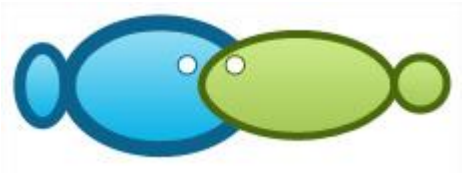

Feeding habit and prey selection of anchovy, *Engraulis encrasicolus* (Engraulidae), from the Moroccan Atlantic coast

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Abstract. The feeding of anchovy, *Engraulis encrasicolus* (Linnaeus, 1758) was investigated in the Moroccan Atlantic coast during the period between January and May 2017. Samples were collected onboard by the commercial purse-seine fleet. A total of 415 specimens were analyzed, with total lengths ranging from 8.37 to 14.41 cm. The diet of *E. encrasicolus* was studied through qualitative analysis of stomach contents. A total of 12 different prey groups were identified: copepods, *Evadne spinifera*, fish, diatoms, ostracods, dinoflagellates, fish eggs, crustacean pieces, Podon, Chaetognatha, mollusks and annelids. The vacuity index showed that the emptiest stomach was detected in Agadir (54%), Assilah (45%), Casablanca (40%), Laayoune (10%) and Larach (8%). According to the occurrence frequency, the dominant prey was copepods, confirming that anchovy is zooplanktivory. Graphical analysis of the feeding strategy of *E. encrasicolus* showed that copepods (Cope) are an important and dominant prey in its diet. A comparison between the diet of two nearby sites, Assilah and Larach, proved that the individuals taken from the two close areas had the same diet.
Key Words: abundance, copepods, feeding, occurrence frequency, vacuity.

Introduction. The diet of predatory fish integrates many ecological components including feeding behaviour, habitat use over time and space, diversity and availability of forage fauna, energy intake and fish condition, inter and intra-specific interactions, and environmental forcing. Food habits are therefore critical for understanding the trophic functioning of marine ecosystems and the sustainability of exploited fish populations. (Alegre et al 2015).

The European anchovy, *Engraulis encrasicolus* (Linnaeus, 1758), is a small pelagic fish that is widely distributed from the North Sea to Central Africa, and throughout the Mediterranean Sea (Pauly & Zeller 2012). *E. encrasicolus* is one of the major species of the Mediterranean pelagic fisheries, where it is heavily exploited by purse seine vessels and pelagic trawlers (Stamatopoulos 1972). This species plays an important role in transferring the energy from plankton to large predators (Cury et al 2000). Anchovies are also essential for the ecosystem given to their position in the trophic chain. Several studies on *Engraulis* species have demonstrated that anchovy can feed by filtering or by particulate feed suspension (Bulgakova 1992; James 2007; Leong & O'Connell 2011; Horton & Lingen 2019). The ability to switch between these feeding modes makes anchovy highly opportunistic and flexible foragers, which can maximize energy intake through employing the most appropriate feeding mode to a particular food environment. Given this ability, the diet of anchovy, which is composed of mesozooplanktonic prey, may also include smaller particles such as phytoplanktonic cells (King & Macleod 1976; Mikhman & Tomanovich 1978; Bulgakova 1992).

E. encrasicolus is characterized by a short life-span, and inter-annual fluctuations in its abundance could be important and more evident, in comparison with other species (Borme et al 2019). The feeding behavior of anchovies and the resulting variability or breadth in their food intake make field and laboratory studies regarding selectivity the

only means of predicting their diet in any particular ecosystem (O'Connell 1972; James & Findlay 1989).

The diet composition, food consumption rate and feeding periodicity of anchovy have been investigated in the Black Sea (Bulgakova 1992), in the Catalan Sea (Tudela & Palomera 1997), in the Gulf of Lions (Plounevez & Champalbert 2000; Palomera & Tirelli 2014), in the Adriatic Sea (Plounevez & Champalbert 2000; Costalago et al 2014), in the Algerian coast (Bacha & Amara 2009), in the North-western Mediterranean (Palomera et al 2007), in the North and Baltic Seas (Raab et al 2010), in the North Aegean Sea (Catala´n et al 2009) and in waters of Mauritania (Gushchin & Corten 2017). Through these studies, it has all been shown that the *E. encrasicolus* is a zooplanktivorous, with copepods usually constituting the major fraction of ingested prey (Tudela & Palomera 1997; Plounevez & Champalbert 2000). Sporadic feeding of *E. encrasicolus* on phytoplankton has also been reported by Mikhman & Tomanovich (1978).

The current study describes the diet of the Atlantic anchovy and the variability in stomach contents between sampling events. Since the distribution of zooplankton is not homogenous, individuals sampled from the same areas were assumed to have a similar diet.

Material and Method

Description of the study sites. The samples of anchovy were collected onboard the commercial purse-seine fleet between January to May 2017 from five important ports in the Moroccan Atlantic Center coast (Assilah, Larach, Casablanca, Agadir, Laayoune) (Figure 1).

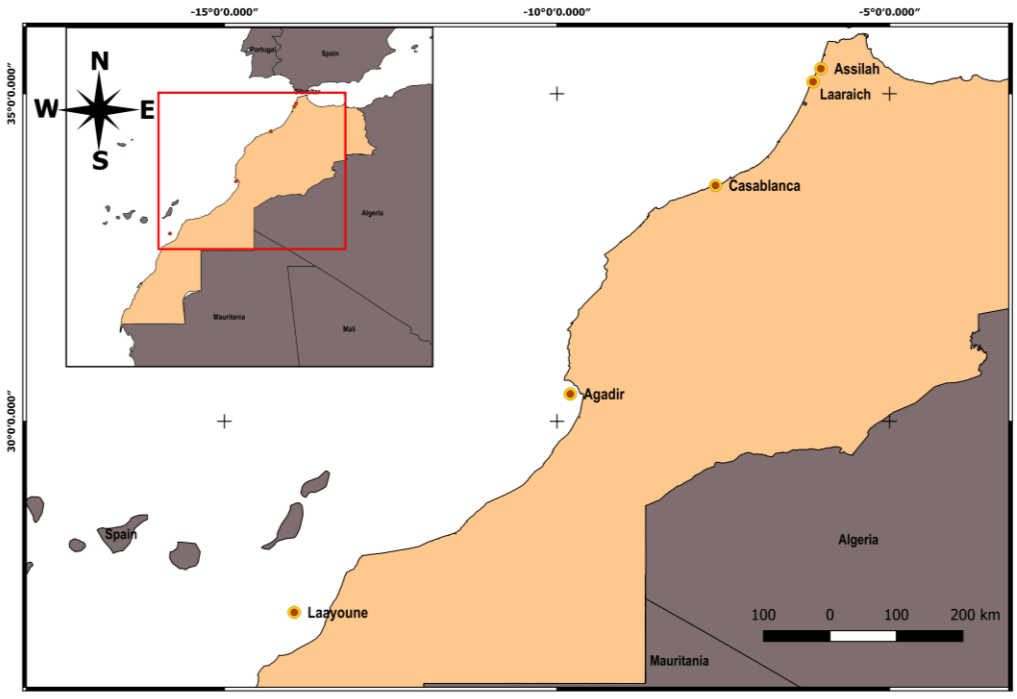

Figure 1. Location of the ports where *Engraulis encrasicolus* was sampled.

Study of stomach contents. The method used in this study to gain information on the anchovy diet, is the analysis of stomach contents. It is a method used for a long time based on the competences of the observer and the digestion degree of the prey items. It allows obtaining information on prey numbers, the size, the identity of the preys, making it highly suited to the investigation of small-scale variability in diet or selectivity studies, when the background is available (Hyslop 1980). Total length (LT) is measured for every individual before dissection, the number of analyzed stomachs for each site is presented in Table 1.

Table 1

Number of analysed stomachs and the total length per individuals

Port	*Number of analysed stomachs (n)*	*TL interval (mm)*
Agadir	65	109.91-138.481
Laayoune	74	83.75-126.66
Assilah	121	108.12-144.0191
Larach	79	109.89-144.10
Casablanca	76	103.13-129.15

Once opened, the stomachs were removed, rinsed with water to carefully detach the prey. Stomach contents were identified using a binocular microscope and determination guides (Rose 1933; Trégouboff & Rose 1957; Larink et al 2011).

The vacuity index (VI). It allows analyzing the intensity of the food activity and corresponds to the ratio in percentage between the number of empty stomachs and the total number of stomachs analyzed (Durieu 1995).

$$VI=E/T*100$$

Where:
VI - the vacuity index;
E - empty stomachs number;
T - the total number of stomachs analyzed.

The percentage frequency of occurrence (O%). It represents the number of stomachs containing at least one individual of prey (n) divided by the total number of non-empty stomachs (N), expressed as a percentage (Sobre 1972).

$$O\ \% = n / N \times 100$$

Where:
O - the occurrence frequency percentage;
n - the number of stomachs containing the prey;
N - the total number of non-empty stomachs.

This index makes it possible to know the food preferences of the predatory species. The prey is then classified into three categories (Sorbe 1972):

- O%≥50% Preferential preys: Generally, define the type of diet, and can fully meet the energy needs of the species studied.
- 10<O%<50% Secondary preys: Represent a food substitute, when the main prey is lacking.
- O%≤10% Occasional preys: Have no precise significance in the diet.

The percentage numerical abundance (N%). Provides information on the feeding behaviour of the predator. It is the ratio between the number of individuals of a given prey, and the total number of various prey, expressed as a percentage.

$$N\ \% = ni / Nt \times 100$$

Where:
N - the numerical abundance percentage;
ni - the number of individuals of a given prey;
Nt - the total number of various preys.

Index of relative importance (IRI%). The materiality index ranks prey in order of their contribution to the diet. In this article the IRI will be used without considering the mass of the prey. Obtained by combining the O% and N%, it is expressed by the following equation (Morote et al 2010).

$$IRI\ \% = O\% \times N\%$$

Where:
O% - the occurrence frequency percentage;
N% - the percentage numerical abundance.

Graphical analysis of feeding strategy (Pi). The graphical analysis method is based on a two-dimensional representation of prey-specific abundance and frequency of occurrence of the different prey types in the diet. This method is suitable for the examination of predictions made from optimal foraging, competition and niche theories (Amundsen et al 1996).

$$Pi = (\sum Si/\sum Sti)*100$$

Where:
∑Si - the stomach content (volume, weight, or number) composed by prey i;
∑Sti - the total stomach content of all stomachs in the entire sample.

Results. A total of 415 stomachs were examined, 280 were full and 135 were empty. 2,032 prey individuals were identified. The maximum number of preys is recorded in Casablanca, with 1,157 preys, followed by larach, with 545 preys, Laayoune, with 143 preys, Agadir, with 121 preys, and Assilah, with 67 preys. The study of the anchovy vacuity index in the five study sites revealed a low food activity, reflected by a high number of empty stomachs, especially for the Assilah site, with a percentage of 54%. During the study season, the feeding activity of the anchovies varies among the five sites. Larach and Laayoune have a low vacuity index values of 8 and 10%, even if they are located far one from each other, with 1,116.2 km. However, the distance between Assilah and Larach is less than 50 km, but the value of the vacuity index values are very different: 54 and 10%, respectively. Agadir, Laayoune and Assilah represent a close and high index vacuity value, 40, 45 and 54%, respectively (Figure 2).

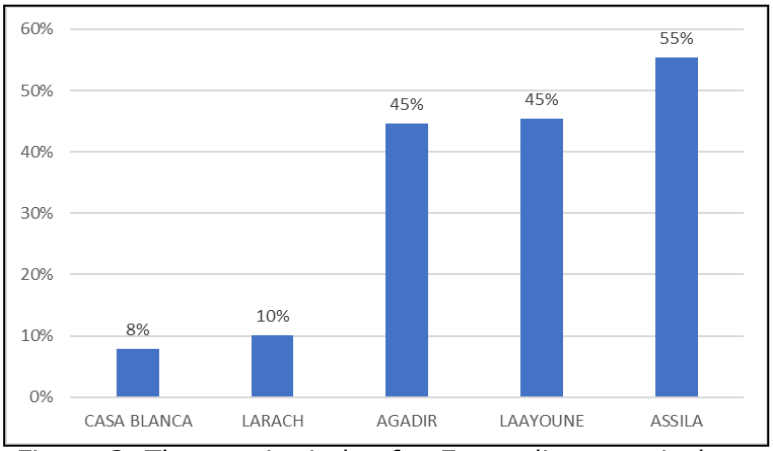

Figure 2. The vacuity index for *Engraulis encrasicolus.*

The frequency of occurrence, numerical abundance and index of relative importance values, obtained in the study, in which twelve food groups were found, including copepods, evadne, fish, diatoms, ostracods, dinoflagellates, fish eggs, crustacean pieces, podon, chaetognath, molluscs, annelids, together with undetermined preys, are given in Table 2 and Table 3.

Table 2

Frequency of occurrence, numerical abundance, and index of relative importance obtained per site (Agadir, Assila, Casablanca)

Groups	*Agadir*			*Assila*			*Casablanca*		
	N%	*O%*	*IRI%*	*N%*	*O%*	*IRI%*	*N%*	*O%*	*IRI%*
Copepod	5.79	15.38	0.89	23.88	47.06	11.24	75.54	98.57	74.46
Evadne	0.00	0.00	0.00	2.99	5.88	0.18	0.26	4.29	0.01
Fish	73.55	66.67	49.04	5.97	11.76	0.70	12.79	44.29	5.66
Diatoms	0.00	0.00	0.00	4.48	8.82	0.40	0.09	1.43	0.00
Ostracods	0.00	0.00	0.00	2.99	5.88	0.18	0.00	0.00	0.00
Dinoflagellates	0.00	0.00	0.00	8.38	5.88	0.49	3.97	4.29	0.17
Fish eggs	10.74	20.51	2.20	14.93	29.41	4.39	3.11	27.14	0.84
Crustacean pieces	1.65	2.56	0.04	29.85	58.82	17.56	7.69	47.14	3.63
Podon	0.00	0.00	0.00	1.49	2.94	0.04	0.00	0.00	0.00
Chaetognath	0.00	0.00	0.00	1.49	2.94	0.04	0.09	1.43	0.00
Mollusks	0.00	0.00	0.00	5.97	8.50	0.51	0.00	0.00	0.00
Annelids	0.00	0.00	0.00	2.99	5.88	0.18	0.00	0.00	0.00
Undetermined prey	8.26	20.51	1.70	0.00	0.00	0.00	0.17	2.86	0.00

Table 3

Frequency of occurrence, numerical abundance, and index of relative importance obtained per site (Laayoune, Larach)

Groups	*Laayoune*			*Larach*		
	N%	*O%*	*IRI%*	*N%*	*O%*	*IRI%*
Copepod	27.27	59.09	16.12	56.15	91.55	51.40
Evadne	0.70	1.52	0.01	0.37	2.82	0.01
Fish	19.58	42.42	8.31	10.28	39.44	4.05
Diatoms	0.70	1.52	0.01	3.30	21.13	0.70
Ostracods	15.38	33.33	5.13	1.28	8.45	0.11
Dinoflagellates	14.67	6.06	0.89	10.69	7.04	0.75
Fish eggs	10.49	22.73	2.38	4.77	25.35	1.21
Crustacean pieces	19.58	42.42	8.31	21.10	66.20	13.97
Podon	1.40	3.03	0.04	0.00	0.00	0.00
Chaetognath	1.40	3.03	0.04	0.00	0.00	0.00
Mollusks	0.70	1.69	0.01	0.18	1.09	0.00
Annelids	0.00	0.00	0.00	0.18	1.41	0.00
Undetermined prey	0.00	0.00	0.00	1.28	8.45	0.11

In Larach, a dominance of the copepods was observed, with a percentage of 34%, followed by crustacean pieces, with 24%, then fish, with 14%, fish eggs, with 9% diatoms, with 8%, Evadne and Annelids, with 3% for each. In Laayoune, a dominance was also observed for the copepods, with a percentage of 27%, followed by crustacean pieces and fish, with the same percentage of 20%. For this site, we observe a diversity of recorded preys: 15% ostracods, 10% fish eggs, 3% dinoflagellates, 1% Podons, Chaetognatha, molluscs, diatoms and Evadne. In Casablanca, a high percentage of Copepods was recorded, with 42%, followed by 20% of crustacean pieces, 19% fish, 12% fish eggs, 2% dinoflagellates and Evadne, and 1% Chaetognatha and Podon. In Assilah, the crustacean pieces dominated with a percentage of 30%, but the copepods also record a high percentage, of 24%. The preys in this site are also diversified: 15% fish eggs, 6% fish, 5% diatoms, 4% molluscs, 3% dinoflagellates, ostracods and annelid,

and 2% Chaetognatha and Podon. In Agadir, 16% of the preys were not determined, most of the recorded preys were fish or fish eggs, with a percentage of 62 and 20%. The Copepods were also detected, with a percentage of 15%, and a low percentage of crustaceans, of 2% (Figure 3).

After a comparison of occurrence frequency between the five studied areas (Figure 3), it appears that there is no remarkable difference, especially for these preys: Podon, Evadne, Dinoflagellates, Chaetognatha, Mollusks and Annelids. The Crustacean pieces had the same level of occurrence for all sites except Agadir, where they were less frequent. Ostracods had the same level of occurrence for all sites except Laayoune with a higher level. Fish had the highest frequency level at Agadir and the lowest at Laayoune, The other sites recorded the same frequency.

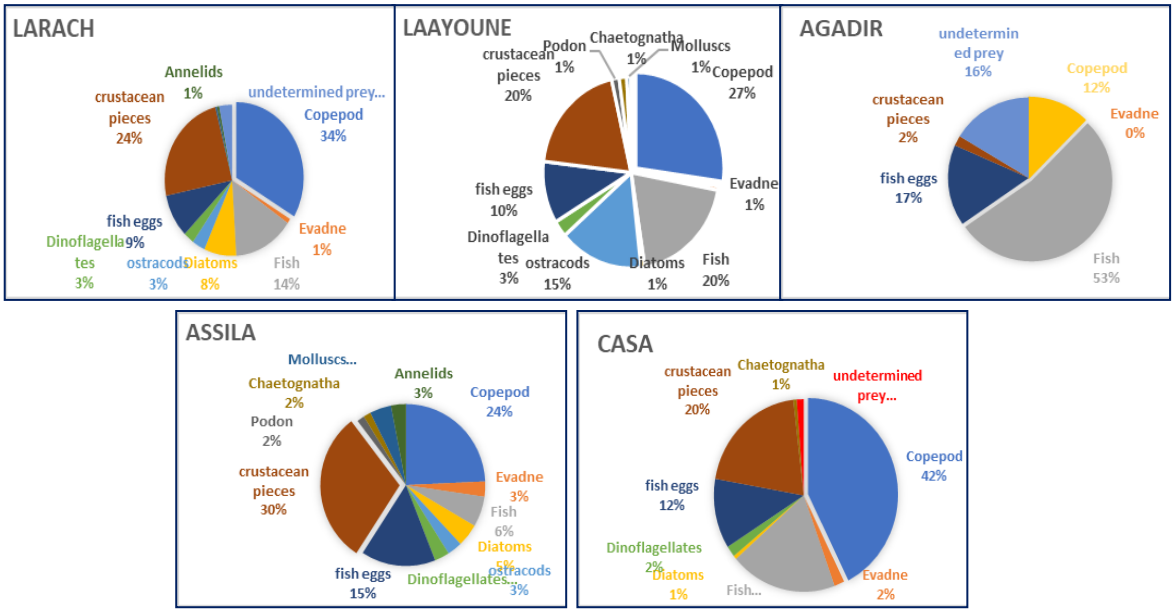

Figure 3. Occurrence frequency of preys by sites.

Regarding the Copepods, Larach and Casa have recorded the highest frequency levels, of almost 100%, while Laayoune, and Assilah are recorded a frequency of 50% and, Agadir presenteds the lowest frequency (Figure 4).

Comparing the frequency of occurrence of pfound in the stomachs of ASSILAH and LARACH, we observe that the sametype of prey found, the results wereosed wih a slight differnce of percentage occequency (Figure 5).

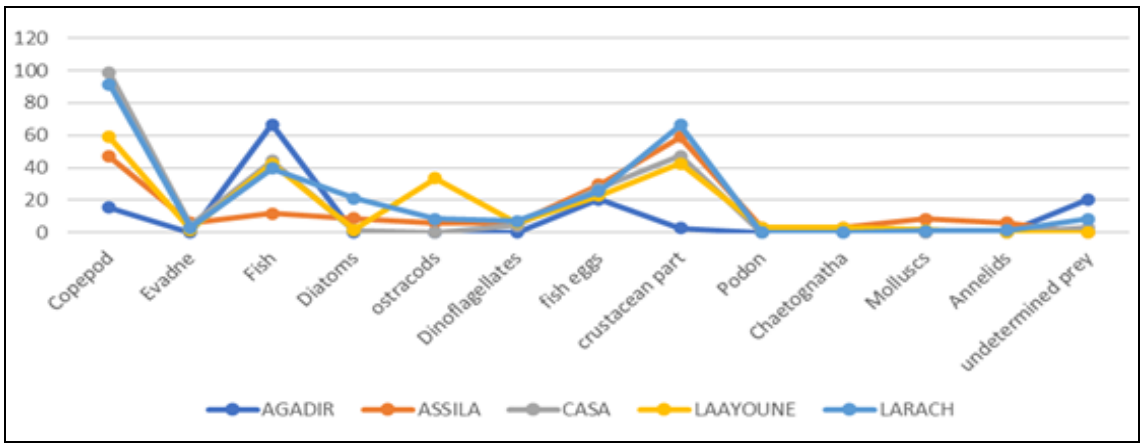

Figure 4. Comparison between occurrence frequencies of two close sites: Assilah and Larach.

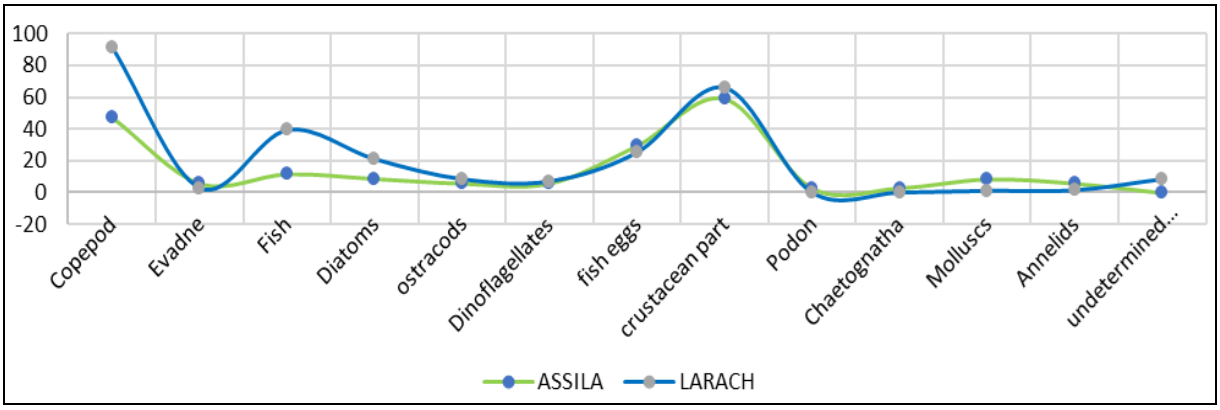

Figure 5. Comparison between occurrence frequencies of two close sites: Assilah and Larach.

The importance index makes it possible to classify the prey consumed by category, in the diet of anchovies (Table 4). Copepods rank first followed by crustacean pieces and fish, so they are three preferential preys for anchovy. Fish eggs, diatoms and ostracods are secondary prey. Evadne, Dinoflagellates, Podon, Chaetognatha, molluscs and Annelids can be considered as occasional prey.

Table 4

Prey classification by category for the five study sites - occasional prey

Groups	*Agadir*	*Assila*	*Casablanca*	*Laayoune*	*Larach*
Copepod	Secondary	Secondary	Preferential	Preferential	Preferential
Evadne spinifera	Occasional	Occasional	Occasional	Occasional	Occasional
Fish	Preferential	Secondary	Secondary	Secondary	Secondary
Diatoms	Occasional	Occasional	Occasional	Occasional	Secondary
Ostracods	Occasional	Occasional	Occasional	Secondary	Occasional
Dinoflagellates	Occasional	Occasional	Occasional	Occasional	Occasional
Fish eggs	Secondary	Secondary	Secondary	Secondary	Secondary
Crustacean pieces	Occasional	Preferential	Secondary	Secondary	Preferential
Podon	Occasional	Occasional	Occasional	Occasional	Occasional
Chaetognatha	Occasional	Occasional	Occasional	Occasional	Occasional
Molluscs	Occasional	Occasional	Occasional	Occasional	Occasional
Annelids	Occasional	Occasional	Occasional	Occasional	Occasional

This classification varies with the study sites: copepods are preferred by anchovy at three sites: Casablanca, Laayoune and Larach; however, they are secondary preys at Assila and Agadir. Fish is preferential at the Agadir site, but at the rest of the sites is secondary.Crustacean pieces are preferential at the sites of Assilah and Larach, but secondary at Casablanca and Laayoune, and occasional at Agadir (Table 4).
The preys were classified by category (Figure 6):

- Copepods are preferential for 60% of the sites studied and secondary for 40%;
- Fish preferential for 20% of sites and secondary for 80%;
- Crustacean pieces are preferential for 40% of the sites studied, secondary for 40% and occasional for 20%;
- Ostracods and diatoms are secondary for 20% of the sites and occasional for 80%
- Fish eggs secondary for all sites;
- Dinoflagellates, Podon, Chaetognatha, Molluscs and Annelids are occasional for all sites.

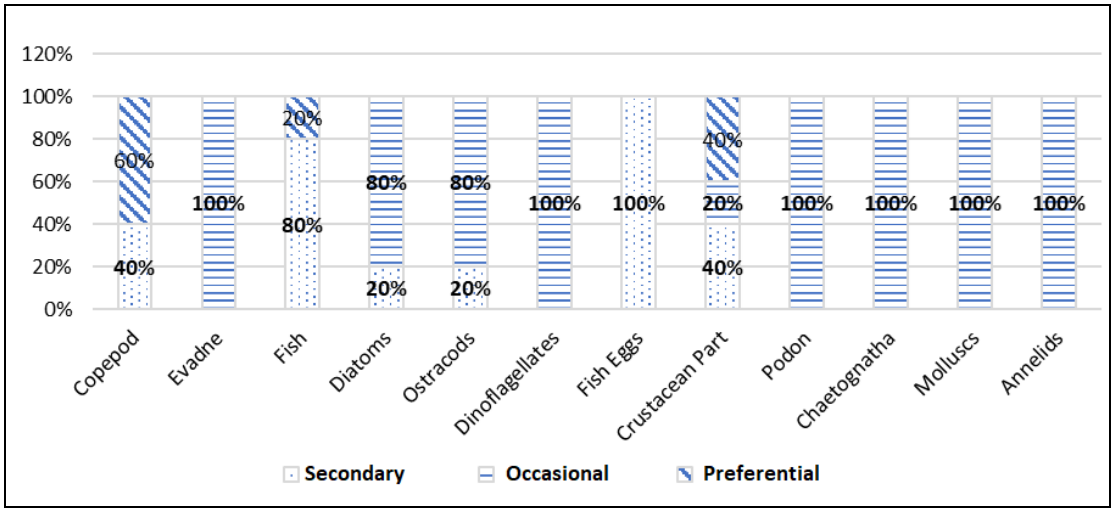

Figure 6. Percentage of category by prey.

Graphical analysis of the feeding strategy of *E. encrasicolus* by the method of Amundsen (1996) showed that copepods (Cope) are important and dominant prey in the anchovy diet. There is a strategy of specialization of the diet of *E. encrasicolus* towards the copepods. Fish, fish eggs and other crustaceans (Crusta) are occasional preys, corresponding to an omnivorous diet strategy (Figure 7).

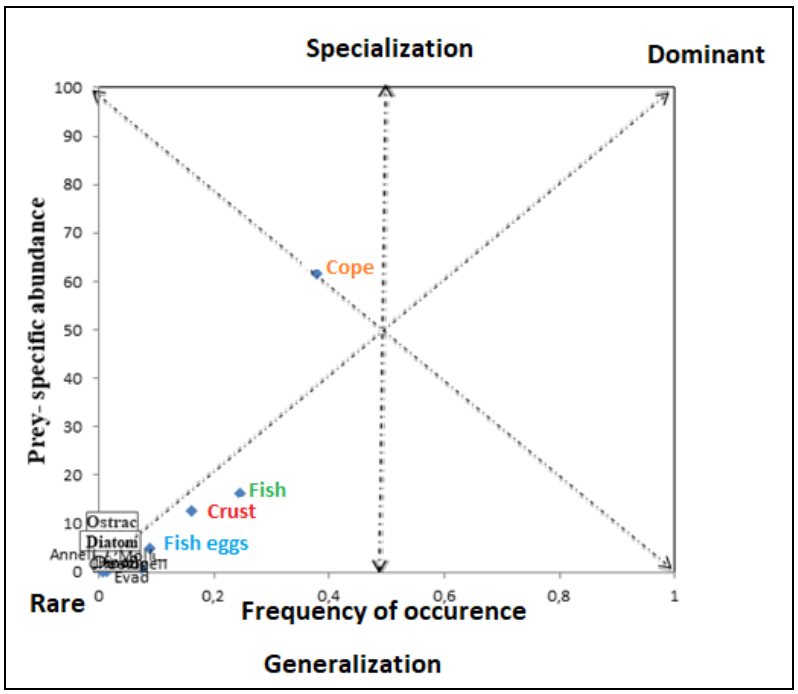

Figure. 7 Graphical analysis of feeding strategy of *Engraulis encrasicolus*.

Discussion. The study of the vacuity index shows a high value of the vacuity coefficient; the same result was indicated by El Qendouci et al (2018) in the Moroccan Atlantic Sea, with a maximum vacuity coefficient value of 38.46%. Jemaa et al (2015) found that the vacuity coefficient varied according to the study sites, with a maximum of 56.67% in the Catalan Sea. On the the Ivory Coast, Ouattara et al (2014) recorded an average vacuity value of 33.8%. A value of 42.22% was observed during the recession season and of 15.03% during the flood season. On the other side, low values were found by Schaber et al (2010): 2.12% in Kiel Bight, 2.85% in German Bight. In the North Sea, 0% were recorded by Raab et al (2010).

The highest value of the vacuity index was recorded in Laayoune and Larach, where small individuals were found (LT<11 cm); this confirms the results found by El

Qendouci et al (2018), who proved that the vacuity index shows significant fluctuations ($p<0.05$), depending on the size. For both sexes, the vacuity index was low for the small individuals (8.5–11 cm) and it was high for specimens with intermediate and large sizes >11 cm. El Qendouci et al (2018) linked the changes in the value of the vacuity index to the season. The low values of the vacuity index in spring and autumn can be an indication of the availability of food and/or the frequency of the trophic activity of anchovy. Therefore, the high value of the vacuity index during the summer is explained by the presence of individuals at the spawning stage, because the mature ovaries take place and exert compression on the digestive tract of the species, which results in the reduction of the trophic activity. It should be noted that the vacuity index must be treated with caution because it is based on the estimation of stomach-filling, it varies with the stage of digestion at the time of the analysis (Plounevez & Champalbert 2000), with the availability of prey accessible in the studied area, with the type of food (soft prey is quickly digested) or with the time of fish capture during the day (Morote et al 2010). The vacuity index does not necessarily reflect the food intensity of the fish (Jemaa et al 2016).

The analysis of stomach contents and the classification of prey by category confirmed that anchovy is a zooplanktivorous in the Moroccan Atlantic Center Coast; the main prey items found in the stomachs were copepods, as it has already been demonstrated in the North Sea and the Baltic Sea (Raab et al 2010), in the Catalan Sea (Palomera et al 2007), in the Gulf of Lion (Plounevez & Champalbert 2000; Costalago et al 2014; Morote et al 2010), in the Aegean Sea (Catala´n et al 2009) and in the southern part of the Mediterranean (Bacha & Amara 2009; Bacha et al 2010). This is not surprising since copepods represent the major zooplankton group in terms of biomass and abundance on the Mediterranean coast (Plounevez & Champalbert 2000; Frangou et al 2002), in the Channel and North Seas (Dauby 1980), and in the Atlantic (Beauchard 2014). The species of copepods which dominate the interior of the stomach contents are, Temora stylifera, Microsetella rosea and Euterpina acutifrons, wich confirm the results of Jemaa et al (2016). The comparison between the two closest sites, Assilah and Larach, confirms the hypothesis that individuals raised in two close sites have the same stomach components. Most of the anchovies in the study sites have a similar diet that is not very diversified, which corresponds to Jemaa et al (2016) results. The food ecology of *E. encrasicolus* on the Moroccan Atlantic coast is rarely studied. Our results are compared to others, also carried out in the Moroccan Atlantic coast (El Qendouci et al 2018) (study 3), in the Atlantic and Mediterranean (Jemaa et al 2015) (study 1), in the Bay of Bénisaf, SW Mediterranean (Bacha et al 2010) (study 6), in the Adriatic Sea (Zorica et al 2016) (study 4), in the İzmir Bay (Akalin et al 2018) (study 7), in the southeast Black Sea (Mazlum et al 2017) (study 8), on the coastline of the Ivory Coast (Ouattara et al 2014) (study 5), and in the Hudson River, New York (Hartman 2011) (study 2). The results are presented in Table 5.

From the comparisons from Figure 8 it can be observed that the results of the current study are not far from the results obtained in other study sites, except for three points (3, 5 and 8, in the graph of Figure 8), related to fish, crustacean pieces and mollusc; these preys are found also in other studies but with a different occurrence percentage (Figure 8).

- For the copepods (Point 1 in the graph), our results are close to the results of the studies 5 and 7.
- For the Evadne (Point 2 in the graph), our results close to all studies except study 5.
- For the fish and crustacean pieces (Point 3 and 8 in the graph), our results record the highest values.
- For the diatoms and Fish eggs (Points 4 and 7 in the graph), our results are close to the results of study 4.
- For the Ostracods (Point 5 in the graph), our results are close to the results of study 6.
- For the Dinoflagellates, Podon, Chaetognath and Annelids (Points 6, 9, 10, 12 in the graph), our results close to all studies.
- For the mollusc (Point 11 in the graph), our results are close to the results of study 5.

Table 5

Comparison between the results of the current study and the results of other researchers at different sites

Groups	*Current results (Study A)*		*The Atlantic and Mediterranean (Study 1)*		*The Hudson River, New York (Study 2)*		*The Moroccan Atlantic coast (Study 3)*		*Adriatic Sea (Study 4)*		*The coastline of the Ivory Coast (Study 5)*		*The Bay of Bénisaf, SW Mediterranean (Study 6)*		*İzmir Bay (Study 7)*		*The southeast Black Sea (Study 8)*	
	N%	*O%*	*N%*	*O%*	*N%*	*O%*	*N%*	*O%*	*N%*	*O%*	*N%*	*O%*	*N%*	*O%*	*N%*	*O%*	*N%*	*O%*
Copepod	37.73	62.33	97.1	94.7	85.2	0.53	90.86	79.91	57.36	86.99	*	62.4	327	82.35	12.92	66.47	13.05	9.66
Evadne	0.86	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*	11.6	0.00	0.00	0.03	0.8	0.31	0.9
Fish	24.43	40.92	2.40	0.10	0.075	0.003	2.34	3.39	0.25	3.76	*	0.00	0.29	15.38	0.08	2.41	22.18	21.98
Diatoms	1.71	6.58	0.50	0.00	0.00	0.00	0.00	0.00	0.09	3.01	*	0.00	0.00	0.00	0.00	0.00	0.37	1.23
Ostracods	3.93	9.53	2.40	0.10	0.00	0.00	0.00	0.00	0.06	0.74	*	0.00	0.53	17.65	0.04	0.8	0.00	0.00
Dinoflagellates	7.54	4.65	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.89	*	0.4	0.00	0.00	0.00	0.00	0.55	1.03
Fish eggs	8.81	25.03	0.00	0.00	0.00	0.00	1.06	2.71	5.58	21.59	*	0.00	0.00	0.00	0.04	0.8	25.81	8.96
Crustacean part	15.98	43.43	1.50	0.10	0.00	0.00	0.00	0.00	0.00	0.00	*	15.8	0.00	0.00	0.00	0.00	3.27	7.02
Podon	0.58	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*	0.00	0.00	0.00	0.08	2.01	0.55	1.1
Chaetognatha	0.60	1.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*	0.00	0.00	0.00	0.1	2.21	0.92	2.71
Molluscs	1.37	2.26	8.00	0.35	0.55	0.021	3.82	11.96	0.00	0.00	*	0.00	3.48	64.71	12.01	29.52	3.49	7.29
Annelids	0.63	1.46	0.00	0.00	0.1	0.011	0.00	0.00	0.32	4.41	*	0.00	0.00	0.00	0.00	0.00	2.38	6.05

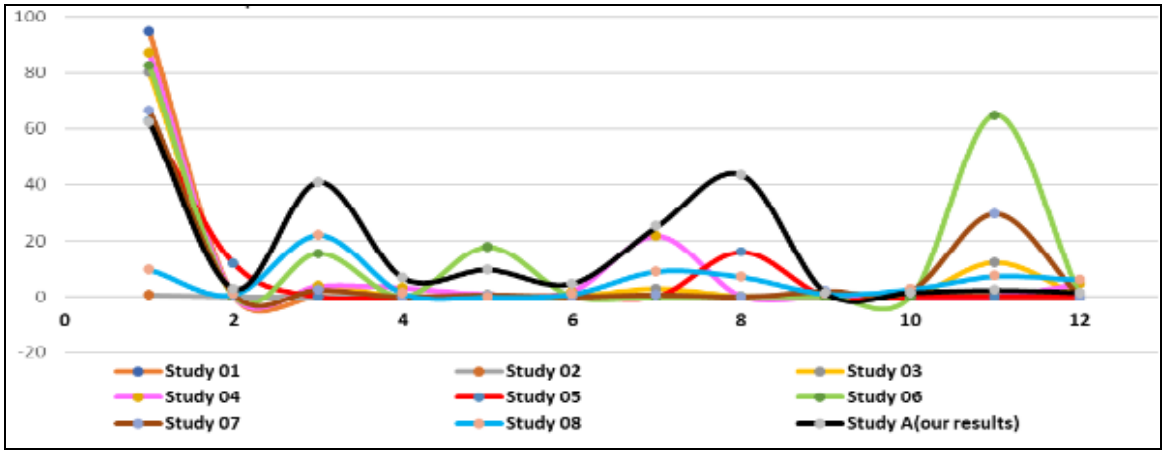

Figure 8. Comparison between the results of the current study and the results of other studies.

The results of the current study were compared with the studies N°1 and N°3, carried out on the Atlantic coast, by calculating the variation rate: current results-other results/current results *100, and they are very close in 67% of the points (Figure 9).

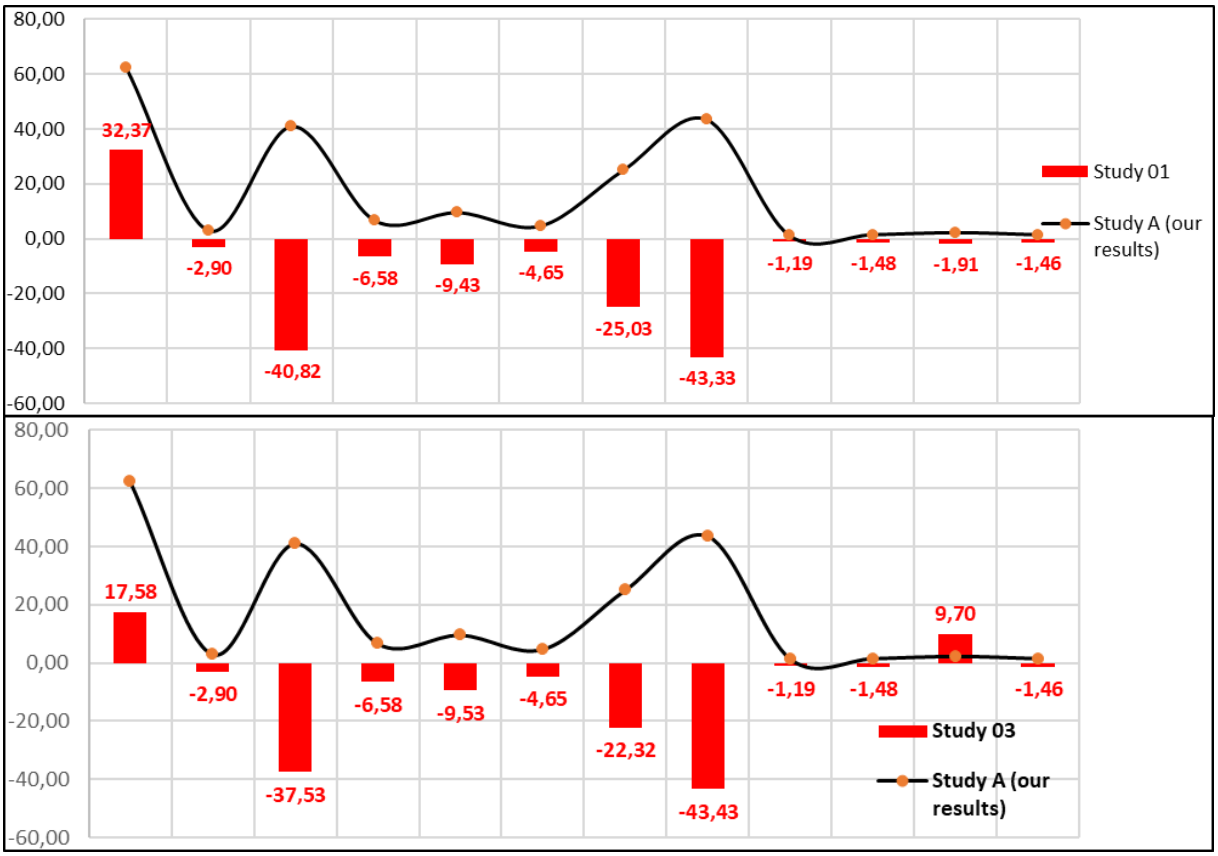

Figure 9. Variation rate between our results and the results of studies 1 and 3.

Conclusions. The current study confirms that *E. encrasicolus* is a zooplanktivorous species and its main preys consist of copepods in all size groups, crustacean pieces and fish. The expectation that samples taken close in time and space are more similar than remote samples was corroborated and it was shown that methodological choices made during the analysis may influence the biological findings. These results will be used to develop management strategies of this species, which has economic value, on the Moroccan Atlantic Coast. More comprehensive studies are needed, including the effects of

abiotic factors, day-night differences and plankton surveys for a complete understandingof the feeding behavior of the anchovy and the role of the zooplanktonic groups in the food of this species.

Conflict of interest. The authors declare no conflict of interest.

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