GROWTH IN LENGTH AND WEIGHT AND MERCURY CONTENT IN SMALL FATTENED BLUEFIN TUNA

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Abstract
In areas where detailed information on wild young bluefin tuna growth is available, the growth performances of fattened specimens of the same age can be estimated. The present study described growth rates and mercury and cadmium content of 3 - 4 years old tuna, caged in the Tyrrhenian Sea.
Keywords : Western Mediterranean, Aquaculture, Growth, Mercury.

Growth rates in length and weight undergo marked variation in bluefin tuna, due to the seasonality of environmental parameters and the peculiar migration and reproductive performances of this species. In the last ten years tuna farms have spread in the Mediterranean: bluefin is fattened in floating cages after the capture by purse seining. The fishing activity is addressed mainly to aggregations of spawners. Fattening practices introduce deviation in natural growth processes both increasing feeding and reducing muscular activity of fish; moreover they alter the natural redistribution of lipids which occurs during maturation of gonads; infact stressed fish cannot complete maturation. However, such growth variation has rarely been precisely measured in fattening farms, except by tagging of individuals [1]. This gap can be filled reading the age of the specimens and comparing them with wild tuna of the same age and seasonal period: such information is available for italian waters of the western Mediterranean [2].
Samples of young bluefin tuna, 111-134 cm fork length (FL) and 30.3-57.2 kg round weight (RW), were purchased from a fattening farm located in the Tyrrhenian Sea, 6 in November 2005 and 10 in April 2006. The following parameters were ascertained: age (by reading the basal section of the first dorsal spine [3]), FL (cm), RW (kg), condition index [4], sex, total mercury, organic mercury and cadmium concentrations in the white muscle, i.e. the largest edible part of fish (table 1).
Tab. 1. Biological parameters and mercury content of fattened tuna.

MALES

harvesting date	FL (cm)	RW (kg)	condition index	age	tot Hg (µg/g d.wt.)	org Hg (µg/g d.wt.)
11/11/2005	111.00	30.28	2.21	~3.5	1.37	0.88
11/11/2005	120.00	32.58	1.89	~3.5	1.93	1.09
11/11/2005	121.00	36.41	2.06	~3.5	1.75	1.07
Average value at 3.5 years	***117.33***	***33.09***	***2.05***		***1.68***	***1.01***
6/04/2006	118.00	36.40	2.22	~3.8	2.28	2.15
6/04/2006	122.00	39.80	2.19	~3.8	1.00	0.95
Average value at 3.8 years	***120.00***	***38.10***	***2.21***		***1.64***	***1.55***
11/11/2005	128.50	44.63	2.10	~4.5	1.65	1.33
Average value at 4.5 years	-	-	-		-	-
6/04/2006	130.50	47.20	2.12	~4.8	2.09	1.94
6/04/2006	130.20	50.20	2.27	~4.8	1.02	1
6/04/2006	134.00	57.20	2.38	~4.8	1.64	1.68
Average value at 4.8 years	***131.57***	***51.53***	***2.26***		***1.58***	***1.54***

FEMALES

harvesting date	FL	RW (kg)	condition index	age	tot Hg (µg/g d.wt.)	org Hg (µg/g d.wt.)
9/11/2005	126.00	36.83	1.84	~4.5	2.97	2.06
9/11/2005	119.00	36.90	2.19	~4.5	1.77	1.04
Average values at 4.5 years	***122.50***	***36.86***	***2.02***		***2.37***	***1.55***
6/04/2006	122.00	39.00	2.15	~4.8	1.44	1.44
6/04/2006	127.00	39.20	1.91	~4.8	1.80	1.8
6/04/2006	133.50	41.80	1.76	~4.8	1.12	0.98
6/04/2006	130.00	44.60	2.03	~4.8	1.76	0.88
6/04/2006	129.00	45.20	2.11	~4.8	1.99	1.68
Average values at 4.8 years	***128.30***	***41.96***	***1.99***		***1.62***	***1.36***

Average values, calculated by keeping the specimens separated by sex and age, are shown in fig. 1, in form of discrete points. Growth performances of wild tuna of age 3 and 4 are shown in the same fig. 1. The growth curves were obtained by the following parameters: $L\infty$=160.61; K=0.296; t_0=-0.571; WP=0.718; C=1, for the growth in cm FL, in the age range 0-5. For the growth in weight (kg) in the above mentioned seasonalized Von Bertalanffy function the length/weight relationship $y=0.000026FL^{2.908450}$; R^2=0.993 was introduced. Given that captures occur at the same time as reproduction, the starting of captive life as well as birth time were set at 1^{st} June.
The growth rates of fattened tuna resulted:
Male aged 3: in the period June- November 3.03 cm/month; 0.092 cm/day; 2.87 kg/month.
in the period June-April 1.78 cm/month; 0.058 cm/day; 1.93 kg/month.
Male aged 4: in the period June- November 2.27 cm/month; 0.069 cm/day; 3.42 kg/month.
in the period June-April 1.44 cm/month; 0.047 cm/day; 2.40 kg/month.
Female aged 4: in the period June- November 1.07 cm/month; 0.033 cm/day; 1.87 kg/month.
in the period June-April 1.12 cm/month; 0.036 cm/day; 1.44 kg/month.
The growth in length resulted moderately higher than in wild fish in males, and almost unchanged in females. The growth in weight was considerable, especially in males: so the sexual dimorphism typical of big adult bluefin, with males larger than females, is apparently evident since the beginning of adult life; i.e. at 3 and 4 years. The comparison of growth rates calculated during approximately five or ten months respectively, gives evidence of seasonality of growth in fattened specimens.
Cadmium concentrations were always very low and frequently below the detection limit of the method. Mean total mercury concentration was 1.72 µg/g d.wt. ranging from 1.00 to 2.97 µg/g d.wt.
A significant ($p<0.01$) difference for the percentage of organic mercury exists between the specimens caught in November (mean Hg-org 65%) and in April (mean Hg-org 90%), even if in total and organic mercury concentrations no significant difference was observed.

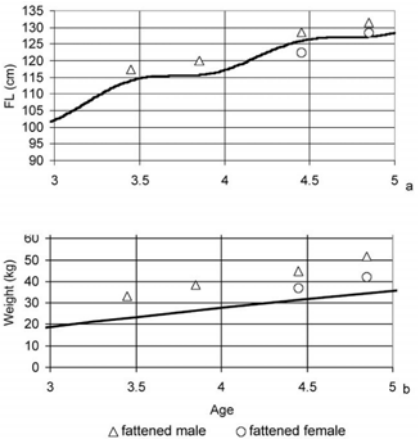

Fig. 1. Seasonalized growth functions of wild tuna, in the age range 3-5 years, and sizes observed in small samples of fattened tuna of the same age (discrete points): a) growth in length - b) growth in weight.

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