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ARAŞTIRMA MAKALESİ RESEARCH PAPER

Panel data analysis to forecast the nutritional values of crab species caught in the United States between 1950 and 2021

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Abstract: Data from twelve distinct crab species collected in the USA between 1953 and 2021 were used in this study. By using the panel data analysis approach, estimates were generated on the data between 2007 and 2021 in light of the information gathered after receiving the nutritional values of the linked species. Based on the species of crabs that are cultivated or harvested, the purpose of these calculations is to ascertain the nutritional values of the crabs that will be available in the upcoming years. This estimation is crucial because of the growing population and depletion of food supplies issues in the future.
The study's findings were compared with the actual values, and it was highlighted that it would be appropriate to estimate values that are closest to the actual values and investigate whether these estimates will be sufficient to fulfill the world's growing food supply.

Keywords: Crab species, nutritional value, panel data analysis, estimation method.

1950-2021 Yılları Arasında ABD Eyaletlerinde Avlanan Yengeç Türlerinin ve Besin Değerlerinin Panel Veri Analizi ile Tahmin Edilmesi

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Öz: Bu araştırmada 1953 ile 2021 yılları arasında ABD'de toplanan on iki farklı yengeç türünden elde edilen veriler kullanıldı. Panel veri analizi yaklaşımı kullanılarak, bağlantılı türlerin besin değerleri toplandıktan sonra toplanan bilgiler ışığında 2007-2021 yılları arasındaki veriler üzerinden tahminler üretildi. Yetiştirilen veya hasat edilen yengeç türlerine göre yapılan bu hesaplamaların amacı, önümüzdeki yıllarda elde edilebilecek yengeçlerin besin değerlerini tespit etmektir. Artan nüfus ve gıda kaynaklarının tükenmesi nedeniyle bunu bilmek çok önemlidir.
Çalışmada elde edilen bulgular gerçek değerlerle karşılaştırılarak, gerçek değerlere en yakın değerlerin tahmin edilmesinin ve bu tahminlerin dünyanın artan gıda arzını karşılamaya yeterli olup olmayacağının araştırılmasının uygun olacağı vurgulandı.

Anahtar kelimeler: Yengeç türleri, besin geğerleri, panel data analizleri, tahmin metodu.

INTRODUCTION

As a result of the increase in the population in the world, the emergence of the problems of reaching quality protein for the increasing population seems to be one of the inevitable ends. For developed and developing countries, it is likely to be faced with malnutrition and food deficiency. The population of the USA in 2010 was announced as 309 million 326 thousand 225. By 2021, it was announced as 331 million 176 thousand 646 (nufusu.com). An increase of around 7% in 11 years is proof that the need for protein and nutrients will be realized at least at this rate. In order to meet this emerging need, it is necessary to use non-traditional sources as well as traditional sources.

Some of the resources in the ecosystem are also met from the aquatic ecosystem. Aquatic biotas such as fish, shrimp, lobster and crabs in the aquatic ecosystem are among the most commonly consumed foods. Animals other than fish have high commercial returns in the international market (Venugopal and Gopakumar, 2017).

When examined globally, crabs are known as the most consumed food source after shrimp and lobster (Narayanasamy et al., 2020). The main reason for consuming crabs is that they are a rich source of nutrients. In addition, it is known as a very popular consumption source due to its taste and quality meat (Wang, et al., 2018). It is frequently used as a consumer product due to the unique taste and aromas in the quality of crab meat (; Sreelakshmi et al., 2016; Anupama et al., 2018; Nanda et al., 2021). Crab, which is used as a healthy consumption product, is very rich in unsaturated fatty acids, omega 3, high protein, zinc, potassium and calcium (Venugopal and Gopakuamar, 2017; Mandume et al., 2019). In addition, crabs have different by-products such as their shells, internal organs, legs and leftover meat from the sliced parts. These by-products are one of the leading sources in the field of food, thanks to their high protein, calcium, antioxidant properties, and sweetener properties (Istiak, 2018; Lorentzen et al., 2018; Tremblay et al., 2020). Various extracts from crab shells produce medicinal substances with antimicrobial, immunomodulatory and antitumor properties (Bernabe et al., 2020; Chen and Wang, 2021, Rainey et al., 2021; Nanda et al., 2021).

Many crab species, especially blue crab, are caught for commercial purposes in the world. In this study, the nutritional values of 12 different crab species over the years 1953 and 2021 were examined. Due to the data of all species have been obtained since 2007, analyzes were conducted on the data by applying panel data analysis between 2007 and 2021.

MATERIAL AND METHOD

Panel data analysis method was applied on the data set to be used for this study. Crab data to be used for 12 different crab species to be analyzed over 15 years between 2007 and 2021 using the SPSS program. Scientific names of the 12 crabs obtained were brachyura, cancer, coenobitidae, decapoda, hippidae, majidae, menippe, mithrax, paguroidea, pagurus, porcellanidae, and uca. The data used in this study, which were based on 312 data obtained from 12 crab species. The variables were total weight of crab caught, nutritional value per ton, total nutritional value, market price of food, type of crab caught or collected. Data were obtained from fisheries.noa.gov.

RESULTS

The data set statistics used in the present study are shown in Table 1. The highest pound value is in the Decapoda species with 6,108,195.90, and the lowest value is in the Cancer species with 800,00 (Table 1). In the metric ton value, the lowest value is 0.22 in Cancer species, the highest value is 2770.83 in Decapoda species; In dollar value, it is seen that the lowest value is calculated as 356.89 in Cancer type and the highest value is calculated as 28.637.733.73 in Menippe type.

Table 1. Mean and Standard Deviations for the Data Set

Crab Species	Pounds	Metric Ton	Dollars
Decapoda	6108195.90±8563727.5	2770.83 ±3884.53	5028669.40±8683551.12
Majidea	24223.44±29735.167	10.89±13.541	8691.89±8260.58
Cancer	800.00±719.491	0.22±0.441	356.89±238.598
Brachyura	251918.27±282563.656	114.20±128.164	112567.00±94381.910
Mithrax	25484.92±15335.391	11.58±6.999	22824.75±13836.099
Uca	1059620.46±754724.96	480.69±342.257	83905.77±64105.91
Pagurus	15325.86±12192.31	7.00±5.447	26030.40±37539.47
Coenobitidae	15097.00±0.00	7.00±0.00	3577.00±0.00
Hippidae	11680.87±10373.745	5.33±4.716	92182.20±63730.639
Menippe	2548797.20±387884.4	1156.13±175.718	28637733.73±6104770.0
Paguroidea	135388.46±39996.36	61.31±0.00	33357.62±14426.732
Porcellanidae	15555.00±840.043	0.50±0.707	1486.50±287.792
TOTAL	2043513.63±5245499.2	926.90±2379.367	3825022.66±9200642.56

According to the total values given in Table 1, it seems that the pound value was calculated as 2.043.513.63, the average of the metric ton was calculated as 926.90, and the average of the dollar value was calculated as 3.825.022.66.

The pounds per unit in Table 2 shows that the lowest value is in Cancer type with 1813.00, the highest value is in Majidea type with 2272.40. When analyzed in terms of the dollar per unit variable, it is seen that the highest value is in the Menippe type with 25669.11, and the lowest value is in the Uca type with 175.057. When the values for the whole data set are examined, it is seen that the average value of pounds per unit is calculated as 2198.09, and the average of the dollar value is calculated as 5729.12.

Table 2. Pound and Dollar Values per Unit.

Crab Species	Pounds Per Unit	Dollars Per Unit
Decapoda	2205.39±10.00	2185.62±1539.24
Majidea	2272.40±169.89	948.95±237.483
Cancer	1813.00±866.91	574.00±217.79
Brachyura	2207.2129±25.89	1676.609±1080.879
Mithrax	2207.1809±73.24	1879.81±609.167
Uca	2203.88±1.168	175.057±83.553
Pagurus	2167.679±85.019	2944.23±4805.505
Coenobitidae	2156.71±0.00	511.00±0.00
Hippidae	2168.65±161.55	19922.717±7738.403
Menippe	2204.576±0.515	25669.11±7935.14
Paguroidea	2206.3392±12.376	543.495±162.888
Porcellanidae	2149.00±0.00	1690.00±0.00
TOTAL	2198.09±107.79	5729.12±9269.276

Table 3. Pound and Dollar Values per Unit by Years

Year	Pounds Per Unit	Dollars Per Unit	Metric Tons
2007	2218.29±101.64	5748.27±8230.27	316.50±495.273
2008	2264.89±123.49	5268.38±6374.84	244.00±519.07
2009	2209.81±54.38	6250.46±7161.30	263.63±424.254
2010	2220.03±29.72	3459.83±6775.68	275.44±434.219
2011	2193.89±70.54	5087.67±7947.72	271.11±472.534
2012	2194.55±36.87	6189.68±8150.78	282.88±474.028
2013	2167.86±53.81	7537.71±10985.57	316.86±475.572
2014	2162.85±158.24	9742.77±155539.01	163.25±307.328
2015	2170.80±94.72	7423.27±10970.77	242.71±462.496
2016	2196.20±43.70	8206.15±10987.52	240.43±508.921
2017	2208.85±40.42	10714.39±13454.61	226.00±458.83
2018	2201.56±35.40	11871.62±150717.62	240.00±381.55
2019	2204.41±26.96	8249.36±12242.61	193.00±371.99
2020	2208.84±23.98	9071.55±12368.08	196.14±363.21
2021	2200.74±24.52	8218.71±13748.65	169.11±315.57
TOTAL	2201.33±73.56	7368.96±10404.56	243.18±409.32

When Table 3 is examined, it is seen that the pound value per unit in 2007 was 2218.29, the dollar value per unit was 5748.27 and the metric ton value was calculated as 316.50. By 2021, it is seen that the pound value per unit was calculated as 2200.74, and the dollar value per unit was calculated as 8218.71. It was concluded that the metric ton value for 2021 was calculated as 169.11.

Table 4. Analysis Results by Years.

Variable	Coefficient	Standard error	t	p > |t|
Pound	0.528	0.031	9145.24	0.000
Dollar	5.75e-9	0.711	0.984	0.327
pound per unit	-0.025	0.210	-6.011	0.000
dollar per unit	-2.45e-6	0.451	-0.672	0.503
Fixed	4.418	0.741	5.964	0.000
F Test	80.723			
N	180			
Year	15			

When the analysis results according to the years in Table 4 are examined, it is concluded that the p values of the data in dollars and dollars per unit are greater than 0.05 and that it is meaningless for the model. When the panel data set was examined, it was concluded that the fixed effects model was preferred according to the Hausman test results. Data analysis was continued under the fixed effects model.

Table 5. Analysis Results by Crab Species.

Variable	Coefficient	Standard Error	t	p > |t|
Decapoda	0.452	0.15	2.35	0.02
Majidea	0.351	0.01	2.92	0.06
Cancer	0.141	0.06	4.75	0.06
Brachyura	0.285	0.10	4.90	0.02
Mithrax	0.359	0.13	2.21	0.00
Uca	0.752	0.23	2.33	0.00
Pagurus	0.984	0.33	4.39	0.14
Coenobitidae	0.722	0.20	3.45	0.21
Hippidae	0.495	0.11	3.65	0.02
Menippe	0.665	0.16	2.72	0.04
Paguroidea	0.721	0.21	2.88	0.03
Porcellanidae	0.213	0.05	2.39	0.07
F Test	450.721			
N	180			
Species	12			

From Table 5, it was concluded that the p values of the Majidea, Cancer, Pagurus, Coenobitidae and Porcellanida variables were greater than 0.05 and that it did not make any sense for the model. It is seen that the p values of the remaining seven variables (decapoda, brachyura, mithrax, uca, hippidae, menippe, paguroidea) are less than 0.05, and these variables are significant for the model.

Table 6. Comparison of Estimated Values with Actual Values

		pound-guess	dollar-guess	pound-real	dollar-real	pounds (difference)	Dollars (Difference)	Pound Difference Avg.	Dollar Difference Avg.
Decapoda	2017	2212.89	3095.99	2202.17	4297.68	-10.72	1201.69		
Decapoda	2018	2207.68	2633.96	2212.59	4435.87	4.91	1801.91		
Decapoda	2019	2218.52	3749.92	2190.51	4633.42	-28.01	883.50	1.95	1655.24
Decapoda	2020	2192.45	2701.98	2215.68	4172.91	23.23	1470.93		
Decapoda	2021	2193.59	3473.46	2213.92	6391.65	20.33	2918.19		
Brachyura	2017	2206.88	1163.74	2177.88	1313.40	-29.00	149.66		
Brachyura	2018	2209.92	1854.26	2144.63	3768.88	-65.29	1914.62		
Brachyura	2019	2203.24	2359.16	2247.83	2883.46	44.59	524.30	4.22	687.55
Brachyura	2020	2204.17	2835.19	2249.62	3119.92	45.45	284.73		
Brachyura	2021	2206.32	2957.20	2231.68	3521.64	25.36	564.44		
Mithrax	2017	2137.47	2001.56	2217.29	1317.21	79.82	-684.35		
Mithrax	2018	2279.01	2565.14	2236.41	2236.35	-42.60	-328.79		
Mithrax	2019	2220.01	848.51	2165.77	2169.18	-54.24	1320.67	-18.60	128.77
Mithrax	2020	2318.51	2335.51	2168.95	2170.21	-149.56	-165.30		
Mithrax	2021	2113.81	1680.11	2187.38	2181.75	73.57	501.64		
Uca	2017	2205.83	76.42	2202.69	57.30	-3.14	-19.12		
Uca	2018	2202.08	197.22	2202.84	320.09	0.76	122.87		
Uca	2019	2204.72	168.85	2203.93	288.67	-0.79	119.82	-1.15	55.96
Uca	2020	2204.93	190.22	2202.32	258.33	-2.61	68.11		
Uca	2021	2204.89	194.56	2204.92	182.67	0.03	-11.89		
Hippidae	2017	2458.51	18302.51	2280.40	30251.00	-178.11	11948.49		
Hippidae	2018	2163.84	15390.84	2254.17	28438.67	90.33	13047.83		
Hippidae	2019	2335.01	17624.26	2230.08	13285.42	-104.93	-4338.84	-85.75	1749.36
Hippidae	2020	2458.52	18302.52	2175.87	14626.13	-282.65	-3676.39		
Hippidae	2021	2153.01	18316.01	2199.64	10081.71	46.63	-8234.30		
Menippe	2017	2204.02	19676.04	2204.85	25562.03	0.83	5885.99		
Menippe	2018	2205.29	13604.29	2204.68	33616.88	-0.61	20012.59		
Menippe	2019	2205.32	14598.75	2204.24	34123.95	-1.08	19525.20	-0.20	15769.75
Menippe	2020	2204.90	20118.24	2203.84	31895.80	-1.06	11777.56		
Menippe	2021	2204.11	19593.34	2205.05	41240.74	0.94	21647.40		
Paguroidea	2017	2182.45	559.89	2222.04	693.04	39.59	133.15		
Paguroidea	2018	2209.98	383.44	2190.45	649.36	-19.53	265.92		
Paguroidea	2019	2209.13	371.37	2185.30	360.42	-23.83	-10.95	-1.09	38.52
Paguroidea	2020	2212.90	424.30	2205.71	356.24	-7.19	-68.06		
Paguroidea	2021	2208.79	587.03	2214.32	459.55	5.53	-127.48		

When the estimates and actual values are compared in Table 6, it is seen that the highest accuracy values are calculated in terms of menippe, paguroidea and uca species in terms of pounds, and in terms of paguroidea, uca and mithrax species in terms of dollars.

CONCLUSION

The reason for choosing dollar and pound values in this study is that it takes into account variables such as weight, price and nutritional value of food, as well as the frequency of crab species in nature (Venugopal and Gopakuamar, 2017; Wang, et el., 2018; Istiak, 2018; Mandume et al., 2019; Narayanasamy et al., 2020; Nanda et al., 2021; Tremblay et al.,, 2020; Chen and Wang, 2021, Rainey et al., 2021). Considering the global context, crabs, which are among the most consumed seafood products together with shrimp and lobster, are among the products that are expected to be consumed more in the future, considering the effects of the global climate crisis on livestock and agriculture. When considered in this context, it is expected that both the need for crab species will increase and the prices will increase due to this excess supply.

Crabs are seen as an important food source for humans, thanks to the calcium, zinc, potassium, omega 3, fatty acids and high protein they contain. In addition, it is used by different sectors with its shells, internal organs, legs and leftover meat from the sliced parts. In this context, the weights and prices of 12 different crab species and other statistical values calculated over these values were examined. In the values in Table 1, it is seen that Decapoda species is obtained with the highest 6 million 108 thousand 195 pounds, and the cancer species is the lowest with 800 pounds. It is seen that cancer values have the lowest values in terms of metric tons and dollars. In Table 2., the pound and dollar values per unit are calculated. When these values are examined, it is seen that the highest value is in the majidea and uca types. In Table 3, the pound and dollar values per unit are analyzed by years. When these values are examined, it is seen that the pound values have an average of 2200, and the dollar value has an average of 7369.

According to the analysis results in Table 4. and Table 5., it was concluded that decapoda, brachyura, mithrax, uca, hippidae, menippe and paguroidea species were significant for the model. In Table 6, successful results of the proposed method for menippe, paguroidea and tip species were determined by comparing with the actual values.

In this study, it was concluded that it is possible to predict the nutritional values to be obtained in the future for menippe, paguroidea and uca species by panel data analysis method in general. It is planned to compile the data in terms of nutritional values of these three species, which are discussed in the following periods, and make the study more comprehensive.

FUNDING

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CONFLICT OF INTEREST STATEMENT

The author declares that there are no financial interests or personal relationships that may have influenced this work.

AUTHOR CONTRIBUTIONS

Study design: OG; Literature review: OG; Methodology: OG; Conducting the experiment: OG; Data analysis: OG; Manuscript writing: OG; Editing: OG. All authors approved the final draft.

Conflict of Interest: No conflict of interest was declared by the authors.

Ethical Approval Statement: Local Ethics Committee Approval was not sought, as the study did not involve the utilization of experimental animals.

DATA AVAILABILITY STATEMENT

Research data is not shared.

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