Received: 26 October, 2011
IOTC–2011–WPNT01–18

Population dynamic parameters of *Thunnus tonggol* in the north of the Persian Gulf and Oman Sea

F. Kaymaram*, M. Darvishi, F. Parafkandeh, Sh. Ghasemi and S.A.Talebzadeh
Iranian Fisheries Research Organization
Farhadkaymaram@gmail.com

Abstract:

Yearly tuna and tuna-like catches in Iran are of the order of 163,991 t, close to 40% of which are longtail tuna. Fork length was measured on a total of 4313 longtail tuna by the technicians of the research centers of the IFRO at a number of sample sites along the north part of the Persian Gulf and Oman Sea from Oct 2006 to Sept 2007.Total fresh weight was recorded for a sub-sample of individuals. Monthly length –frequency distributions grouped in three centimeters class intervals. The Von Bertalanffy parameters were then estimated by the software of FISAT. The length – weight relationship was estimated as: $W=0.00002\ L^{2.83}$. Total mortality (Z) was estimated by using the Powell-Wetherall plot as 1.82 per year. Natural mortality was obtained by Pauly equation (M=0.44).Fishing mortality (F) then estimated from Z-M=1.38.

Introduction:

Tunas form an important part of the marine fishery production of Iran, and are traditionally caught by artisanal fishermen in the Persian Gulf and Oman Sea (Figure 1). Most of the catches are made using drifting gillnets and trolling.
The main tuna species caught in Iranian waters are:
Longtail tuna (*Thunnus tonggol*), Yellowfin tuna (*Thunnus albacares*), Skipjack tuna *(Katsuwonus pelamis*), Kawakawa (*Euthynnus affinis*), Frigate tuna (*Auxis thazard*).
Yearly tuna & tuna – like species catch in Iran are of the order of 163991 t, close to 40 % of which are longtail tuna. Table 1 shows the estimated catches of tuna species in Iranian waters in 2010.

Table 1: Tuna & tuna like species catch in Iranian waters (2010)(IFO, 2011)

Species	Catch (t)
T.tonggol	64,450
T.albacares	31,485
K.pelamis	22,285
E.affinis	16,336
S.commerson	10,884
I.platypterus&M.indica	9,209
A.thazard	6,172
S.guttatus	3,170
Total catch	163,991

Few studies have been undertaken on longtail tuna, such as estimation of growth parameters and mortality rates of *T. tonggol* and determination of its exploitation pattern in coastal waters of Hormuzgan province (M.Sc. thesis by Davarpanah, 2007). In this regard, some biological and

population dynamic parameters studies of tuna and tuna like species were carried out in the Persian Gulf & Oman Sea by using fishery- dependent data (kaymaram, 2009).

Material and methods:

Length and weight data were collected randomly from five traditional fish-landing sites: Chabahar, Jask, Bandar Abbas, Bandar Lengeh and Parsian in the Persian Gulf and Oman Sea coastal waters (Figure.1) from October 2006 to September 2007.

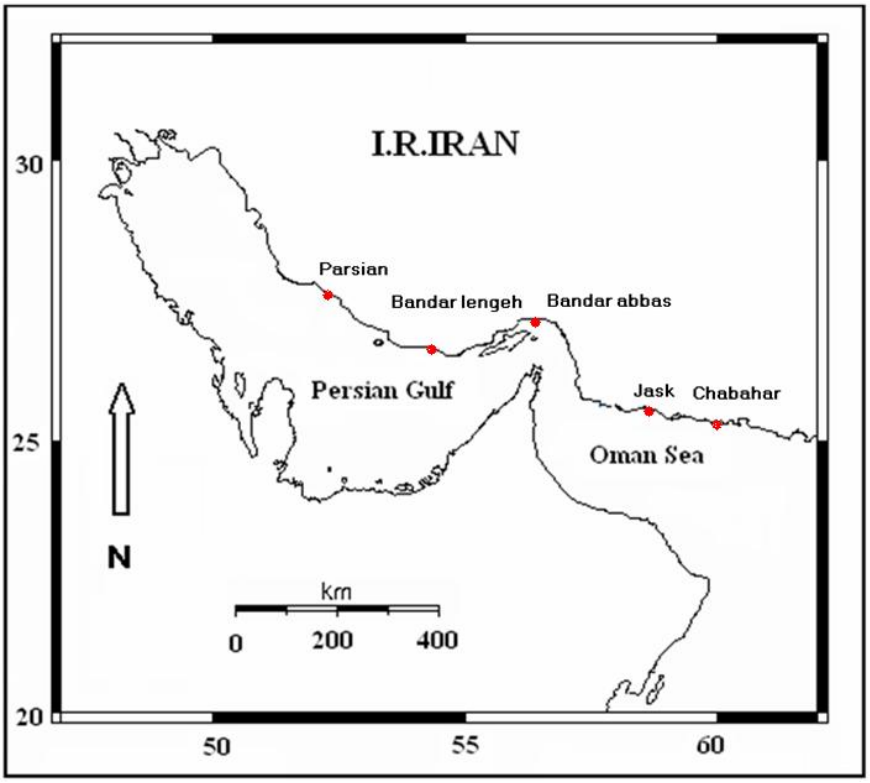

Fig 1. Landing sites for sampling of *T.tonggol* in the north Persian Gulf and Oman Sea

The fishes were simply measured and weighed to the nearest cm (fork length) and 50 g. respectively. The length frequencies were grouped in 3 cm intervals. The total samples size for population dynamic parameters was 4313.

Length – weight relationships were studied with the equation $W = a FL^b$, in order to verify if calculated b was significantly different from 3, the Student's t-test was employed (Zar, 1996). Predicted maximum length was obtained by extreme value theory (Formacion et al., 1991).

Growth parameters (K, L∞) were estimated by FISAT II software (FAO-ICLARM STOCK ASSESSMENT TOOLS) (Gayanilo *et al*., 1996) with using Shepherd's method for scan of K value , L∞ and Z/K was estimated by Powell-Wetherall plot (Wetherall et al., 1987).
Natural mortality coefficient (M) was calculated with the equation of Pauly (1980) (multiplied by 0.8 as recommended by Pauly for pelagic species.

$$\text{Log } M = 0.0066 - 0.279 \text{ Log } L\infty + 0.6543 \text{ Log } K + 0.4634 \text{ Log } T$$

Where T is the mean temperature of surface water, which was considered in this study as 26.5^0C. Fishing mortality (F) was then estimated (F=Z-M) (Sparre & Venema, 1998).

Results:

The parameters of the length-weight relationship $W = a L^b$ were calculated after linear transformation and regression analysis. The relationship between W (Kg) and FL (Cm) is:
$W=0.00002\ L^{2.83}$

Length weight relationship of *T. tonggol* caught by gillnet is shown in figure 2.

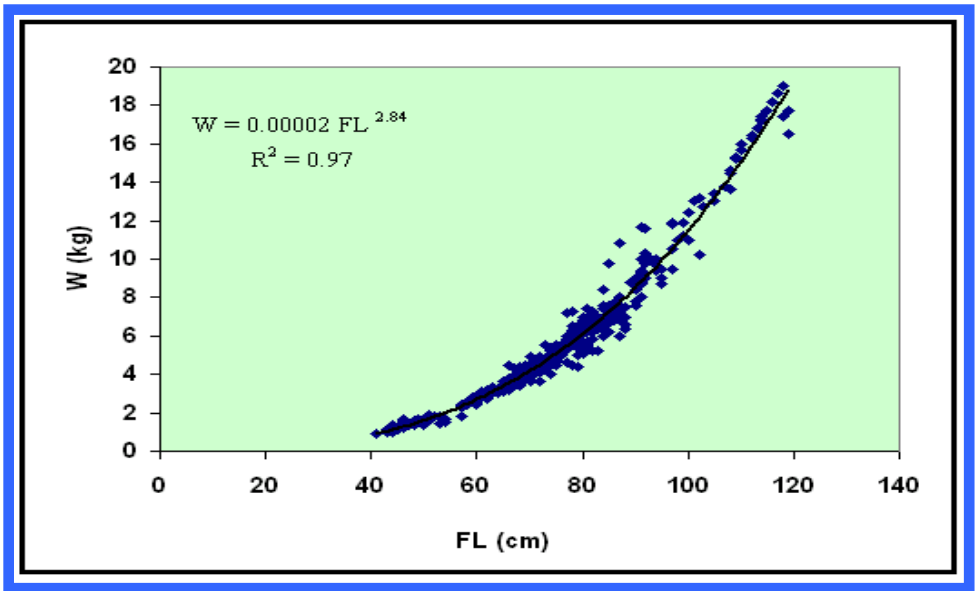

Figure 2. Length-weight relationship of longtail tuna in the Persian Gulf & Oman Sea

The monthly length frequency distributions used in the analysis are presented in figure 3.

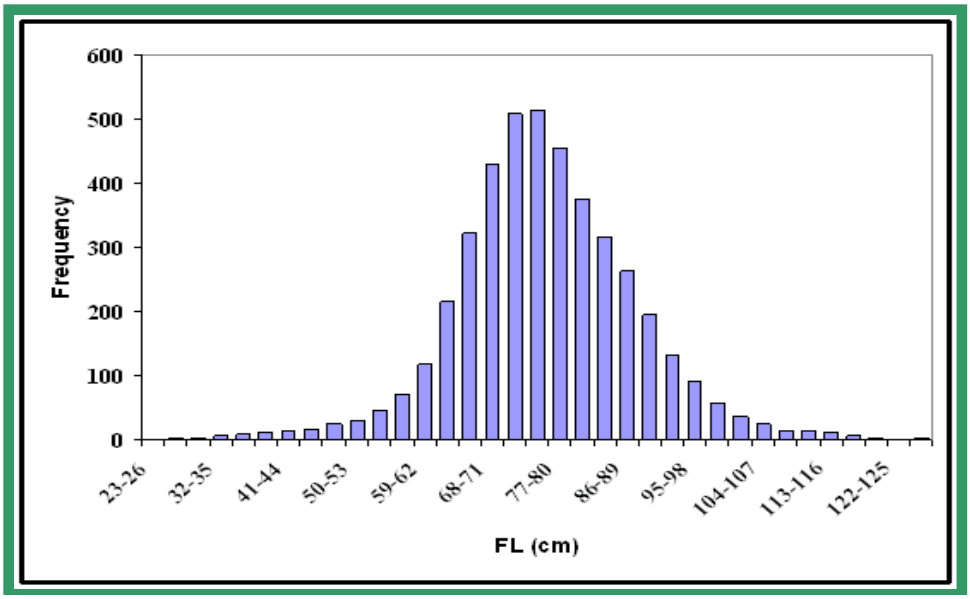

Figure 3.Length frequency distribution of longtail tuna in the Persian Gulf & Oman Sea

The average length of the fish was 74 cm. The smallest fish measured was 26-29 Cm and the largest one was 125-128 Cm.Most of the individuals was found between 74-77 Cm.
The observed extreme fork length was 125 Cm. The range of 95 % confidence interval for extreme fork length was 122.11-142.49 Cm (Fig 4).Estimated length infinity was 133.7 Cm which was based upon the largest fork length in each sampled month.

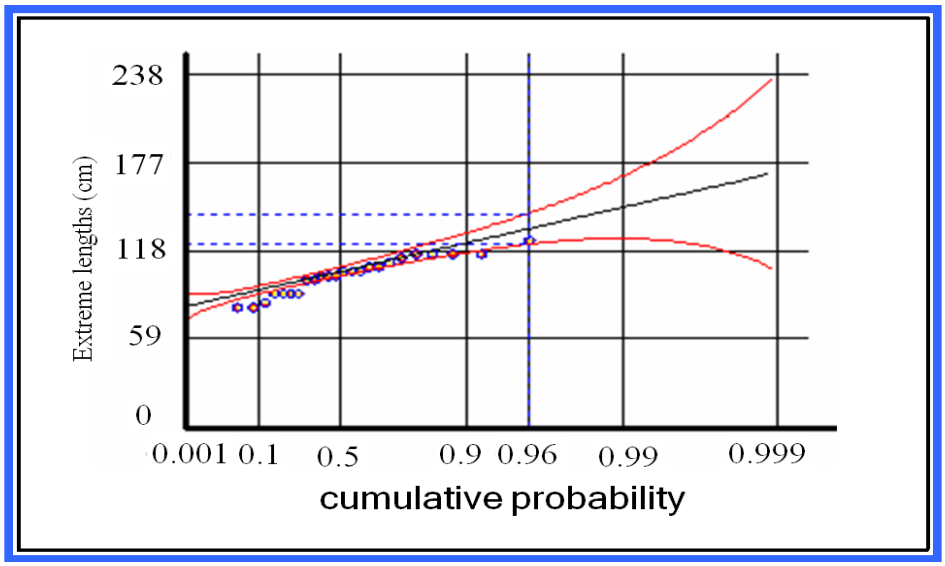

Figure 4. Predicted maximum length of *T. tonggol* based on extreme value theory (2006-07).

The growth coefficient (K) was calculated by scan of K value as 0.35 per year (Fig.5).

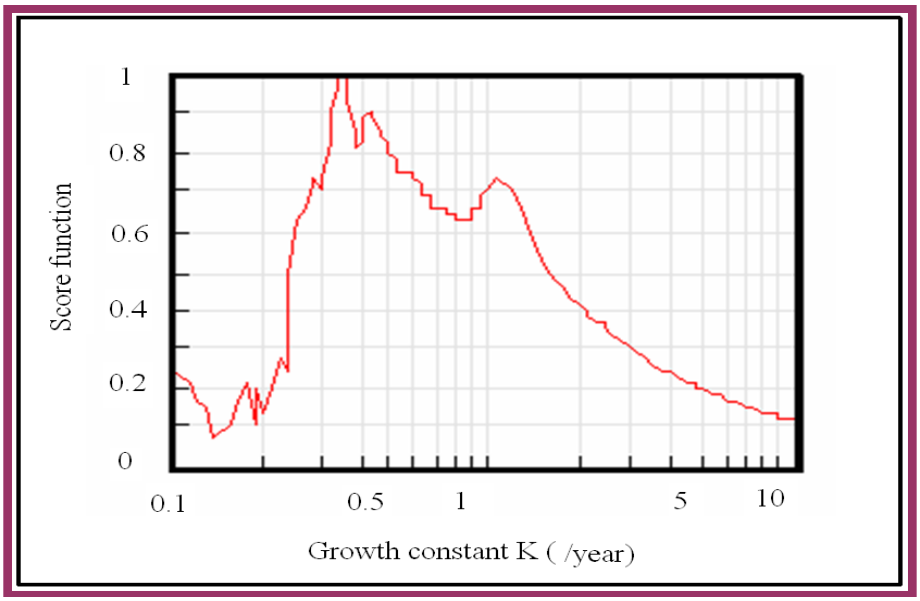

Figure.5. Scan of K value of *T.tonggol (2006-07).*

Z/K and length infinity were estimated by Powell-Wetherall plot 5.2 and 133.79 Cm respectively. Coefficient correlation was r =-0.9.

The natural mortality coefficient "M" was estimated at 0.55 by employing the equation of Pauly, where mean sea surface temperature considered in this study as 26.5^{oC}. As the pelagic species grows to a large size very fast, the "M" value may be an over-estimation. Hence the value was multiplied by 0.8 to get a revised estimate of "M" as 0.44.

F= Z-M = 1.82-0.44= 1.38

Discussion:

The parameters of the length-weight relationship were estimated as:

a=0.00002

b=2.83

Iranian gillnet catches of longtail tuna in Hormozgan province are seasonal and showed some differences in the size composition between the Iranian and Omani fisheries on the northern and southern shores of the Oman Sea which could be the result of a size-related migration or of differences in the mesh size of the gillnets used (Khorshidian & Carrara,1993).

The results of different studies about length-weight relationship parameters were presented in Table 2.

Table 2. Summary of length- weight relationship parameters on longtail tuna.

Authors	Area	Base of length	a	b
James *et al.*, 1993	India	TL	0.000083	2.71
Khorshidian &carrara,1993	Iran	FL	0.0015	2.43
Griffiths *et al.*,2011	Australia	FL	0.00005	2.82
Darvishi *et al.*,2003	Iran	FL	0.00004	2.7

Estimated length infinity and growth coefficient appears to vary markedly between studies using different estimation techniques and among regions. This is probably a result of very different maximum sizes of fish present in each study region or differences in the size selectivity of the sampling methods (i.e. gillnets). These factors would therefore affect estimates of $L\infty$ and the instantaneous growth rate (K). A comparison of the growth curves and growth model parameter estimates in each study from various regions is provided in Table 3.

Table 3. Summary of growth studies on longtail tuna

Author	Area	Length infinity (cm)	Growth coefficient (per year)
This study	Persian Gulf	133.79	0.35
Wilson, 1981	Gulf of Papua	122.9	0.41
Silas et al.,1985	1985 India	93	0.49
Prabhakar & Dudley,1989	Omani Waters	133.6	0.23

The natural mortality of longtail tuna (M) of 0.44 is in line with estimate obtained in 1992-93 as 0.49 in the same area (Khorshidian & Carrara, 1993). These two estimates through the Pauly's formula appears to be very low when compared to natural mortality of 0.8 per year obtained in Indian waters by James et al.,1993.

The total mortality obtained in this study seems to be under estimated in comparison with other studies such as 3.84 reported in Gulf of Thailand by Supongpan & Saikliang, 1987 and 3.13 by Khorshidian & Carrara, 1993.

Morphometric studies of longtail tuna indicated that differences exist between sub populations of this species throughout its range of distribution (Yesaki, 1991). According to different definitions of unit stock such as Gulland in Sparre & Venema, 1998, further studies to identifying stock and its distribution should be carried out in different areas of Indian Ocean.It should be emphasized that whole areas such as Australia, India, Thailand, Oman, Iran and other countries situated in the Indian Ocean should be covered in this study.

References:

Biswas, S.P.1993. Manual of methods in fish biology.South Asian Publishers,New Delhi.India.

Darvishi, M., Kaymaram, F., Talebzadeh, and S.A., Behzadi, S., 2003. Population dynamics of five Scombrid fish in Hormozgan Province (Iran).
Persian Gulf and Oman Sea Ecological Research Institute (In Persian). P.183.

Davarpanah, E.2007. Estimation of growth parameters and mortality rates of Thunnus tonggol and determination of its exploitation pattern in coastal waters of Hormozgan province. (in Persian).M.Sc,thesis.Tarbiat Modares University.

Formacion, S.P., J.M.Rongo and V.C.Sambilay, 1991.Extreme value theory applied to the statistical distribution of the largest lengths of fish.Asian Fisheries Science, 4 (1992):123-135.

Gayanilo, F. C., P. Sparre., and D. Pauly., 1996. The FAO ICLARM Stock Assessment Tools (FISAT), User,s guide. FAO Computerized Information Series (Fisheries).No.8.ROME, fao. 126P.

Griffiths,S. J. Pepperell, M. Tonks, W. Sawynok, L. Olyott, S. Tickell, M. Zischke, J. Lynne, J. Burgess, E. Jones, D. Joyner.C.Makepeace.and K.Moyle.2010. Biology, fisheries and status of longtail tuna (Thunnus tonggol), with special reference to recreational fisheries in Australian waters. Fisheries Research and Development Corporation.CSIRO.

Gulland, J.A., 1983.Fish stock assessment: a manual of basic methods.Chichester,U.K.,Wiley interscience,FAO/Wiley series on food and agriculture,Vol .1:223 p.

Iranian Fishery Organization, 2011.Fisheries data statistics of 2010.

James,P.S.B.R,Pillai,P.P,Pillai,N.G.K,Jayaprakash,A.A,Gopakumar,G,MohamedKasim,Sivadas, M,andK.P.SaidKoya.1993.Fishery,biology and stock assessment of small tunas.In:Sudarsan,D.and M.E.John.,1993.Tuna research in India. Fishery survey of India,Bombay.

Kaymaram, F.2009. Population dynamics and management of *Thunnus albacares* of the Oman Sea.Ph.D thesis.Islamic Azad University.Science and Research Branch.

Khorshidian,K and G.Carrara.1993.An analysis of length frequencies of Thunnus tonggol in Hormozgan waters.In:Ardill,J.D.,1994,Ed.,Proceedings of the expert consultation on Indian Ocean Tunas,5th Session,Mahe,Seychelles,4-8 Oct 1993.275p.

King, M., 1995. Fisheries biology: Assessment and management. Fishing News Books.

Pauly, D., 1980.On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks.J.Cons.CIEM, 39(2):175-92.

Prabhakar,A. and R.G.Dudley.1989. Age, growth and mortality rates of longtail tuna in Omani waters .Indo-Pacific Tuna DevelopmentandManagementProgramme.IPTP/89/GEN/16:90-96.

Silas, E.G., editor.1985.Tuna fisheries of the exclusive economic zoneofIndia: Biology and stock assessment. Bull.Cent.Mar.Fish.Res.Inst.36.216.

Sparee,P, and S.C.Venema, 1998. Introduction to tropical fish stock assessment. Part 1.Manual.FAO Fisheries Technical Paper No.306.1,Rev.1.Rome, FAO.

Wetherall,J.A,J.J.polovina and S.ralston,1987.Estimating growth and mortality in steady-state fish stocks from length-frequency data.ICLARM Conf.Proc., (13):53-74.

Wilson, M.A.1981.The biology, ecology and exploitation of longtail tuna in Oceania.M. Sc. thesis, school of Biological Sciences, Macquarie University. Sydney .N.S.W. Australia.

Yesaki, M., 1991.A review of the biology and fisheries for longtail tunas in the Indo-pacific region.In: Proceedings of the FAO Expert consultation on interactions of pacific tuna fisheries, Noumea, New Caledonia.Dec 1991.

Zar, J.H., 1996. Biostatistical analysis. 3rd edition. Prentice-Hall Inc., New Jersey, USA.662P.