

BLUEFIN TUNA FARMING GROWTH RATES IN THE MEDITERRANEANSusana Sainz Trápaga¹, Sergi Tudela², Gemma Quílez-Badia¹*SUMMARY*

Fattening ratios of farmed bluefin tunas in Mediterranean farms were estimated from reported data of weight at catch and at harvest, respectively. Based on a literature review, fattening ratio values for adult tunas under prevalent conditions in tuna fattening farms in the Mediterranean do not exceed 40 %. Fattening ratios computed in this analysis ranged from -6 % up to 289 % and 80 % of these fattening ratios were higher than 40 %. The data reported, therefore, seem to suggest that most fattening ratios derived from the reported catch and harvested figures in BCDs could not be explained biologically. The high fattening ratios (extreme in some cases), the independence of the ratios from the starting fish size and the fattening time and the big discrepancies arisen from BCDs from different nations but covering a same batch of fish suggest potential measuring or reporting errors.

RÉSUMÉ

Les taux d'engraissement du thon rouge d'élevage dans les fermes de la Méditerranée ont été estimés à partir des données de poids déclarées à la capture et à la mise à mort, respectivement. D'après l'examen de la documentation, les valeurs de taux d'engraissement des thons adultes dans les conditions qui prévalent actuellement dans les fermes d'engraissement des thons dans la Méditerranée ne dépassent pas les 40%. Les taux d'engraissement calculés dans la présente analyse ont fluctué de -6% jusqu'à 289 % et 80% de ces taux d'engraissement étaient supérieurs à 49%. Les données déclarées semblent donc donner à penser que la plupart des taux d'engraissement dérivés des chiffres déclarés de capture et de mise à mort dans les BCD ne pouvaient pas être expliqués de manière biologique. Les taux d'engraissement élevés (extrêmes dans certains cas), l'indépendance des taux par rapport à la taille initiale du poisson et la durée de l'élevage et les divergences importantes entre des BCD de différentes nations mais couvrant un même lot de poissons donnent à penser qu'il existe vraisemblablement des problèmes de déclaration ou de mesure.

RESUMEN

Las ratios de cría de atún rojo en las granjas del Mediterráneo se estimaron a partir de los datos en peso en el momento de la captura y en el momento del sacrificio. Basándose en una revisión de la bibliografía, los valores de las ratio de cría de atunes adultos, en las condiciones existentes en las granjas de cría de atún en el Mediterráneo, no superaron el 40%. La ratios de cría contabilizadas en el análisis oscilaron entre -6% y 289%, el 80% de estas ratios de cría eran superiores al 40%. Los datos comunicados más arriba parecen sugerir que muchas ratios de cría derivadas de las cifras de captura y sacrificio declaradas en los BCD no pueden explicarse desde el punto de vista biológico. Los elevados valores de las ratios de cría (que en algunos casos son extremos), su independencia de la talla inicial del pez y del periodo de cría y, las grandes discrepancias entre los BCD de diferentes naciones que cubren un mismo lote de peces sugieren posibles errores de medición o de declaración.

*KEYWORDS**Thunnus thynnus, Growth rates, Farms, Mediterranean*

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1. Introduction

According to the available scientific literature, fattening ratios achieved by tunas subject to fattening activities in farms vary depending on a number of factors ranging from fattening time, starting size and condition of the fish, feeding regime or season (Aguado Gimenez and García García, 2005; Gimenez Casalduero and Sanchez Jerez, 2006; Deguara *et al.*, 2010; Gordo, 2010 and Galaz, 2012). Still, notwithstanding such room for variation, fattening ratios applicable to adult bluefin tuna reared in Mediterranean farms in a typical farming season are constrained by physiological aspects pertaining to the deep biology of the species. Such typical values for the adult age classes prevalent in most Mediterranean fattening farms (excluding Croatia) have been reported to range between 25-38 % (for fish above 60 kg; Gordo, 2010) and up to a maximum 35 % (for fish above 60 kg; Galaz, 2012).

Based on the above, any fattening ratio values above 40 % for adult tunas could be considered as difficult to be explained biologically and may alert on a potential measuring or reporting error.

2. Materials and Methods

In this analysis (based on a consultancy carried out by FishSpektrum) we have estimated fattening ratios - computed as the increase in weight at the end of the rearing period relative to the weight at catch (in %) - of farmed tunas in Mediterranean farms based on the information in ICCAT BCD documents pertaining to fish caught in the 2012 fishing season and reported before 1st April 2013. The calculation was carried out only for those cases for which harvest was completed or almost completed, i.e. a total of 90 cases for which over 90 % of the original wild fish were already harvested (**Table 1**). In the event the harvest was not fully complete data was corrected for actual fish harvested.

It should be noted not all 90 cases analyzed represented independent live fish shipments to cages, as in the case of joint fishing operations involving two different nations a catch is split into two different BCDs, each recording the corresponding share of the national quota; all fish is nevertheless transferred together to the same farming facility as a single batch.

3. Results

Figure 1 shows the distribution of the frequency of the computed fattening ratios, which range from - 6 % to 289 %. 80 % of the fattening ratios computed in this analysis were higher than 40 %. A majority of fattening values (62 %) ranged between 40 % and 90 %. Besides, many values were far beyond the physiological capabilities of fish under the prevalent fattening conditions in the Mediterranean, and no apparent trends were observed regarding size at catch and fattening period (**Figure 2**).

The above was further illustrated by the following selected examples:

- a) Fattening ratios calculated from different BCDs but pertaining to same catch operations and same shipments to farms were inconsistent in spite of the fish having been transferred, farmed and harvested together (JFOs involving vessels from two different nations, **Table 2**).
- b) Among the most biologically realistic fattening ratios in this study, 6 values corresponded to catches of a vessel for which there were strong discrepancies between the figures reported by the ROP and those in the respective BCDs. Fattening ratios based on these BCDs were between 15 and 30% but there was an excess of a total of 1087 individuals in the ROP observer report compared to the respective BCDs (**Table 3**).
- c) Fattening ratios corresponding to catches from four fishing operations of the same vessel were the same (57-58 %), despite considerable differences in the mean weight at catch (52, 80, 208 and 81 kg); see **Table 1**.

4. Conclusions

The data reported above seem to suggest that many fattening ratios derived from the reported catch and harvested figures in BCDs could not be explained biologically. The high fattening ratios (extreme in some cases), the independence of the ratios from the starting fish size and the fattening time and the big discrepancies arisen from BCDs from different nations but covering a same batch of fish suggest potential measuring or reporting errors. The results obtained in this analysis raise particular concerns over the accuracy of the reporting of the fish caught and transferred to the farms.

Finally, WWF would like to point out the considerable distortion of traceability linked to the current practice of splitting a single catch achieved by a vessel operating under a multinational JFO into different BCDs (one per flag state, accounting for the total national share of the catch). This practice means, for example, that fish from a same shoal that is fished in a same fishing operation, shipped together to a farm within a same transport cage and is fattened together in the same pen is reported in different BCDs (of different nationality). This, as showed in this study, becomes all the more relevant as discrepancies often arise on fattening ratios calculated for such fish, which was never physically separated from the moment of the catch to that of the harvest.

References

- Aguado Gimenez, F. and García García, B. 2005, Changes in some morphometric relationships in Atlanticbluefin tuna (*Thunnus thynnus thynnus* Linnaeus, 1758) as a result of fattening process. *Aquaculture*, 249: 303-309. E.
- Deguara, S., Caruana, S., Agius, C. 2010, Results of the first growth trial carried out in Malta with 60kg farmed Atlantic bluefin tuna (*Thunnus thynnus* L.). *Collect. Vol. Sci. Pap. ICCAT* 65(3): 782-786.
- Galaz, T. 2012. Eleven years –1995-2005- of experience on growth of bluefin tuna (*Thunnus thynnus*) in farms. *Collect. Vol. Sci. Pap. ICCAT*, 68 (1): 163-175.
- Gimenez Casalduero, F. and Sanchez Jerez, P. 2006, Fattening rate of bluefin tuna *Thunnus thynnus* in two Mediterranean fish farms. *Cybium*, 30: 51-56.
- Gordoa, A. 2010, Estimating the fattening factor of Atlantic Bluefin Tuna (*Thunnus thynnus*) on tuna farms: The Ametlla de Mar facility as a case Study. *Collect. Vol. Sci. Pap. I CCAT*, 65(3): 848-857.

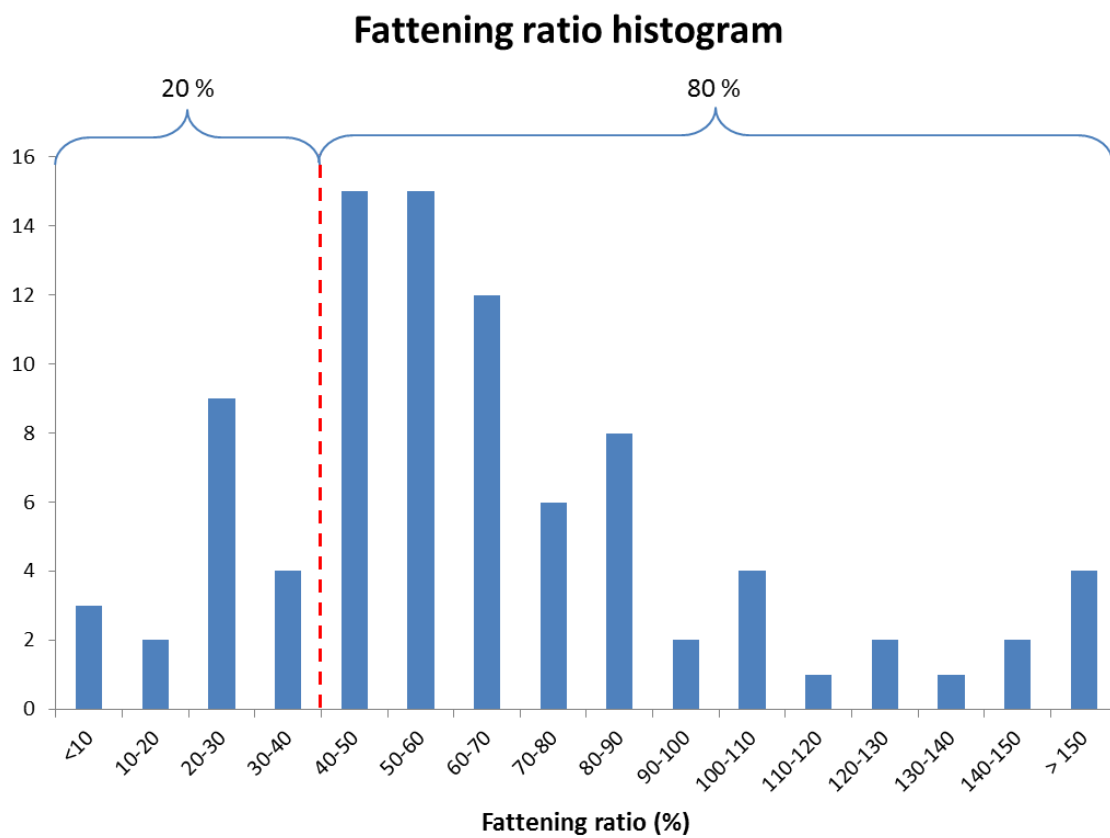


Figure 1. Frequency distribution of the computed fattening ratios.

Fattening ratio vs Mean weight

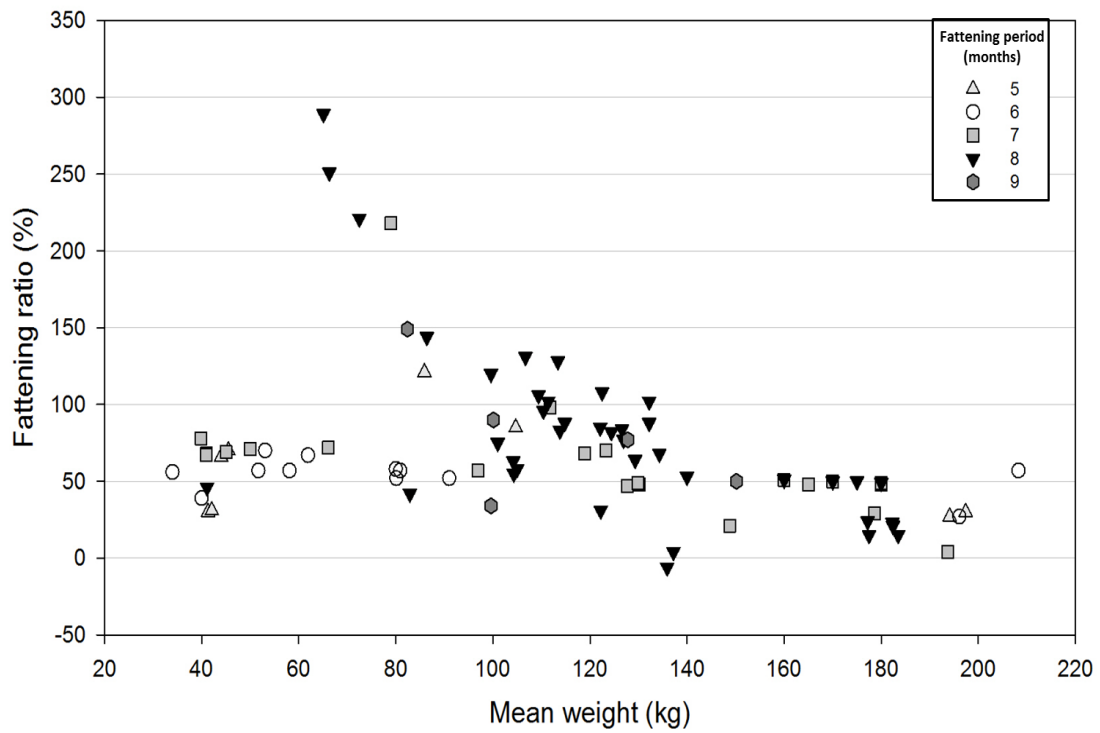


Figure 2. Relation between the mean weight of the caught fish and its computed fattening ratio. Colors represent the length of the fattening period in months.

Table 1. Catching and farming information related to the 90 analyzed cases for which more than 90% of the caught fish was harvested.

BCD	Caught fish (No.)	Harvested fish (No.)	Harvested fish (%)	Mean weight at catch (kg)	Fattening ratio (%)	Fattening period (months)
1	1.300	1221	94	53,1	70	6
2	706	697	99	91	52	6
3	26	26	100	106,7	131	8
4	46	46	100	122,5	108	8
5	42	42	100	124,4	82	8
6	79	76	96	134,3	68	8
7	26	26	100	113,4	128,1	8
8	42	42	100	132,2	88	8
9	305	300	98	104,7	85	1-5
10	38	38	100	99,6	34	9
11	92	92	100	100,1	90	9
12	1714	1629	95	61,9	67	6
13	44	44	100	111,4	102	8
14	58	58	100	122,1	85	8
15	76	76	100	82,9	42	8
16	313	311	99	104,2	63	8
17	109	109	100	109,4	106	8
18	141	141	100	122,2	31	8
19	186	174	94	82,4	149	8-9
20	761	761	100	104,3	55	5-8
21	156	156	100	196,1	27	5-6
22	81	81	100	182,3	23	5-8
23	224	224	100	177,5	15	8
24	377	377	100	197,4	30	4-5
25	197	197	100	182,4	21	6-8
26	546	546	100	177,2	24	8
27	1776	1749	98	41	67	5-7
28	494	490	99	41	68	5-7
29	3784	3771	100	58,1	57	5-6
30	511	507	99	135,9	-6	7-8

31	141	140	99	137,2	4	7-8
32	900	893	99	129,9	49	6-7
33	125	124	99	41,1	46	7-8
34	250	249	100	130,2	48	5-7
35	1681	1669	99	45,5	70	5
36	795	794	100	44	66	5
37	2810	2769	99	80,1	52	5-6
38	900	899	100	51,7	57	5-6
39	650	649	100	80	58	5-6
40	96	95	99	208,3	57	5-6
41	624	615	99	80,9	57	5-6
42	410	410	100	180	48	6-7
43	340	339	100	165	48	6-7
44	1180	1080	92	66,1	72	6-7
45	137	137	100	113,8	83	7-8
46	75	75	100	110,4	96	8
47	106	105	99	129,3	64	7-8
48	714	708	99	127,8	77	7-9
49	180	174	97	111,8	98	7
50	37	37	100	99,6	120	8
51	43	43	100	66,3	251	8
52	374	374	100	126,9	77	8
53	217	217	100	150,17	50	6-9
54	15	15	100	101	75	8
55	18	18	100	65,1	289	8
56	154	154	100	126,6	84	8
57	90	90	100	148,8	21	7
58	29	29	100	79	218	7
59	40	40	100	178,6	29	7
60	493	493	100	194,1	27	5
61	13	13	100	72,5	221	8
62	16	16	100	183,5	15	8
63	203	203	100	193,7	4	6-7
64	16	16	100	132,2	102	8

65	180	178	99	127,7	47	1-7
66	133	132	99	114,8	88	8
67	13	13	100	86,4	144	8
68	49	49	100	118,9	68	7
69	99	97	98	123,3	70	7
70	33	33	100	85,9	121	5
71	1070	1018	95	34	56	6
72	1231	1198	97	50	71	6-7
73	2260	2106	93	45	69	5-7
74	2580	2432	94	39,9	78	6-7
75	1777	1728	97	96,9	57	6-7
76	1500	1424	95	41,3	30	5
77	750	709	95	42,1	31	5
78	1550	1470	95	40	39	6
79	20	20	100	180	49	7
80	28	28	100	160	51	7
81	8	8	100	180	49	7
82	20	20	100	170	50	7
83	171	171	100	140	53	7-8
84	21	21	100	160	51	7-8
85	19	19	100	175	50	7-8
86	21	21	100	175	50	7-8
87	18	18	100	170	50	7-8
88	22	22	100	105	58	7-8
89	19	19	100	180	49	7-8
90	18	18	100	160	51	7-8

Table 2. Data corresponding to 10 individual fishing operations carried out under JFOs involving two nations where catches are reported under two BCDs (one per nation). Fish was farmed and harvested in the same farming facility; physical separation of fish based on the nationality attributed to the catch does not occur.

Date of catch	Nation A			Nation B		
	Mean weight at catch (kg)	Date of harvest	Fattening ratio (%)	Mean weight at catch (kg)	Date of harvest	Fattening ratio (%)
23/5	106,7	16/02	131	124,4	16-18/02	82
24/5	122,5	18/02	108	134,3	20-21/02	68
23/5	113,4	16/02	128	132,2	18-20/02	88
19/5	99,6	16/02	34	101,1	16/02	90
24/5	122,1	14-15/02	85	122,2	14-17/02	31
26/5	82,9	1-21/02	42	82,4	5/02-12/03	149
23/5	101	17/02	75	99,6	16-17/02	120
24/5	65,1	13-15/02	289	66,3	17/02	251
27/5	148,8	2/01-10/02	21	150,17	12/11-13/02	50
27/5	193,7	11/11-4/01	4	194,1	6-11/11	27

Table 3. Fishing operations carried out by a same vessel operating under a JFO involving two nations, showing inconsistent reports on the number of fish.

Date of catch	Fattening ratio (BCD nation A)	Fattening period (nation A)	Fattening ratio (BCD nation B)	No. of fish (ROP)	Fattening period (nation B)	No. of fish (BCD nation A)	No. of fish (BCD nation B)	Difference from ROP and both BCDs
18/5	27%	5-6	30%	1211	4-5	156	377	678
25/5	23%	5-8	21%	392	6-8	81	197	114
27/5	15%	8	24%	1065	8	224	546	295