Biolife AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES 2(2):572-578

ISSN (online): 2320-4257
www.biolifejournals.com

BIOLIFE RESEARCH ARTICLE

LIFE TABLE ANALYSIS OF *ANTILOCHUS CONQUEBERTI* FABR. (HEMIPTERA: PYRRHOCORIDAE) IN LABORATORY CONDITIONS

Bertrand Horne[*1], JunasEkka[2], Evangelin G[3], Muthupandi M[4], John William S[5]

[1-5] School of Entomology and Centre for Natural Resources Management (SECNARM), Department of Advanced Zoology and Biotechnology, Loyola College (Autonomous), Chennai- 600034, Tamil Nadu, India

E-mail: bertrandhorne28@gmail.com

ABSTRACT

Life table of *Antilochus conqueberti* Fabr. (Hemiptera: Pyrrhocoridae), a potential predator of *Dysdercus cingulatus*was studied with the data being constructed and analysed under laboratory conditions. The study paved the way for comparing the nymphal mortality and adult longevity for three generations and the mean values were found which proved that the mortality rate in nymphal stage differed with the mortality in adult stage. The mortality rate was at its high during egg stage (9.23%)and III instar (4.95%) and the mortality rate dropped when the organism crossed IV instar (2.37%) and V instar (0.97%). It was also revealed that 77.2 % organisms survived until the attainment of sexual maturity and took part in reproduction.

Key words : *Antilochus conqueberti*, *Dysdercus cingulatus*, life table, mortality rate, adult longevity.

INTRODUCTION

Antilochus coqueberti Fabr belongs to the family Pyrrhocoridae which consists of more than 300 species world-wide. It is a common species found in all parts of India, which is a serious predator on different cotton strainers belonging to the genus *Dysdercus*. The genus *Antilochus* currently contains about 25 species, occurring in tropical Africa including Madagascar, South and Southeast Asia, the Malay Archipelago, and New Guinea. *Antilochuscoqueberti* is usually a brightly coloured pyrrhocorid which can be easily differentiated from other genera of Pyrrhocoridae by the head being transversely depressed posterior to the eyes. Muthupandi *et al.*, 2014 studied the biology, prey stage preference and the functional response of a pyrrhocorid predator, *Antilochus conqueberti* under laboratory conditions which were fed *ad libitum* with *Dysdercus cingulatus*. The functional response shown by the predator were found to be of type II, since the number of prey consumed per predator initially arose quickly as the density of prey increases but then levels off with further increase in prey density. The stage preference experiments suggest that the third instars of *Dystercus cingulatus* were preferred by II and III instars of the predator, *Antilochus conquebberti*. The V instars of *A. conqueberti* fed minimum on all the stages of the pest *D. cingulatus*. Understanding how and why insect numbers fluctuate through time and space has been a central theme in ecological research for more than a century (Robert *et al.*, 2009). Birch (1948) defined the intrinsic rate of increase as the actual area of increase of population under specified constant environmental conditions where space and food are unlimited where there are no mortality factors other than the physiological ones.

Life tables have been used to understand temporal and spatial patterns in insect numbers (Robert *et al.,* 2009). In ecological study, life table is a most important analytical tool, which provides detailed information of population dynamics to generate simple but more informative statistics. It also gives a comprehensive description of the survivorship, development and expectation of life (Ali, *et al.*, 2007). The collection of data on life-table at different temperature gives an important task for pest management in different environmental conditions (Ali *et al.*, 2008. 2009). Life table parameters are important in the measurement of population growth capacity of species under specified conditions. These parameters are also used as indices of population growth rates responding to selected conditions and as bioclimatic indices in assessing the potential of a pest population growth in a new area (Southwood, 2000).

Fertility life tables are appropriate to study the dynamics of animal populations, especially arthropods, as an intermediate process for estimating parameters related to the population growth potential, also called demographic parameters (Maia *et al.*, 2000). This information could be extremely valuable for the future development of IPM programs using *Antilochus conqueberti* against *Dysdercus cingulatus*. Life table studies have several applications including analyzing population stability and structure, estimating extinction probabilities, predicting life history evolution, predicting outbreak in pest species, and examining the dynamics of colonizing or invading species (Vargas *et al.*, 1997, Haghani*et al.*, 2006). Life table information may also be useful in constructing population models (Carey, 1993, 2001) and understanding interactions with other insect pests and natural enemies. Life table can be constructed by following the life history of a group of insects from their birth to adult emergence and recording all death as they occur together with sex of those which die in as adults (Howe, 1953). There is no previous record of the life table analysis of *Antilochus conqueberti*. Thus a study was made.

MATERIALS AND METHODS

To study the life table and mortality rate in laboratory conditions, adults of *Antilochus conqueberti*were collected from Loyola college campus, Chennai and were kept in bisexual pairs. Plastic jars of 1 litre capacity containing 3 cm thick sand at the bottom were taken as the rearing cage. The open portion of the cage was covered with nylon net in order to maintain the air supply properly. The organisms were fed ad libitum with *Dysdercus cingulatus* during the study period. For feeding purpose, a culture of *Dysdercus cingulatus* was raised on the seeds of cotton plant, Gossypium arboreum in the laboratory. Rearing was carried out in the laboratory conditions, the temperature ranging between 19^0C and 34^0C and relative humidity ranging between 59% and 75%. After copulation the female laid eggs in the sand, some eggs were hatched and some remain unhatched in the pod. After approximately 8 days of incubation period, the first instars hatched out from the eggs. From the cluster of eggs which were laid in the sand, some eggs were hatched and some remain unhatched in the pod. On the basis of the number of hatched first instar nymph on the same day and the number of organisms that successfully underwent ecdysis and became sexually mature adults, we got an absolute number of organisms passed from a lower generation towards higher generation. In such a way 6 pods from three generation were studied and a total number of 136 eggs were taken into account for the present study.

Explanation of symbols used in the life table (Ricklefs& Miller, 1999; Dash, 2005):

X = age in days;
lx = Number of individuals out of the cohort who are expected to complete exactly x days of life;
dx = Number of individuals out of lx who die after completing age x+1;
sx = Survival rate (proportion of individuals of age x surviving to age x+1);
mx = Mortality rate (proportion of individuals of age x surviving to age x+1);

Lx = Number of individuals alive between age x and x+1;
Tx = Total number of days lived by the cohort after age x days. In fact, this is the total future life time of the lx individual (until all of them die off);
qx = Mortality rate for an age interval;
ex = Expectation of further life of individuals of age x;
k value = It is the key factor, which is primarily responsible for increase or decrease in number from one generation to another and was computed as the difference between the successive values for log "log lx".

However the total generation mortality was calculated by adding the k-values of different development stages of the insect, which is designed/ indicated as "K".

Life Table Construction

Age Specific Life-Table:

Observations on number of alive and dead were recorded daily. The following assumptions were used in the construction of life-table of *Antilochus conqueberti*.

qx= [dx / lx] x No. of eggs laid by the organism in each generation.
x = Age of the insect in days.
Lx = Number surviving at the beginning of each interval
dx = Number dying during the age interval
qx = Mortality rate at the age interval x and calculated by using the formula
ex= Tx/ lx
ex = Expectation of life or mean life remaining for individuals of age x

Life expectation was calculated using the following equation:
Lx = lx+l(x+1)/2
To obtain ex two other parameters Lx and Tx were also computed as below.
Lx = The number of individuals alive between age x and x+ 1 and calculated by the equation.
Tx = lx + (lx + 1) + (lx + 2)………………..+ lw.
Where, lw = The last age interval.

Tx = The total number of individual of x age units beyond the age x and obtained by the equation;

Stage Specific Life-Table:

Data on stage specific survival and mortality of eggs, larvae, pupae and adults of *A. conqueberti* were recorded from the age specific life-table. Following standard heads were used to complete stage specific life table.

x = Stage of the insect.
Lx = Number surviving at the beginning of the stage x.
dx = Mortality during the stage indicated in the column x.
The data calculated through above assumptions were used for computing various life parameters as given below:
Survival Fraction (Sx): Data obtained on apparent mortality was used for the calculation of the stage specific survival fraction (Sx) of each stage by using the equation:
Sx of particular stage = [lx of subsequent stage] / [lx of particular stage].
k-values: k value is calculated by the formula
K = log lx of particular stage – log lx of subsequent stage.
.

RESULTS

The study was conducted with a bisexual pair of *Antilochus conqueberti* collected from the Loyola College campus. After successful mating, the female organism laid 24 eggs out of which 22 eggs hatched while 2 eggs did not hatch out. So the mortality percentage of eggs was 8.3 per cent. The entire lot of first instar nymphs (22 no) were metamorphosed into second instars and the mortality rate was 0 percent. From the 22 first instar nymphs 21 organisms were metamorphosed into 21 third instar nymphs and the mortality percentage was 4.5 and from the 21 third instar nymphs, 20 organism metamorphosed into fourth instar nymphs and the mortality percentage was found to be 4.5 and all the third instar organisms successfully crossed fourth and fifth instars and became adults with 0 per cent mortality rate. The second batch of 27 eggs were laid by the same organism a week later from its first batch which hatched out into 25 first instar nymphs leaving two eggs unhatched and the mortality percentage was found to be 7.4 per cent. From the 25 first instar nymphs, 23 organisms metamorphosed into second instar nymphs with a mortality percentage of 8 and during the next metamorphosis, 0 per cent mortality rate was observed and from the 23 third instar nymphs, 21 fourth instar nymphs metamorphosed into 20 fifth instar nymphs and the mortality percentage was found to be 4.7 per cent and all the organism successfully metamorphosed into adults. From the emerged adults, a bisexual pair was selected and allowed for mating and the organism laid 15 eggs, of which 14 eggs hatched out into nymphs and the mortality rate was found to be 6.6 per cent and the first instar nymphs metamorphosed into second instar nymphs with a mortality rate of 0 per cent and from 14 second instar nymphs, 13 were metamorphosed into third instar nymphs having a mortality rate of 7.1 per cent and from 13, 12 were metamorphosed into fourth instar nymphs with a mortality rate of 7.6 per cent and all the 12 organisms crossed fifth instar and metamorphosed into adult with a zero percent mortality rate.

Table-1. Representation of mortality rate in different instars from three generation of *Antilochus conqueberti.*

Stage	I_x	d_x	d_x as % of l_x
Egg	22.66	2	**9.23**
I instar	20.66	1	4.63
II instar	19.83	0.66	3.95
III instar	19.16	1	4.95
IV instar	18.16	0.5	2.37
V instar	17.67	0.17	**0.97**
Adult	17.5	0	0

The second batch of 25 eggs were laid by the same organism three days later from its first batch and of which 22 eggs successfully hatched out into first instar nymphs with a mortality percentage of 12 per cent and from the 22 first instar nymphs, 20 organisms metamorphosed into second instar nymphs with a mortality percentage of 9 per cent and from 20 organisms, 19, 18, 17 and 16 organisms metamorphosed into third, fourth, fifth instars and adult respectively and the mortality rate was found to be 5, 5.2, 5.5, 5.8 respectively. From the laboratory reared second generation adults, a bisexual pair was selected for mating and the organism laid 17 eggs which hatched out into 14 nymphs leaving three eggs unhatched and the mortality rate was 17.6 per cent and all of them metamorphosed into second instar nymphs with a mortality rate of 0 per cent and during the next metamorphosis, the mortality rate was found to be 7.1 since 13 second instar nymphs metamorphosed into third instar and all the 13 third instar nymphs crossed 4th, 5th instars and became adults with zero percent mortality rate. The second batch of eggs was laid by the organism numbering 28 and 27 of them hatched out into first instar nymphs leaving one egg unhatched and the mortality rate was found to be 3.5 per cent and 26 organisms metamorphosed into second instar nymphs with a mortality rate of 3.7 per cent and all the 26 organisms metamorphosed into third instar nymphs with a mortality rate of 0 per cent, from the 26 organisms, 25 organisms metamorphosed into fourth instar with a mortality rate of 4 per cent, from the 25 organisms, 24 organisms crossed fifth instar and became adults with a mortality rate of 0 per cent. The mean values of mortality percentage found during each life cycle was calculated and tabulated in Table-1 and statistically illustrated in Fig-1.

Based on the mortality, an attempt was made to estimate the number of winged *Antilochus conqueberti* that were capable of reaching the 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, etc., days. The life expectation of the adult A. conqueberti of different ages observed from three generations were calculated and the mean values were tabulated. It was evident that the freshly emerged adult could be expected to survive for 11.8 days while those that attained the age of 2 days were expected to survive for 11 days and those that attained the age of 10 days were expected to survive for 8.96 days and the organisms which

Figure-1. Representation of mortality rate in different instars from three generation of *Antilochus conqueberti*

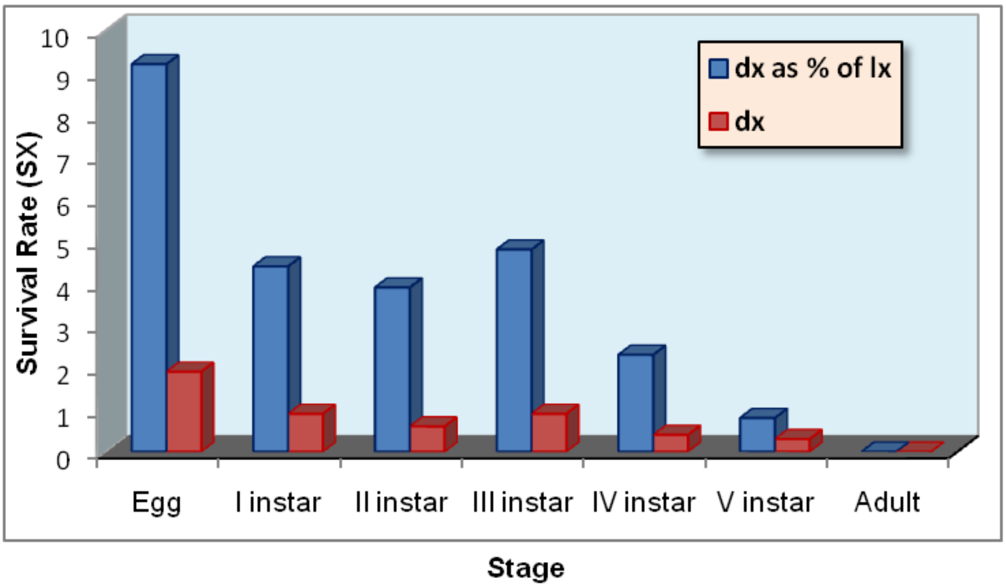

Table-2. Life table of adult *Antilochus conqueberti*.

x(days)	Lx	Dx	Sx	Mx	Lx	Tx	qx	ex	Loglx	k value
0	17.5	0.333	0.978	0.021	15.323	216.61	0.333	11.881	1.2299	0.0096
2	17.166	0.166	0.968	0.181	15.051	201.28	0.498	11.005	1.2202	0.013
4	16.666	0.166	0.951	0.048	14.468	737.5	0.506	10.528	1.2071	0.0198
6	16	0.166	0.963	0.036	13.968	171.43	0.348	10.18	1.1873	0.015
8	15.5	0.166	0.968	0.031	13.621	157.79	0.571	9.621	1.1723	0.0136
10	15	0.5	0.968	0.031	13.358	144.17	0.596	8.963	1.1586	0.0139
12	14.666	0.666	0.921	0.078	12.941	133.65	0.831	8.238	1.1447	0.0272
14	13.833	0.5	0.923	0.076	12.326	117.89	0.701	7.813	1.1174	0.0283
16	13.166	0.833	0.91	0.09	11.726	105.56	1.191	7.355	0.9224	0.0356
18	12.333	0.5	0.966	0.033	11.29	93.838	0.788	6.998	1.0534	0.0146
20	12	0.5	0.921	0.078	10.851	82.548	0.816	6.223	1.0381	0.0333
22	11.166	0.666	0.926	0.073	10.326	71.696	1.251	5.723	1.0054	0.031
24	10.666	0.5	0.888	o.111	9.826	61.37	1.155	5.123	0.9744	0.0523
26	9.833	0.666	0.939	0.068	9.265	51.571	1.478	4.763	0.922	0.0324
28	9.333	0.666	0.92	0.081	8.89	42.306	1.643	4.055	0.8898	0.0398
30	9	0.5	0.931	0.068	8.416	33.416	1.033	3.341	0.8498	0.0321
32	8.333	0.333	0.931	0.068	7.833	26.666	0.583	2.826	0.8177	0.0297
34	7.666	0.666	0.826	0.156	6.833	18.833	1.268	2.076	0.788	0.0837
36	6.333	1.666	0.608	0.391	5.75	12	8.266	1.418	0.7042	0.1458
38	5.166	2	0.308	0.525	4.416	6.25	18.066	0.716	0.5082	0.0111
40	3.666	2	0	0.333	1.833	1.833	4	0.166	0.3465	0

managed to attain the age of 16 days were expected to survive for 7.3 days and the organisms which attained the age of 20 days were expected to survive for 6.2 days and the organism which attained the age of 30 days were expected to survive for 3.3 days. Similarly the expectations for other age groups of adult male were calculated and the results are tabulated in

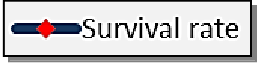

Figure-2. Survivorship curve of adult of Antilochus conqueberti

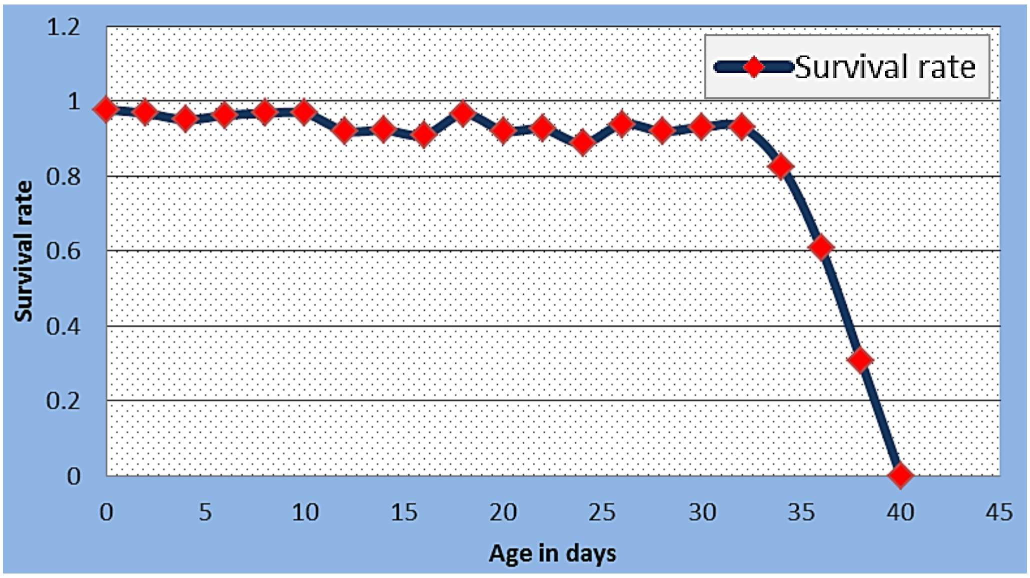

Table 2.

The life table shows a low rate of mortality in the initial period followed by a slight increase in the rate of mortality. The survivorship curve revealed that survival rate of 17.5 organisms might be 0.978, 15 organisms have a survival rate of 0.968. The shape of the survivorship curve was almost convex type as is shown in Fig. 1.

DISCUSSION

The study of the life table in *Antilochus conqueberti* indicated that the impact of nymphal mortality and adult mortality was different on the population. This observation conforms to those recorded in other group of insects by Togashi (1990). Unlike a death, the nymphal mortality is an early death and that to some or many extant counterbalances the reproduction effect in many animal populations. The reproductive capacity of the species is dependent on the pre- reproductive mortality or nymphal death rate which is required to hold a populatin in check. The present study reveals that the pre-reproductive mortality i.e., death prior to attainment of sexual maturity (adult) in *Antilochus conquenberti* was 22.6 per cent, while 77.4 per cent of the individuals survived until the attainment of sexual maturity and took part in reproduction.

The survivorship study revealed almost a convex curve in which the mortality rate of population is low until near the end of the life span. This result conforms to the observation of Pearl & Parker (1921) and Srivastava et al (2013) in Drosophila melanogaster i.e., a higher mortality rate in old adult than the younger one. The high mortality rate during first and fourth instar provided a drastic change on the increase in *Antilochus conqueberti* population and this was evident from the above study.

The mortality rate observed from the present study revealed that the highest mortality rate was observed during the hatching stage (9.23 per cent) followed by third instar (4.95 per cent). the mortality rate was found to be at lowest percentage during fourth (2.37) and fifth instar (0.97). From the present study it is clear that the mortality rate decreases as the organisms cross higher instars and the predatory response of the organism against the pest, *Dysdercu scingulatus*can be made of good use since the organism is found to prey upon higher instars of the pest.

CONCLUSION

In the present study, the life table of *Antilochus conqueberti*, a predator of *Dysdercus cingulatus* was studied for the first time. The organism was studied for a period of four months and three generation of the organism was studied and the values were calculated every generation and the mean values were tabulated. Since the organism was found to have a positive functional response and stage preference over the serious cotton pest, *Dysdercus cingulatus*, an effort was taken to calculate its mortality rate and life expectancy after attaining sexual maturity.

REFERENCES

1. **Ali, A**, P.Q. Rizvi, 2009. Life table studies of *Menochilussexmaculatus*Fabr. (Coleoptera: Coccinellidae) at varying temperature on *Lipaphiserysimi*Kalt. *World Applied Science Journal*. 7: 897-901.
2. **Ali, A**, P.Q. Rizvi., 2007. Age specific survival and fecundity table of *Coccinellaseptempunctata* L. (Coleoptera: Coccinellidae) on different aphid species. *Annals of Plant Protection Sciences*. 15: 329-334.
3. **Ali, A, Rizvi**, P.Q., 2008. Effect of varying temperature on the survival and fecundity of *Coccinellaseptempunctata* (Coleoptera: Coccinellidae) fed on *Lipaphiserysimi*. Journal of Entomology. 5: 133-137.
4. **Birch, L. C**., 1948. The Intrinsic rate of natural increase of an insect population. *Journal of Animal Ecology*. 17:15–26.
5. **Carey J. R**., 1993. Applied Demography for Biologists with Special Emphasis on Insect, Oxford University Press, New York, NY, USA.
6. **Carey J. R**., 2001. Insect biodemography. *Annual Review of Entomology*. 46: 79–110.
7. **Dash M.C**., 2005. Fundamentals of Ecology. 2nd Edn. Tata Mcgraw-Hill Publishing Company Ltd. New Delhi. 256-260.
8. **Haghani M**., Y. Fathipour, A. A. Talebi, and V. Baniameri., 2006. Comparative demography of *Liriomyzasativae* Blanchard (Diptera: Agromyzidae) on cucumber at seven constant temperatures. *Insect Science*. 13: 477–483.
9. **Howe, R. W**., 1953, The rapid determination of intrinsic rate increase of an insect population. *Annals Appl. Biol*. 40: 134-155.\
10. **Maia A. D. H. N, A**. J. B. Luiz, C. Campanhola., 2000. Statistical inference on associated fertility life table parameters using jackknife technique: computational aspects. *Journal of Economic Entomology*. 93,2: 511–518.
11. **Pearl R., Parker S.L**., 1921. Experimental studies on the duration of life: introductory discussion of the duration of life in Drosophila. *American Naturalist*. 55: 481-509.
12. **Ricklefs, R. E**, G. L.Miller., 1999. Ecology, 4th ed.W. H. Freeman, New York.
13. **Robert K. D**, Peterson, Ryan S. Davis, Leon G. Higley, Odair A. Fernandes., 2009. Mortality Risk in Insects. Environ. *Entomol*. 38(1): 2-10.
14. **Southwood T. R**, P. A. Henderson, 2000. Ecological Methods, Blackwell Science, London, UK, 3rd edition.
15. **Srivastava, K and Upadhyay, V.B**. 2013. Effect Of Phytoecdysteroid On Fecundity Of Multivoltine Mulberry Silkworm *Bombyx Mori* Linn. Biolife, 1(2); 78-83.
16. **Togashi K**., 1990, Life table for *Monochamusalternatus* (Coleoptera, Cerambycidae) with in dead trees of *Pinusthunbergii*. *Japan Journal of Entomology*, 58 (2): 217-230.
17. **Vargas R. I**., W. A. Walsh, D. Kanehisa, E. B. Jang, J. W., 2007. Armstrong. Demography of four Hawaiian fruit flies (diptera: tephritidae) reared at five constant temperatures. *Annals of the Entomological Society of America*. 90,2: 162–168.

DOI: https://dx.doi.org/10.5281/zenodo.7209051
Received: 7 April 2014;
Accepted; 22 May 2014;
Available online : 14 June 2014