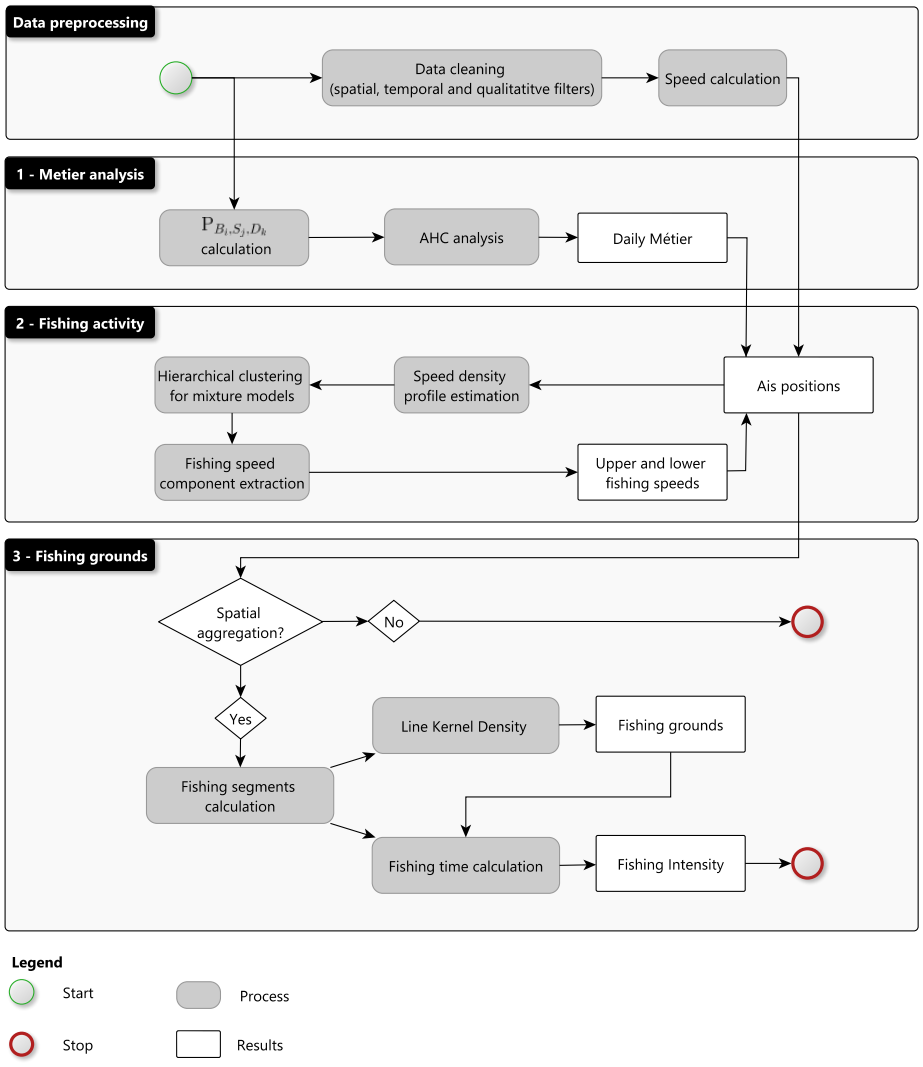

Figure 1: Graphical overview of the three main steps involved in data preprocessing and analysis.

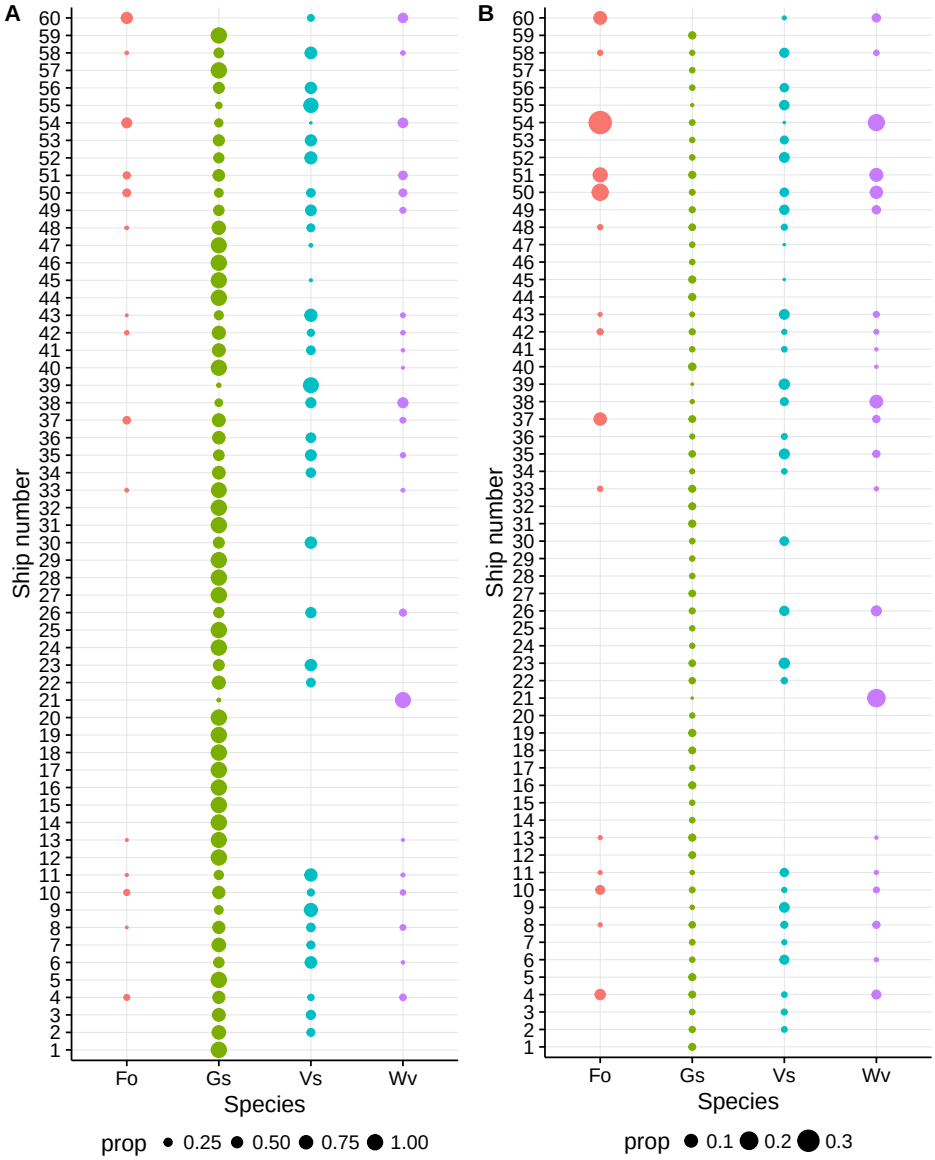

Figure 2: Proportions of the weights of landings A) per boat and B) per species (Fo: flat oyster, Gs: great scallop, Vs: variegated scallop and Wv: warty venus).

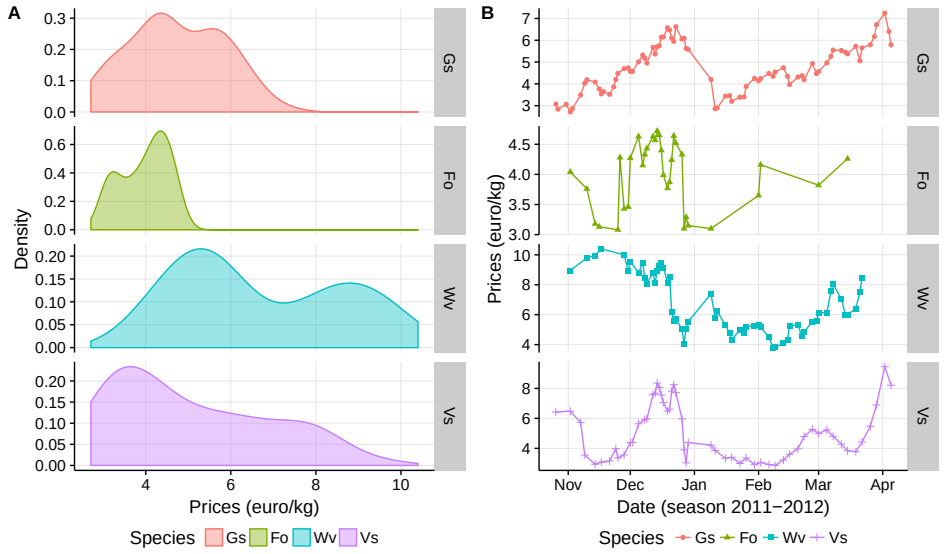

Figure 3: A) Density and B) variations in auction prices during the 2011–2012 season for the target species (Gs: great scallop, Fo: flat oyster, Wv: warty venus and Vs: variegated scallop).

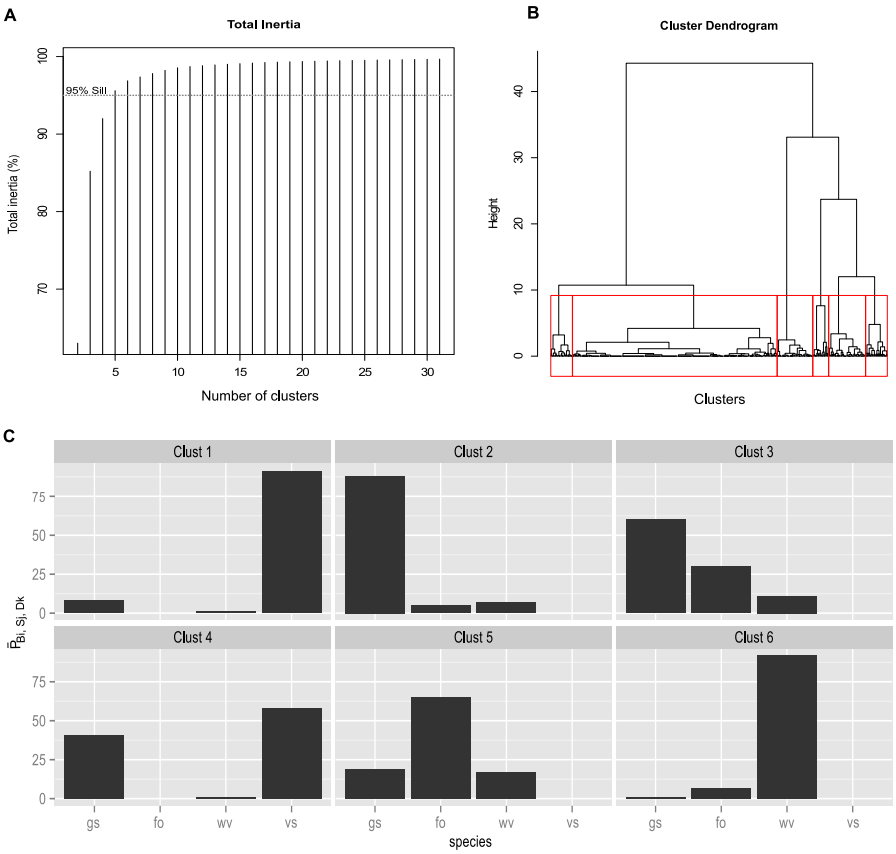

Figure 4: Results of the AHC carried out on the species composition expressed as a relative percentage of the total commercial value (P_{B_i,S_j,D_k}): A) hierarchical dendrogram and homogeneous classes corresponding to B) the number of clusters that explain 95% of the total inertia and C) the clusters composition based on $\bar{P}_{B_i,S_j,D_k}$, where cs: great scallops, fo: flat oyster, wv: warty venus and vs: variegated scallops.

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Results of the AHC carried out on P_{B_i,S_j,D_k} values are shown in Figure 4. 95% of the total inertia can be explained by 6 homogeneous classes (Figure 4.A). The resulting dendrogram cut is shown in Figure 4.B. The composition of $\bar{P}_{B_i,S_j,D_k}$ values for each classes Figure 4.C) identify 3 clusters where $\bar{P}_{B_i,S_j,D_k} > 80\%$: cluster 1 (92% for variegated scallops), cluster 6 (91% for warty venus) and cluster 2 (85% for great scallops), respectively.

These classes were selected because they involved no ambiguity concerning the target species. Clusters 3, 4 and 5 were not selected because their maximum $\bar{P}_{B_i,S_j,D_k}$ values ($< 60\%$) were below our 80% threshold.

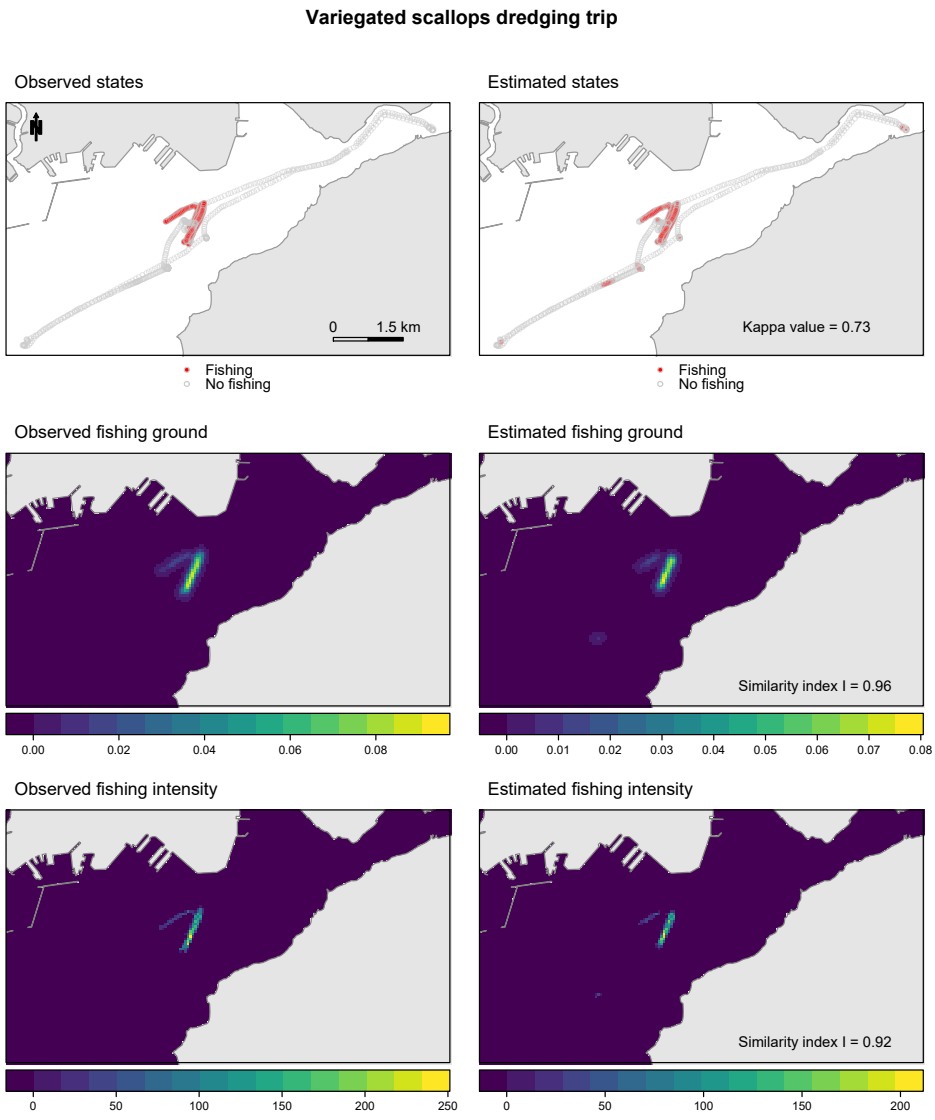

Figure 5: Evaluation of the method: spatial distributions of the observed (left) and the estimated (right) descriptors (states, fishing grounds and fishing intensity) for the variegated scallop dredging trip. See text for details. GPS data have been anonymized and positions coordinates have been modified with a vectorial translation for confidentiality matters.

Data and replication R code for Fig.5 are available in this Github repository: https://github.com/dleguyader/LeGuyader-etal-2016-SM.