BOOKLET

on

GROWTH DATA OF PHYSICAL CHARACTERISTICS

and

USE OF TRANQUILIZATION/ANTIDOTE DRUGS, INDUCTION TIME, REVERSAL TIME

For

free ranging

ROYAL BENGAL TIGER

(*Panthera tigris*)

@ PANNA TIGER RESERVE, MP.

Authored by

UTTAM KUMAR SHARMA, IFS

VEJAYANANTHAM TR, IFS

SANJEEV KUMAR GUPTA, Wildlife Vet.

आलोक कुमार भा.व.से.
प्रधान मुख्य वन संरक्षक (वन्यप्राणी) एवं
मुख्य वन्यप्राणी अभिरक्षक, मध्यप्रदेश

Alok Kumar IFS
Principal Chief Conservator of Forest (Wildlife) &
Chief Wildlife Warden, Madhya Pradesh

कार्या. प्रधान मुख्य वन संरक्षक (वन्यप्राणी) एवं
मुख्य वन्यप्राणी अभिरक्षक, मध्यप्रदेश
प्रगति भवन तृतीय तल, जोन-1 एम.पी. नगर, भोपाल-462011
O/o Principal Chief Conservator of Forest
(Wildlife) & Chief Wildlife Warden, Madhya Pradesh
Pragati Bhavan IIIrd Floor, M.P. Nagar, Zone-I, Bhopal-462011
Tel. 0755-2674206, 2674337 Fax : 0755-2766315

FOREWORD

I must place on record my appreciation for the team of Panna Tiger Reserve (PTR) to have successfully bringing out this comprehensive Booklet on 'Growth Data of Physical Characteristics and use of Tranquilization/Antidote drugs, Induction Time and Reversal Time'. This probably is the first compilation and analysis of tiger growth data and use of Tranquilization/Antidote drugs of the wild tigers. I fully understand the highly technical nature of this Booklet which demands massive efforts in terms of time and energy.

PTR does have a controversial conservation history by losing all its tigers in 2009. But the area immediately regained its status on the tiger front by successfully reintroducing tigers and successfully re-wilding orphaned tigers and achieving a rare 100% breeding success of reintroduced tigers. By the end of year 2021, the whole reintroduction Program met with an outstanding breeding success by producing more than 122 cubs in 54 litters which by no means is a small feat. The whole process of reintroduction has generated immense management experience in last 12 years since 2009 for all wildlife managers. It has also generated sufficient data,which has been gathered by PTR authorities, of tiger physical characteristics like weight, total length etc.and also ofquantities of tranquilization and reversal (antidotes) drugs used, Induction time, Reversal time. This Booklet not only compiles this data in a usable format but also presents analysis of this data based on different variables like age, weight etc. Generally, there is a lack of body growth data of tigers in the wild. Also information regarding use and quantity of tranquilizers and antidotes is patchy. This Booklet brings Body Growth Data of wild tigers along with use and quantity of tranquilizers and antidotes under different set of variables and conditions. As currently, the genetic diversity of PTR tigersstructurally represent genetic mixture of tigers of whole of Central India, the data collected of tigers of PTR may be true and used for all Central Indian tiger populations.

We cannot deny the fact that the kind of information and analysis presented in the Booklet for the wild tigers is rare and offer many opportunities to wildlife managers. We can build on this Booklet to have an All India Booklet on Tiger Body Growth Data representing all regions of the country.

The entire team of PTR under the leadership of Shri Uttam Kumar Sharma, Field Director, deserve my congratulations and appreciation for putting up hard work for this excellent publication.

14/01/2022

ALOK KUMAR,
PCCF & CWLW, MP.

Uttam Kumar Sharma, IFS
CCF & Field Director

मध्य प्रदेश शासन

Office of the Field Director
Panna Tiger Reserve
Panna, Madhya Pradesh, (India) 488001

FOREWORD

Though tiger remains one of the most talked wild animal in India, very less authentic data about wild tiger's physical characteristics exist. Of late, there is a growing management trend of re-introducing tigers in areas where it has gone locally extinct or supplementing where numbershave reduced to a critically low level. Also tigers are radio-collared to study their behaviour, home range etc. For all these management practices, tiger needs to be tranquilized with the help of Tranquilizer drug and revived with the help of Antidote or Reversal drugs. The quantity of Tranquilizer or Reversal drugs for a wild tiger in a particular region is an important factor in this whole process and it depends on factors like age, sex, weight etc. of the tiger. Similarly physical characteristics like weight, length, height etc. and their growth rate plays important role in taking management decisions like Radio Collaring etc.

After my taking responsibility as Field Director, Panna Tiger Reserve (PTR), I realized that information regarding growth rate of tiger's physical characteristics and quantity of Tranquilizers/Reversal drugs to be used for tranquilizing wild tiger is vital to make informative managerial decisions. Generally, there is a lack of body growth data of tigers in the wild but to my surprise, I found all information about tiger's physical characteristics and tranquilizers/antidote drugs collected as per the guidelines of NTCA and kept in PTR since 2010. Data collected is of nine physical characteristics for 30 tigers in 60 tranquilization procedures over 10 years. The only work left was to make it understandable, putting it in useable form and analysing it to generate more information about tigers of wild. This Booklet is the result of efforts made to complete this work. This Booklet analyses and presents (i) the variation in tigers' physical characteristics with age; (ii) the relation between amount of tranquilization/antidote drugs used, induction time, Reversal time and age of tiger, effect of ambient temperature; for both male and female tigers.

Though the collected data is only of the limited geographical spread of PTR, but it should hold true for tigers from other tiger bearing areas of Madhya Pradesh. This data, which is currently unavailable for tigers of the wild, along with analysis can be used by researchers and academicians who are working in this field for further studies and for comparing the physical characteristics of wild tigers in other areas. This can also be useful for wildlife managers who can use it for various managerial decisions like fixing collar size or amount of Tranquilizer/Reversal drugs required based on age, sex, and weight for different tigers. I wish it will open ways to develop an 'All India Booklet on Tiger Body Growth Data' representing all regions of the country.

UTTAM KUMAR SHARMA,
FIELD DIRECTOR,
PANNA TIGER RESERVE, MP
16/01/2022

fdptr82@gmail.com, fdpnp.pna@mp.gov.in, pannatigerreserve.in, Ph:07732-252135, Fax: 07732-252120

Dr. Sanjeev Kumar Gupta
Wildlife Veterinarian

Office of the Field Director
Panna Tiger Reserve
Panna, Madhya Pradesh, (India) 488001

FOREWORD

I was working as wildlife vet in Panna Tiger Reserve (PTR)when re-introduction of tigers started in 2009. Before the re-introduction of tigers in PTR, there was very few opportunities for tranquilization of tiger and hence very less information was available on use of Tranquilization and Reversal drugs and of vital body parameters of tigers. During and after the reintroduction of tiger in PTR, need for more information regarding Tranquilization and Reversaldrugs and its effect on a particular tiger was felt by everybody. It was verychallenging to perform tranquilization procedures without complete information on this front. But it was taken as a challenge by all of us at PTR and it resulted in grand success with no casualty of tiger during tranquilization procedures. Tranquilization was done for the purpose of treatment,surgery, replacing of radio-collar,and relocation of tigers.The whole process also resulted in generation of plenty of information regarding tiger's physical characteristics and tranquilization procedures.I was involved in successfully tranquilising 60 tigers in Panna Landscape and 8 tigers outside the PTR. Measurement of all the physical parameters of tigers along withcollection of biological samples like hairs,blood and swabs for DNA profile, and complete blood chemistry as per NTCA guideline was done during immobilisation of tigers. Record of all measurements and other necessary information like quantity of tranquilization/reversal drugs was kept in PTR.

We have now tried to develop this collected information in the form of a Bookletwhich will become a tool for wildlife management to be used specially by wildlife managers, wildlife vet and wildlife researchers for immobilisation of tigers. In addition to this, this Booklet provides information about free ranging tiger's body growth which is rarely available otherwise.

I sincerely express my gratitude to all the officers and field staff with whom I got the opportunity to work with in this journey. This Booklet is result of their selfless work, whetherdirectly and indirectly, of reviving the tigers in PTR.

Sanjeev

DR. SANJEEV KUMAR GUPTA,
WILDLIFE VET,
PANNA TIGER RESERVE, MP.

fdptr82@gmail.com, fdpnp.pna@mp.gov.in, pannatigerreserve.in, Ph:07732-25213

Vejayananthan TR, IFS
Deputy Director

मध्य प्रदेश शासन

Office of the Field Director
Panna Tiger Reserve
Panna, Madhya Pradesh, (India) 488001

FOREWORD

Panna Tiger Reserve is known for its successful reintroduction of wild tigers all over the world. Over a period of time, because of its effective management practices, PTR recorded 40+ tigers as per Tiger census of 2020.From zero tigers in 2009 to 42 tigers in 2020, the entire management practice was completely scientific. We measured each and every tiger on various physical parameters from the phase of reintroduction. The data on utilization of amount of tranquilization/antidote drugs over the period of time was also maintained. After years of experience and data collection from Tranquilization operations, PTR has now come up with a Booklet on 'GROWTH DATA OF PHYSICAL CHARACHTERISTICS AND USE OF TRANQUILIZATION/ANTIDOTE DRUGS, INDUCTION TIME, REVERSAL TIME FOR FREE RANGING ROYAL BENGAL TIGERS AT PANNA TIGER RESERVE, MADHYA PRADESH'.

This booklet is perhaps the first in the history of wildlife management where the physical characteristics of 30 Wild Tigers have been recorded, the Tranquilization/Antidote drugs given to Male/Female Tigers were analyzed by the world-renowned Tiger Reserve. This booklet will be a guiding light for young wildlife managers and veterinarians to make right decision about the quantity of drugs required to tranquilize/recover wild tigers in Central Indian landscape. There is a lot of scope to extend upon this booklet by including data from various tiger reserves in India which will bring remarkable changes in the procedure of Tranquilization of wild tigers in India.

VEJAYANANTHAM TR,
DEPUTY DIRECTOR,
PANNA TIGER RESERVE, MP.

fdptr82@gmail.com, fdpnp.pna@mp.gov.in, pannatigerreserve.in, Ph:07732-25213

PREFACE

The importance of the presence of the Royal Bengal Tiger (*Panthera tigris*) in the Indian forest as an apex predator cannot be understated. The Government of India along with State Governments is running various programs for protecting tigers in the wilderness. This includes the reintroduction of tigers in those forested areas where currently tiger has no presence due to local extinction or in areas where tiger numbers are very low and the threat of their becoming locally extinct looms large. Panna Tiger Reserve (PTR) located in the State of Madhya Pradesh is a success story of tiger reintroduction after it was declared to be locally extinct in the year 2009. Reintroduction by translocating seven tigers to PTR, six from the other three Tiger Reserves of MP and one form Bhopal Forest division, between the year 2009 and 2014, under 'Species Recovery and Reintroduction Project' has led to establishing a healthy tiger population in PTR within 10 years. The whole process of reintroduction has not only generated immense management experience but in this process, sufficient data has been gathered of (i) tiger physical characteristics like weight, total length, neck, chest and abdomen girth, shoulder height, and canine size at different ages; and (ii) amount of tranquilization and reversal (antidotes) drugs used, Induction time, Reversal time.

This Booklet on 'Growth Data of Physical Characteristics and use of Tranquilization/Antidote drugs, Induction Time and Reversal Time' presents the analysis of this data. Growth curves for tiger physical characteristics and relation between amount of tranquilization/antidote drugs used, induction time, Reversal time and age of tiger, effect of ambient temperature, have been developed for both male and female tiger of the wild. As data regarding the body growth of a tiger in wild and amount of tranquilization/antidote drugs to be used under different conditions, Induction time, Reversal time are mostly unavailable, this Booklet, perhaps for the first time anywhere, presents these data and its analysis. The data analysed and discussed in this Booklet have been collected for the tigers of PTR which represents a Dry Deciduous Forest type. The climate of PTR is hot and dry for about seven months with an average annual rainfall of

864.9 mm. The forest mainly consists of dry teak forest or dry miscellaneous forest. The result obtained can further be checked with tiger body data obtained from other Tiger bearing areas in different climatic conditions. The aim of this is to bring out the body size, growth details and details about requirement of tranquilization/antidote drugs for tranquilization, Induction time, Reversal time etc. of Royal Bengal tiger (*Panthera tigris*) found in the wilderness of India especially in Central India. It will be very useful not only for those who are looking for these parameters for academic purposes but also for all field managers who are managing tigers and also for those who are looking for tiger reintroduction in their area, for taking appropriate decisions.

Acknowledgments

The authors are thankful to all the persons especially Officers and Field Staff of Panna Tiger Reserve, who were involved in the tranquilization and collection of data for past 12 years.

We are also thankful to Sh. Alok Kumar, CWLW, Madhya Pradesh for providing the opportunity to use and analyse data collected and kept in Panna Tiger Reserve Panna, Panna, MP.

We are also thankful to NTCA, New Delhi for issuing timely guidelines on performing Tranquilization Procedure and using Tranquilization/Reversal drugs and format of data collection.

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Glossary

Anaesthesia: From Greek an-“without” and aesthesis-“sensation”, a state of total loss of sensation in a body, induced by a drug that depresses activity of nervous tissue peripherally.

Anaesthetic Antagonists: are some of the notable pharmacological developments to wildlife immobilization that are useful to reverse the anaesthetic effects of tranquilizers such as xylazine, detomidine and Medetomidine after completion of procedures on wild animals. Thus antagonists help to recover the animals from anaesthesia as and when required.

Central Nervous System (CNS) Depressants: These drugs have an effect predominantly on the CNS. The effects range from calmness (tranquilization), depression (sedation), loss of pain (analgesia) to a complete loss of consciousness

Dissociative Anaesthetics: are used when an animal needs to be unconscious and unaware for an extended period of time. When used singly, they usually cause rough inductions and recoveries and convulsions may be experienced. Therefore are used in combination with tranquilizers that produces synergistic effect to yield good induction and smooth recovery. Ex: Ketamine HCL.

Induction Time: time between last dose of tranquilizers given and complete loss of awareness, sensation and consciousness when animal can be approached.

Reversal Time: time between dose of reversal drugs given and return of body movements.

Sedation: Calming due to mild degree of depression of central nervous system, most sedative cause drowsiness.

Tranquilization: A state of behavioural changes in which the animal is relaxed and unconcerned by his surroundings.

Tranquillizers: Produces calmness, loss of aggression and loss of alertness. Animal do not get immobilized fully with tranquilizers. Ex: Xylazine.

1. INTRODUCTION

Panna Tiger Reserve (PTR) is located in northernmost areas of Vindhyan range of Central India. The Reserve with its North-Central location in Madhya Pradesh forms part of the Indo-Malayan Realm floristically. Zoo-geographically, it is a member of the Oriental region and lies in Zone 6 E-'Deccan Peninsula – Central Highlands'. The dominant forest type in PTR is the Dry Deciduous forest type. The climate of PTR is hot and dry for about 7 months with an average annual rainfall of 864.9 mm. The main tree species are dry teak (*Tectona grandis)*, Kardhai *(Anogeissus pendula)*, Khair (*Acacia catechu*), Salai *(Boswellia serrata)*, common bamboo, a host of *Ziziphus* species etc. PTR does have a controversial conservation history by losing all its tigers in 2009. But the area immediately regained its status on the tiger front by successfully reintroducing tigers and successfully re-wilding orphaned tigers and achieving a rare 100% breeding success of reintroduced tigers. The Tiger Re-introduction Programme started in 2009 and by the end of year 2021, the re-introduced/re-wilded tigers met with an outstanding breeding success by producing more than 122 cubs in 54 litters.

All the re-introduced tigers were radio-collared at the time of re-introducing them in PTR. Later some of these tigers were tranquilized for re-collaring when the old radio collars did not work properly. Along with 5 translocated tigers (2 male and 3 females), 23Panna progeny (8 male and 15 females), total of 28 tigers, were also collared for management purposes by PTR Authorities in last the 10 years starting from year the 2011 till now. Collaring is done by tranquilizing the tiger. PTR has transformed the tiger tranquilization process from an enigmatic science to a regular managerial instrument. Starting from 22/09/2011, 60 times tiger tranquilization procedures have been performed on 30 individual tigers in PTR till now. Few tigers have been tranquilized more than once (5 times for tiger P111) at different age. These tranquilizations were mainly for radio-collaring/ de-collaring (28 tigers), rescue and treatment of serious injuries, and for transportation purposes. In most of these tranquilization processes performed, when the animal is immobile, measurement of nine Physical Characteristics was done as per standard procedure of measurement for tigers under the guidance of a veterinary doctor. All data regarding Physical Characteristics and amount of tranquilization drugs used, Induction time, Reversal time etc. for male and female tiger both, are officially kept in PTR. This Booklet analyses (i) the variation in these physical characteristics with age; (ii) the relation between amount of tranquilization/antidote drugs used, induction time, Reversal time and age of tiger, effect of ambient temperature; for both male and female tigers. Graphs have been plotted and analysed. These data, which is currently unavailable for tigers in the wild, along with analysis can be used by researchers and academicians who are working in this field for further studies and for comparing the physical characteristics of wild tigers in other areas. This can also be useful for wildlife managers who can use it for different managerial decisions like fixing collar size or amount of tranquilizer/antidote drugs required based on age, sex, and weight for different tigers.

2. MATERIALS AND METHODS

Starting from 22/09/2011, 60 tiger tranquilizations have been performed in PTR till now. These 60tiger tranquilization procedures have been performed on 30 individual tigers (11 males and 19 females). Sometimes the same tiger has been tranquilized more than once at different ages for different purposes. Details of tranquilization done of these 30 tigers with age at the time of tranquilization, along with the purpose of tranquilization are given in ***Table 1***. The age of female tiger tranquilized varies from 1 year 4 months to 11 years and in the case of male tiger, age varies from 1 year 2 months to 15 years.

A) Physical Characteristics

In most of these tranquilization processes performed, when the animal is immobile, measurement of following nine Physical Characteristics was recorded:

(i) Weight
(ii) Nose tip to tail base (Body Length)
(iii) Tail base to tail tip (Tail Length)
(iv) Total length (Nose tip to Tail tip)
(v) Neck Girth
(vi) Shoulder Height
(vii) Chest Girth
(viii) Abdomen Girth
(ix) Canine Length
    a. Upper Right and Left
    b. Lower Right and Left

While recording measurements, the standard method prescribed by NTCA (Standard Operating Procedure/Guidelines, November 2019, NTCA) has been used for measuring these physical characteristics. In these 60 tranquilization procedures on 30 tigers, data of these nine physical characteristics were collected. This collected data is given in ***Table 2***. Not every time during these 60 tranquilization procedures, data of all 9 physical characteristics could be collected due to exigencies or oversight. Hence not every physical characteristic will have 60 different values.

Analysis of this collected data has been done to get the growth curve for these Characteristics for both males and females. Then the comparison of growth curve for males and females, obtained for each Characteristic has been done and the results are discussed.

Table 1

Details of Tranquilization of Tiger at PTR

no. of tigers	Tiger ID	Sex	Age at the time of Tranquilization	Purpose
1	T-1	F	5 yrs	Re-collaring
		F	6 yrs 6 months	Re-collaring
		F	11 yrs	Re-Collaring
2	T-2	F	6 yrs	Re-collaring
		F	7 yrs 6 months	Re-collaring
3	T-3	M	9 yrs	Re-collaring
		M	10 yrs	Re-collaring
		M	15 yrs	Re-collaring &Surgery
		M	18 yrs	De-Collaring
4	T-4	F	6 yrs 9 months	Collaring
		F	8 yrs 9 months	Re-collaring
5	T-6	F	3 yrs 6 months	Rescue
6	T-7	M	5 yrs	Collaring
		M	6 yrs	Re-collaring
7	P-111	M	1 yr 9 months	Collaring
		M	2 yrs 6 months	Re-collaring
		M	5 yrs 6 months	Re-collaring
		M	8 yrs10 months	Re-Collaring
		M	10 yrs 8 months	De-Collaring
8	P-112	M	2 yrs 6 months	Collaring
9	P-121	M	1 yr 8 months	Collaring
		M	1 yr 10 months	De-collaring
10	P-141	F	1 yr 8 months	Collaring
11	P-142	F	1 yr 8 months	Collaring
		F	4 yrs 4 months	Re-Collaring
12	P-151	F	2 yrs 4 months	Collaring
13	P-211	M	1 yr 6 months	Collaring
		M	2 yrs 4 months	Rescue & Re-collaring
14	P-212	M	1 yr 7 months	Collaring
		M	1 yr 10 months	Rescue
		M	2 yrs 6 months	Re-collaring
		M	2 yrs 6 months	Treatment &Surgery
		M	2 yrs 6 months	Treatment &Surgery
		M	2 yrs 11 months	Treatment & Isolation
15	P-213	F	1 yr 7 months	Collaring
		F	2 yrs 5 months	Re-collaring
		F	5 yrs	Re-collaring &Surgery
		F	9 yrs	Re-Collaring
16	P-213 (21)	M	1 yr 4 months	Treatment
17	P-213 (22)	F	1 yr 10 months	Collaring
		F	6 yrs	Re-Collaring
18	P-213 (23)	F	1 yr 10 months	Collaring
		F	2 yrs 9 months	Collaring & Relocation
19	P-213 (32)	F	4 yrs	Collaring

20	P-213 (33)	F	2 yrs	Rescue & Collaring
		F	2 yrs 2 months	Relocation
21	P-213 (63)	F	2 yrs 2 months	Collaring
22	P-214	F	1 yr 7 months	Collaring
23	P-221	M	1 yr 5 months	Rescue & Collaring
24	P-222	F	1 yr 4 months	Rescue & Collaring
		F	2 yrs	Collaring
		F	6 yrs	Re-Collaring
25	P-233	F	1 yr 10 months	Collaring
26	P-234	F	1 yr 10 months	Collaring
		F	2 yrs 1 month	De-collaring &Surgery
27	P-234 (31)	M	1 yr 2 months	Collaring
28	P-243	M	6 yrs	Collaring
29	P-433	F	1 yr 6 months	Rescue & Collaring
		F	7 yrs	De-Collaring
30	P-521	F	1 yr 9 months	Collaring

Table 2

MEASUREMENT OF PHYSICAL CHARACTERISTICS OF TIGERS DONE AT PTR

S.No.	Tiger ID	Sex	Age	Actual Weight	Body Measurement											
					Nose tip to Tail base cm	Tail base to tail tip cm	Total length cm	Neck girth cm	Collar girth cm	Soulder height cm	Chest girth cm	Abdomen girth cm	Upper Canine R cm	Upper Canine L cm	Lower Canine R cm	Lower Canine L cm
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	T-1	F	5 yrs	-	-	-	-	-	-	-	-	-	-	-	-	-
2	T-2	F	6 yrs	-	183	66	249									
3	T-3	M	9 yrs	-	-	-	-	-	-	-	-	-	-	-	-	-
4	P-111	M	1 yr 9 months	-	152	82	234	77	-	-	132	-	-	-	-	-
5	P-211	M	1 yr 6 months	110 kgs	182	91	273	64	-	97	106	128	-	-	-	-
6	P-212	M	1 yr 7 months	113 kgs	175	84	259	61	-	55	-	-	-	-	-	-
7	P-213	F	1 yr 7 months	87 kgs	151	77	228	57.5	63	-	136	104	-	-	-	-
8	P-214	F	1 yr 7 months	-	165	86	251	57	-	-	-	-	-	-	-	-
9	T-4	F	6 yrs 9 months	106 kgs	172	87	259	59	-	88	-	-	-	-	-	-
10	P-212	M	1 yr 10 months	-	-	-	-	-	-	-	-	-	-	-	-	-
11	P-111	M	2 yrs 6 months	-	211	99	310	76	80.5	-	-	-	-	-	-	-
12	P-112	M	2 yrs 6 months	-	-	-	-	-	-	-	-	-	-	-	-	-
13	T-3	M	10 yrs	-	201	92	293	79	-	-	132	134	-	-	-	-
14	T-1	F	6 yrs 6 months	-	182	87	269	58	62	-	-	-	-	-	-	-
15	P-211	M	2 yrs 4 months	-	-	-	-	68	75	-	-	-	-	-	-	-
16	T-2	F	7 yrs 6 months	133 kgs	193	92	285	-	-	-	100	124	5	5	-	-
17	P-212	M	2 yrs 6 months	-	-	-	-	-	-	-	-	-	-	-	-	-
18	P-213	F	2 yrs 5 months	100 kgs	185	92	277	53	-	-	92	110	4	4	5	5
19	P-212	M	2 yrs 6 months	184 kgs	-	-	-	-	-	-	-	-	-	-	-	-
20	P-212	M	2 yrs 6 months	180 kgs	-	-	-	-	-	-	-	-	-	-	-	-
21	P-222	F	1 yr 4 months	82 kgs	151	72	223	52	61.5	-	-	96	-	-	-	-
22	P-212	M	2 yrs 11 months	179 kgs	-	-	-	-	-	-	-	-	-	-	-	-
23	P-221	M	1 yr 5 months	99 kgs	-	-	-	-	-	-	-	-	-	-	-	-
24	P-121	M	1 yr 8 months	159 kgs	205	102	307	57.3	61.5	107	-	-	5.6	5.7	4.5	4.7
25	P-121	M	1 yr 10 months	-	205	102	307	68	-	107	-	-	5.6	5.7	4.5	4.7
26	T-6	F	3 yrs 6 months	144 kgs	-	-	-	-	-	-	-	-	-	-	-	-
27	P-222	F	2 yrs	-	165	82	247	-	-	-	100	122	-	-	-	-
28	T-4	F	8 yrs 9 months	112.7 kgs	137	88	225	53	-	-	-	-	-	-	-	-

29	P-433	F	1 yr 6 months	68 kgs	-	-	-	50	56	-	-	-	-	-	-	-
30	P-213 (21)	M	1 yr 4 months	110 kgs	163	92	255	58	-	92	-	-	2.8	3	2.5	2.5
31	P-234	F	1 yr 10 months	126 kgs	157	94	251	70	76	98	104	118	4.5	4.5	3.5	3.9
32	P-233	F	1 yr 10 months	103 kgs	157	98	255	56	62	86	102	104	4	4	3.5	3.5
33	P-234	F	2 yrs 1 month	124 kgs	160	94	254	70	76	99	106	114	4	4.5	4	4.5
34	P-213 (22)	F	1 yr 10 months	129.5 kgs	167	93	260	65	70	108	124	144	5	5	4	4
35	P-213 (23)	F	1 yr 10 months	124.7 kgs	182	93	275	57	62	102	120	126	5	4.7	4.5	4.5
36	P-111	M	5 yrs 6 months	226.7 kgs	184	99	283	70	73.5	127	154	158	5.2	5	5	4.5
37	P-213	F	5 yrs	105 ks	175	96	271	57	58.5	92	98	104	5	5	4	4
38	T-7	M	5 yrs	180 kgs	183	93	276	75	80	113	116	140	6.5	5	6.5	5
39	P-141	F	1 yr 8 months	-	178	95	273	64	68	98	104	110	-	-	-	-
40	P-142	F	1 yr 8 months	118 kgs	169	96	265	56	61	103	104	110	5	4.5	4.5	4.5
41	P-213 (23)	F	2 yrs 9 months	-	182	93	275	57	62	102	120	126	5	4.7	4.5	4.5
42	T-7	M	6 yrs	-	198	94	292	75	77.5	113	116	140	6.5	5	5.5	5
43	P-521	F	1 yr 9 months	94 kgs	162	81	243	56	61	-	96	100	-	-	-	-
44	T-3	M	15 yrs	202 kgs	201	92	293	83	88	118	-	-	4	6	2.5	5
45	T-1	F	11 yrs	141 kgs	-	-	-	-	-	-	-	-	-	-	-	-
46	P-213 (33)	F	2 yrs	110 kgs	171	90	261	51	56	96	-	-	-	-	-	-
47	P-213 (33)	F	2 yrs 2 months	120 kgs	172	91	263	51	56	97	-	-	-	-	-	-
48	P-151	F	2 yrs 4 months	126 kgs	177	96	273	61	66	104	-	-	-	-	-	-
49	P-111	M	8 yrs10 months	-	211	100	311	76	79	120	75	90	6	4	5	3
50	P-142	F	4 yrs 4 months	152 kgs	183	97	280	64	67.5	112	116	128	-	-	-	-
51	P-222	F	6 yrs	131 kgs	178	100	278	56	59	107	118	128	-	-	-	-
52	P-213	F	9 yrs	104 kgs	164	96	260	60	62	94	96	98	4.5	5.5	2	4.5
53	P-213 (32)	F	4 yrs	-	172	101	273	61	66	104	106	110	4.5	5	5	4.5
54	P-213 (22)	F	6 yrs	-	178	94	272	65	70	107	110	124	5	5	4	4.5
55	P-433	F	7 yrs	-	164	91	255	56	-	97	98	104	5	4.5	5	4.5
56	P-111	M	10 yrs 8 months	-	192	108	300	79	-	128	136	148	3	3.5	3	3.5
57	P-213 (63)	F	2 yrs 2 months	116 kgs	130	92	222	59	65	93	100	106	4	4	3.5	3.5
58	T-3	M	18yrs	-	203	103	306	83	88	93	122	134	3	3	1.5	4
59	P-234 (31)	M	1 yr 2 months	120 kgs	176	102	278	58	61	106	110	118	2.5	2.5	2	2
60	P-243	M	6 yrs	228 kgs	193	102	295	-	-	-	-	-	-	-	-	-

B) Tranquilization Procedure: Tranquilization/antidote drugs, Induction time, Reversal time

Modern immobilizing techniques using Chemical Restraint method, are more humane methods for handling of wild animals that has drastically reduced side-effects of drugs and causalities. Chemical Restraint is a form of animal restraint technique in which a drug or a chemical is used to restrict the movement (walking, running, aggression) of an animal or sometimes just to sedate or to calm down. However, chemical capture may have disadvantages such as occasional failure of the equipment on site, undesirable side effects of drug in unknown excited or diseased animal, improper darting of an animal due to occasional operator's mistakes. The use of antagonist/antidotes of anaesthesia is being preferred to avoid undesirable and harmful effects of drugs and for speedy recovery. As animal do not get immobilized fully with tranquilizers, these are primarily used as adjuncts to Dissociative Anaesthetics for harnessing smoother induction and to reduce the quantity of anaesthetic for achieving more effective immobilization. In PTR, for the purpose of Chemical Restraint, tranquilizers drug 'Xylazine HCL' (later refer as Xylazine) is used along with Dissociative anaesthetic drug 'Ketamine HCL' (later refer as Ketamine). Ketamine is a non-competitive, centrally acting, dissociative general anaesthetic that provides amnesia, analgesia, and immobility. When combined with xylazine, the combination is regarded as the agent of choice for injectable anaesthesia to wild animals. The popularity of ketamine–xylazine (KX) is mainly due to its supplemental effects (that is, analgesic properties, muscle relaxation, and sedation).Although the combination of KX provides relatively safe anaesthesia, the whole tranquilization procedure inherits risk.

The name 'Tranquilization Procedure' used here includes both chemical restraint by using tranquilizers and anaesthetics as well as recovery of animal using antidotes. Similarly, the name 'tranquilizer drug' used here will include both tranquilizers drug 'Xylazine HCL' and anaesthetic drug 'Ketamine HCL'

During the initial years, for Tranquilization Procedure, amount of Ketamine drug use was more than Xylazine but later since 2015, gain of experience has led to change in quantity of drugs used. Since 2015, a mixture of Xylazine and Ketamine in a proportion of 1.25 : 1 known as 'Hellabrunn mixture' has been effectively used in PTR. For reversal of tranquilizers and anaesthetic drugs, 'Yohimbine HCL' has been used as antagonist (antidote) drug. During each tranquilization procedure done in PTR, along with amount of tranquilization and reversal (antidote) drugs used, Induction and Reversal time have also been recorded. ***Table 3*** and ***Table 4*** give detail of tranquilization and reversal drugs used, Induction time, Reversal time along with Ambient Temperature and Age and Weight of male and female tiger respectively. Of 60 tiger tranquilization procedures done in PTR, 26 procedures have been performed on male tigers and 34 procedures on female tigresses.

The genetic diversity of tiger at PTR is moderate with 60% heterozygosity and structurally represents all the source populations i.e. Kanha, Pench, Bandhavgarh and also include gene pool of

original Panna population (Sreenivasa Murthy, R and Ramesh, K 2013). As tigers reintroduced in PTR form varied gene pools, a mix of Kanha, Pench, Bandhavgarh, and Panna, data collected and analysis done from these observations may hold good for most of the tigers spread in Central India.

Table 3: Male Tigers Tranquillization Data

S.No.	Tranquilizing date	Tiger ID	Age (in years)	Purpose	Ambient Temp (in C)	Estimated Weight (in kg)	No. of Dart	Xylazine 100 mg (in mg)	xylazine per Kg body wt	Ketamine 100 mg (in mg)	Ketamine per Kg body wt	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2011/11	T-3	9	Re-collaring	22	200	2	250	1.250	300	1.500	10	50	28
2	2012/01	P-111	1.75	Collaring	19	130	3	180	1.385	370	2.846	45	45	43
3	2012/03	P-211	1.5	Collaring	24	100	3	166.68	1.515	233.32	2.121	17	25	36
4	2012/05	P-212	1.58	Collaring	36	110	1	194.45	1.721	155.56	1.377	10	40	13
5	2012/08	P-212	1.83	Rescue	28	120	2	222.23	1.852	227.78	1.898	15	40	19
6	2012/09	P-111	2.5	Re-collaring	30	140	4	250	1.786	350	2.500	24	50	16
7	2012/11	P-112	2.5	Collaring	21	180	3	444.56	2.470	606	3.367	60	80	21
8	2013/01	T-3	10	Re-collaring	21	200	4	444.56	2.223	556.46	2.782	73	90	22
9	2013/02	P-211	2.33	Rescue & Re-collaring	28	150	2	277.77	1.852	272.2	1.815	10	55	13
10	2013/03	P-212	2.5	Re-collaring	30	120	1	277.75	2.315	222.2	1.852	11	60	21
11	2013/04	P-212	2.5	Treatment & Surgery	30	184	5	500	2.778	400	2.222	37	90	39
12	2013/04	P-212	2.5	Treatment & Surgery	30	170	5	555.55	3.019	444.44	2.415	28	100	8
13	2013/09	P-212	2.91	Treatment & Isolation	28	180	3	500	2.793	550	3.073	16	100	15
14	2013/10	P-221	1.42	Rescue & Collaring	30	90	2	180.57	1.824	194.5	1.965	49	36	11
15	2013/11	P-121	1.66	Collaring	24	120	3	402.81	2.533	422.29	2.656	47	80	21

16	2014/01	P-121	1.83	De-collaring	19	160	1	250	1.563	300	1.875	19	60	18
17	2015/04	P-213 (21)	1.33	Treatment	41.5	100	3	300	2.727	350	3.182	47	60	11
18	2015/10	P-111	5.6	Re-collaring	27.6	200	3	416	1.835	334	1.473	34	110	12
19	2015/11	T-7	5	Collaring	28.6	170	3	304	1.689	246	1.367	23	120	17
20	2016/10	T-7	6	Re-collaring	33	180	2	325	1.806	325	1.806	20	120	32
21	2017/11	T-3	15	Re-collaring & Surgery	26	200	2	421.75	2.088	333.25	1.650	15	100	13
22	2019/03	P-111	8.83	Re-Collaring	25	250	4	611.16	2.445	489	1.956	58	100	17
23	2020/12	T-3	18	De-Collaring	20	250	3	610.36	2.441	488.76	1.955	36	120	7
24	2020/12	P-111	10.66	De-Collaring	28	240	4	721.44	3.006	577.68	2.407	37	120	15
25	2021/01	P-234 (31)	1.17	Collaring	20	110	3	333.36	2.778	266.76	2.223	45	70	13
26	2021/05	P-243	6	Collaring	36	240	3	500	2.193	400	1.754	32	100	21

Table 4: Female Tigress Tranquilization Data

S. No.	Tranquilizing date	Tiger ID	Age	Purpose	Ambient Temp.	Estimated Weight	No. of Dart	Xylazine 100 mg	Ketamine 100 mg	Induction time	Yohimbine HCL 10 mg	Reversal time
1	2	3	4	5	6	7	8	9	10	11	12	13
1	22.09.2011	T-1	5 yrs	Re-collaring	25^0C	140 kgs	4	200 mg	350 mg	27 mints.	40 mg	48 mints.
2	23.09.2011	T-2	6 yrs	Re-collaring	27^0C	150 kgs	2	225 mg	300 mg	22 mints.	45 mg	48 mints.
3	17.05.2012	P-213	1 yr 7 months	Collaring	41^0C	90 kgs	2	166.68 mg	183.35 mg	10 mints.	40 mg	18 mints
4	21.05.2012	P-214	1 yr 7 months	Collaring	39^0C	85 kgs	3	180.57 mg	194.42 mg	12 mints	40 mg	22 mints
5	24.06.2012	T-4	6 yrs 9 months	Collaring	37^0C	110 kgs	3	222.23 mg	327.78 mg	17 mints	45 mg	20 mints
6	31.01.2013	T-1	6 yrs 6 months	Re-collaring	21^0C	140 kgs	3	416.33 mg	433.66 mg	68 mints	85 mg	11 mints
7	10.03.2013	T-2	7 yrs 6 months	Re-collaring	32^0C	140 kgs	3	416.65 mg	433.32 mg	44 mints	85 mg	18 mints
8	25.03.2013	P-213	2 yrs 5 months	Re-collaring	34^0C	110 kgs	2	222.20 mg	277.76 mg	10 mints.	45 mg	17 mints
9	10.09.2013	P-222	1 yr 4 months	Rescue & Collaring	30^0C	75 kgs	2	166.67 mg	183.38 mg	21 mints	33 mg	08 mints
10	03.02.2014	T-6	3 yrs 6 months	Rescue	22^0C	137 kgs	1	250 mg	250 mg	38 mints	65 mg	23 mints
11	25.05.2014	P-222	2 yrs	Collaring	42^0C	110 kgs	1	225 mg	225 mg	08 mints	45 mg	16 mints
12	03.06.2014	T-4	8 yrs 9 months	Re-collaring	42^0C	110 kgs	3	325 mg	325 mg	55 mints	70 mg	07 mints
13	11.12.2014	P-433	1 yr 6 months	Rescue & Collaring	24^0C	70 kgs	2	175 mg	175 mg	8 mints	40 mg	12 mints
14	15.05.2015	P-234	1 yr 10months	Collaring	39.9^0C	120 kgs	2	275 mg	275 mg	43 mits	60 mg	25 mints
15	24.05.2015	P-233	1 yr 10months	Collaring	41^0C	105 kgs	1	200 mg	200 mg	7 mints	40 mg	10 mints
16	02.09.2015	P-234	2 yrs 1 month	De-collaring &Surgeory	28.6^0C	126 kgs	3	650 mg	750 mg	20 mints	50 mg	10 mints

17	14.10.2015	P-213 (22)	1 yr 10months	Collaring	30.3^{0}C	110 kgs	2	278 mg	222 mg	24 mints	55 mg	11 mints
18	16.10.2015	P-213 (23)	1 yr 10months	Collaring	27.1^{0}C	110 kgs	3	278 mg	222 mg	40 mints	55 mg	8 mints
19	29.10.2015	P-213	5 yrs	Re-collaring &Surgeory	23.5^{0}C	110 kgs	3	332 mg	268 mg	39 mints	70 mg	9 mints
20	02.06.2016	P-141	1 yr 8 months	Collaring	40^{0}C	85 kgs	3	389.12 mg	311.92 mg	60 mints	90 mg	15 mints
21	03.06.2016	P-142	1 yr 8 months	Collaring	36^{0}C	110 kgs	1	250 mg	250 mg	23 mints.	60 mg	10 mints
22	24.09.2016	P-213 (23)	2 yrs 9 months	Collaring & Relocation	26^{0}C	140 kgs	1	250 mg	250 mg	20 mints	50 mg	17 mints
23	11.01.2017	P-521	1 yr 9 months	Collaring	16^{0}C	100 kgs	1	200 mg	200 mg	2 mints	40 mg	17 mints
24	06.12.2017	T-1	11 yrs	Re-Collaring	24^{0}C	140 kgs	2	417.75 mg	333.25 mg	12 mints	100 mg	12 mints
25	10.01.2018	P-213 (33)	2 yrs	Rescue & Collaring	28^{0}C	90 kgs	5	402.81 mg	322.34 mg	180 mints	80 mg	7 mints
26	25.03.2018	P-213 (33)	2 yrs 2 months	Relocation	28^{0}C	110 kgs	1	277 mg	222 mg	8 mints	70 mg	13 mints
27	02.12.2018	P-151	2 yrs 4 months	Collaring	23^{0}C	120 kgs	2	304.78 mg	244.23 mg	18 mints	65 mg	9 mints
28	05.03.2019	P-142	4 yrs 4 months	Re-Collaring	26^{0}C	150 kgs	2	388.12 mg	310.92 mg	33 mints	70 mg	15 mints
29	15.03.2019	P-222	6 yrs	Re-Collaring	25^{0}C	135 kgs	2	388.12 mg	310.92 mg	36 mints	70 mg	7 mints
30	25.11.2019	P-213	9 yrs	Re-Collaring	25^{0}C	105k gs	3	443.67 mg	355.38 mg	41 mints	70 mg	14 mints
31	11.02.2020	P-213 (32)	4 yrs	Collaring	21^{0}C	110 kgs	2	388.12 mg	311 mg	18 mints	80 mg	7 mints
32	14.02.2020	P-213 (22) Chitrakoot	6 yrs	Re-Collaring	21^{0}C	130 kgs	2	388.12 mg	310.92 mg	28 mints	80 mg	8 mints
33	19.09.2020	P-433	7 yrs	De-Collaring	36^{0}C	100 kgs	2	388.12 mg	310.92 mg	26 mints	70 mg	8 mints
34	13.12.2020	P-213 (63)	2 yrs 2 months	Collaring	24^{0}C	110 kgs	2	388.12 mg	310.92 mg	29 mints	80 mg	12 mints

3. RESULTS AND DISCUSSION

A) Physical Characteristics

Data collected of nine Physical Characteristics for both male and female tigers of different ages have been analyzed and plotted against age. Each Physical Characteristics has been taken separately and curves are drawn for both males and females in a single graph so that comparison can easily be made. Results are shown and discussed for each Physical Characteristic as follows:

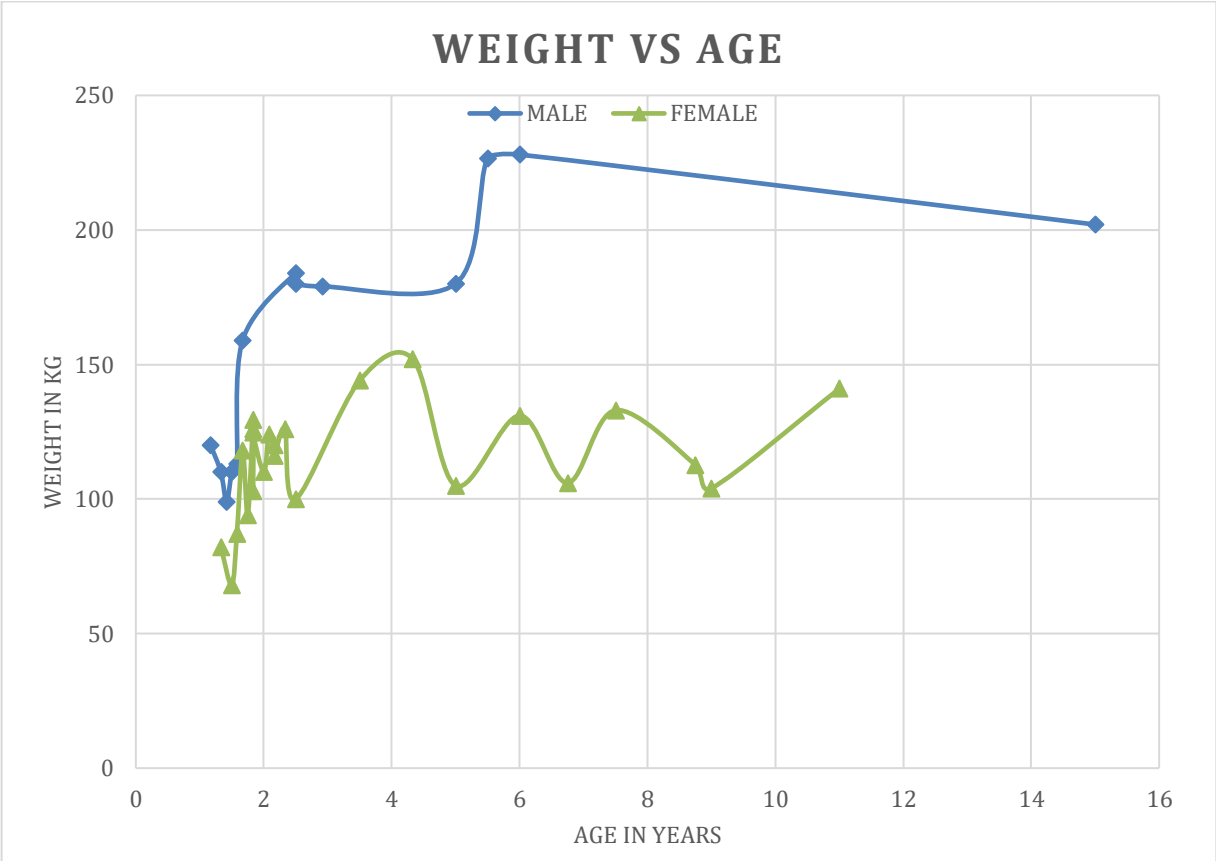
(i) Weight: Weight data for male and female tigers is given in ***Table3.A.1***. Weight curves have been drawn against Age as shown in ***Figure 3.A.1***.The result shows that a male tiger has more weight compare to a female tiger in all the stages of its life. The male tiger attains its maximum weight at around 5-6 years and then it stabilizes. The average weight of a male tiger of age more than 5 years at PTR is more than 200 kg. The female tiger attains its maximum weight a little earlier than the male tiger at around 4.5 to 5.5 years and then it stabilizes. The average weight of a female tiger of age more than 5 years at PTR is around 140 kg.

Table 3.A.1

WEIGHT

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Weight (in Kg)	Age (in years)	Weight (in Kg)	Tiger ID
1						
2	P-213 (21)	1.33	110	1.5	68	P-433
3	P-221	1.42	99	1.58	87	P-213
4	P-211	1.5	110	1.67	118	P-142
5	P-212	1.58	113	1.75	94	P-521
6	P-121	1.67	159	1.83	126	P-234
7	P-212	2.5	184	1.83	103	P-233
8	P-212	2.5	180	1.83	129.5	P-213 (22)
9	P-212	2.92	179	1.83	124.7	P-213 (23)
10	T-7	5	180	2	110	P-213 (33)
11	P-111	5.5	226.7	2.08	124	P-234
12	P-243	6	228	2.167	120	P-213 (33)
13	T-3	15	202	2.17	116	P-213 (63)
14				2.33	126	P-151
15				2.5	100	P-213
16				3.5	144	T-6
17				4.33	152	P-142
18				5	105	P-213
19				6	131	P-222
20				6.75	106	T-4
21				7.5	133	T-2
22				8.75	112.7	T-4
23				9	104	P-213
24				11	141	T-1

Figure 3.A.1: Weight vs Age graph for tigers at PTR



(ii) Nose Tip to Tail Base Length: Nose Tip to Tail Base Length(Body Length) data for male and female tigers is given in ***Table3.A.2***. Body Length curves have been drawn against Age as shown in ***Figure 3.A.2***.

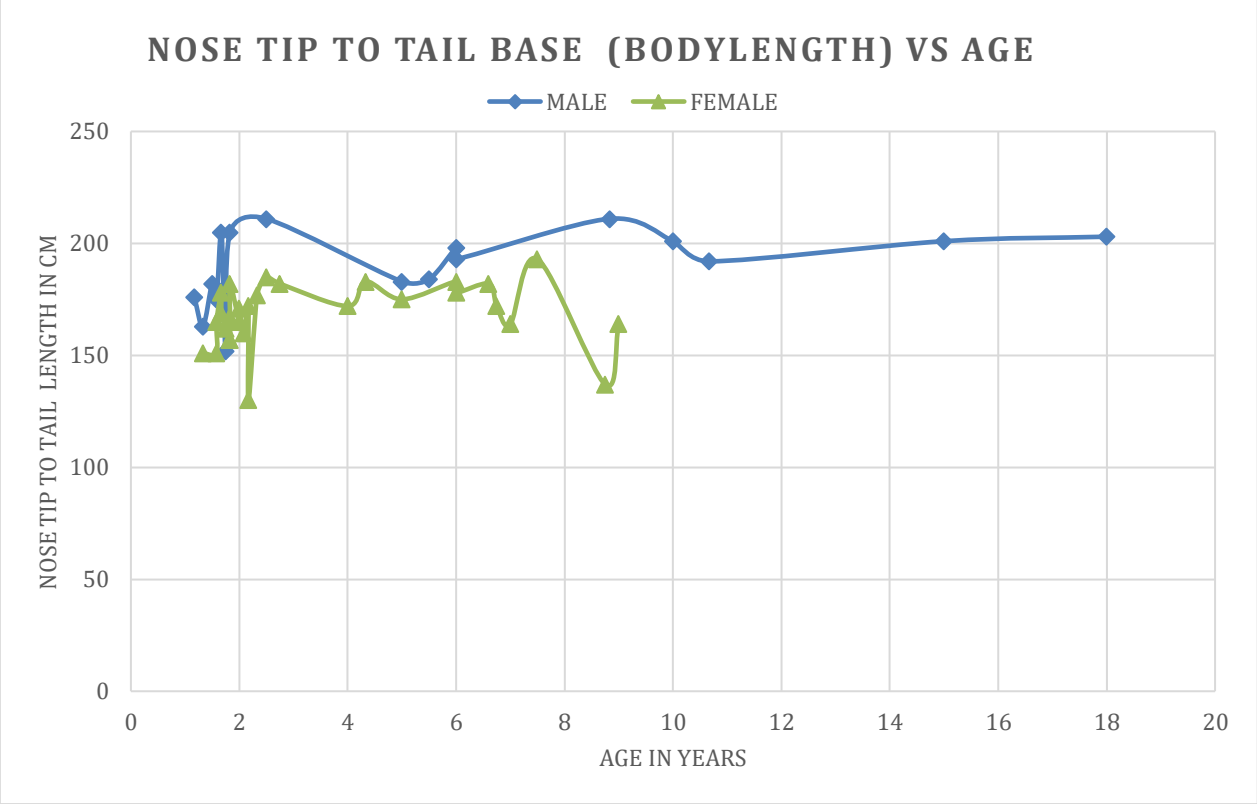
The result shows that the male tiger is slightly bigger in Body length compare to the female tiger in all the stages of its life. The male tiger attains its maximum body length at around 2 years of age and then it stabilizes. The average body length of a male tiger of age of more than 2 years at PTR is around 200 cm. The female tiger attains its maximum body length at around 2.5 years of age and then it stabilizes. The average body length of a female tiger of age more than 2 years at PTR is around 175 cm.

Table 3.A.2

NOSE TIP TO TAIL BASE LENGTH

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Nose tip to Tail base cm	Age (in years)	Nose tip to Tail base cm	Tiger ID
1	P-234 (31)	1.17	176	1.33	151	P-222
2	P-213 (21)	1.33	163	1.58	151	P-213
3	P-211	1.5	182	1.58	165	P-214
4	P-212	1.58	175	1.67	178	P-141
5	P-121	1.67	205	1.67	169	P-142
6	P-111	1.75	152	1.75	162	P-521
7	P-121	1.83	205	1.83	157	P-234
8	P-111	2.5	211	1.83	157	P-233
9	T-7	5	183	1.83	167	P-213 (22)
10	P-111	5.5	184	1.83	182	P-213 (23)
11	T-7	6	198	2	165	P-222
12	P-243	6	193	2	171	P-213 (33)
13	P-111	8.83	211	2.08	160	P-234
14	T-3	10	201	2.167	172	P-213 (33)
15	P-111	10.67	192	2.17	130	P-213 (63)
16	T-3	15	201	2.33	177	P-151
17	T-3	18	203	2.5	185	P-213
18				2.75	182	P-213 (23)
19				4	172	P-213 (32)
20				4.33	183	P-142
21				5	175	P-213
22				6	183	T-2
23				6	178	P-222
24				6.6	182	T-1
25				6.75	172	T-4
26				7	164	P-433
27				7.5	193	T-2
28				8.75	137	T-4
29				9	164	P-213

***Figure 3.A.2*: Nose Tip to Tail Base (Body Length) vs Age graph for tigers at PTR**



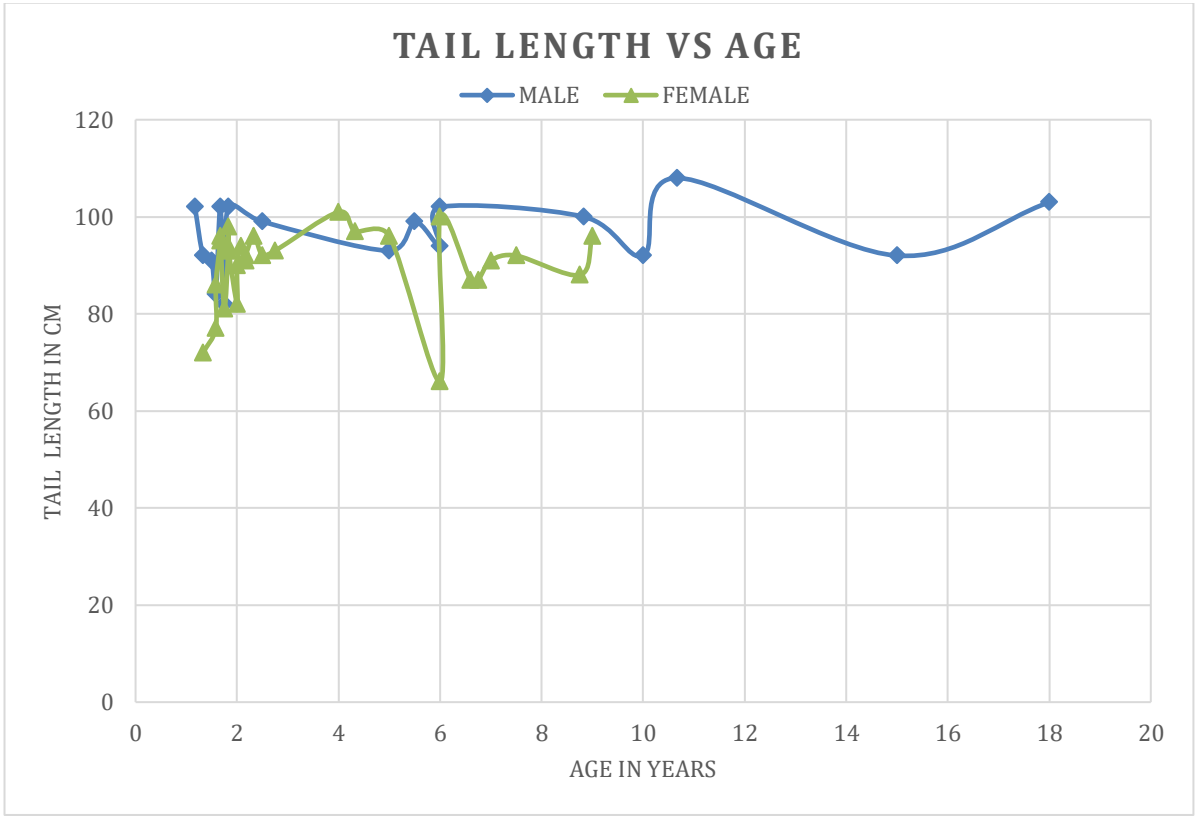
(iii) Tail Base to Tail Tip (Tail Length): Tail Base to Tail Tip (Tail Length) data for male and female tigers is given in ***Table 3.A.3***. Tail Length curves have been drawn against Age as shown in ***Figure 3.A.3***.

The result shows that the Tail Length of the male tiger is just slightly bigger compare to the female tiger in all the stages of its life. The male tiger attains its maximum Tail Length at around 20 months of age and then it stabilizes. The average Tail Length of a male tiger of age more than 2 years at PTR is around 100 cm. The female tiger also attains its maximum Tail Length at around 20 months of age and then it stabilizes. The average Tail Length of a female tiger of age more than 2 years at PTR is around 90 cm.

Table 3.A.3
(TAIL LENGTH)

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Tail base to tail tip cm	Age (in years)	Tail base to tail tip cm	Tiger ID
1	P-234 (31)	1.17	102	1.33	72	P-222
2	P-213 (21)	1.33	92	1.58	77	P-213
3	P-211	1.5	91	1.58	86	P-214
4	P-212	1.58	84	1.67	95	P-141
5	P-121	1.67	102	1.67	96	P-142
6	P-111	1.75	82	1.75	81	P-521
7	P-121	1.83	102	1.83	94	P-234
8	P-111	2.5	99	1.83	98	P-233
9	T-7	5	93	1.83	93	P-213 (22)
10	P-111	5.5	99	1.83	93	P-213 (23)
11	T-7	6	94	2	82	P-222
12	P-243	6	102	2	90	P-213 (33)
13	P-111	8.83	100	2.08	94	P-234
14	T-3	10	92	2.167	91	P-213 (33)
15	P-111	10.67	108	2.17	92	P-213 (63)
16	T-3	15	92	2.33	96	P-151
17	T-3	18	103	2.5	92	P-213
18				2.75	93	P-213 (23)
19				4	101	P-213 (32)
20				4.33	97	P-142
21				5	96	P-213
22				6	66	T-2
23				6	100	P-222
24				6.6	87	T-1
25				6.75	87	T-4
26				7	91	P-433
27				7.5	92	T-2
28				8.75	88	T-4
29				9	96	P-213

Figure 3.A.3: Tail Length vs Age graph for tigers at PTR



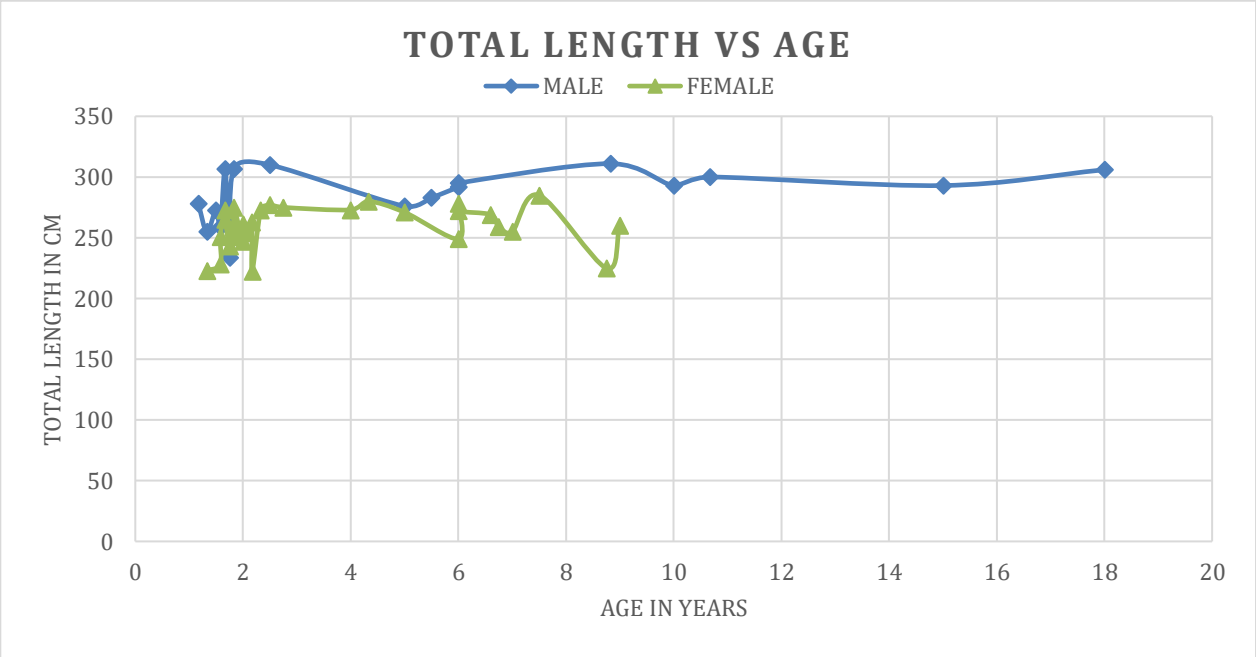
(iv) Total Length: Total length data for male and female tigers is given in ***Table 3.A.4***. Total length curves have been drawn against Age as shown in ***Figure3.A.4***.

The result shows that the Total Length of the male tiger is slightly bigger compare to the female tiger in all the stages of its life as Total Length is addition of Body Length and Tail Length. The male tiger attains its maximum Total Length at around 2 years of age and then it stabilizes. The average Total Length of a male tiger of age more than 2 years at PTR is around 300 cm. The female tiger attains its maximum Total Length at around 2.5 years of age and then it stabilizes. The average Total Length of a female tiger of age more than 2 years at PTR is around 275 cm.

Table 3.A.4
(TOTAL LENGTH)

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Total length cm	Age (in years)	Total length cm	Tiger ID
1	P-234 (31)	1.17	278	1.33	223	P-222
2	P-213 (21)	1.33	255	1.58	228	P-213
3	P-211	1.5	273	1.58	251	P-214
4	P-212	1.58	259	1.67	273	P-141
5	P-121	1.67	307	1.67	265	P-142
6	P-111	1.75	234	1.75	243	P-521
7	P-121	1.83	307	1.83	251	P-234
8	P-111	2.5	310	1.83	255	P-233
9	T-7	5	276	1.83	260	P-213 (22)
10	P-111	5.5	283	1.83	275	P-213 (23)
11	T-7	6	292	2	247	P-222
12	P-243	6	295	2	261	P-213 (33)
13	P-111	8.83	311	2.08	254	P-234
14	T-3	10	293	2.167	263	P-213 (33)
15	P-111	10.67	300	2.17	222	P-213 (63)
16	T-3	15	293	2.33	273	P-151
17	T-3	18	306	2.5	277	P-213
18				2.75	275	P-213 (23)
19				4	273	P-213 (32)
20				4.33	280	P-142
21				5	271	P-213
22				6	249	T-2
23				6	278	P-222
24				6	272	P-213 (22)
25				6.6	269	T-1
26				6.75	259	T-4
27				7	255	P-433
28				7.5	285	T-2
29				8.75	225	T-4
30				9	260	P-213

Figure 3.A.4: Total Length vs Age graph for tigers at PTR



(v) Shoulder Height: Shoulder Height data for male and female tigers is given in ***Table 3.A.5***. Shoulder Height curves have been drawn against Age as shown in ***Figure 3.A.5***.

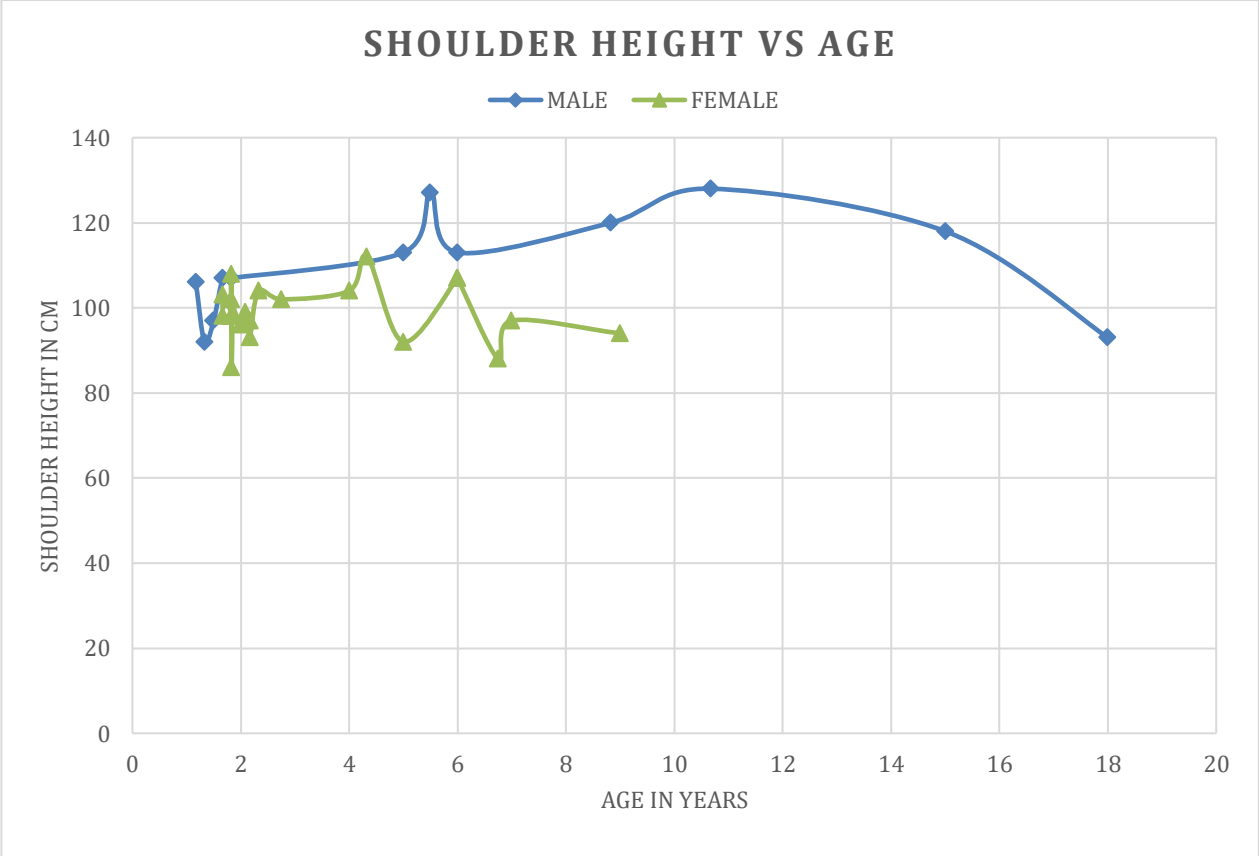
The result shows that a male tiger has slightly more Shoulder Height compare to a female tiger in all the stages of its life. The graph shows that the male tiger Shoulder Height keeps on increasing though slightly till the age of 10 years with a maximum shoulder height of around 125 cm. The female tiger attains its maximum Shoulder Height at around 2.5 years of age and then it stabilizes. The average Shoulder Height of a female tiger of age more than 2.5 years at PTR is around 100 cm.

Table 3.A.5

SHOULDER HEIGHT

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Soulder height cm	Age (in years)	Soulder height cm	Tiger ID
1	P-234 (31)	1.17	106	1.67	98	P-141
2	P-213 (21)	1.33	92	1.67	103	P-142
3	P-211	1.5	97	1.83	98	P-234
4	P-121	1.67	107	1.83	86	P-233
5	P-121	1.83	107	1.83	108	P-213 (22)
6	T-7	5	113	1.83	102	P-213 (23)
7	P-111	5.5	127	2	96	P-213 (33)
8	T-7	6	113	2.08	99	P-234
9	P-111	8.83	120	2.167	97	P-213 (33)
10	P-111	10.67	128	2.17	93	P-213 (63)
11	T-3	15	118	2.33	104	P-151
12	T-3	18	93	2.75	102	P-213 (23)
13				4	104	P-213 (32)
14				4.33	112	P-142
15				5	92	P-213
16				6	107	P-222
17				6	107	P-213 (22)
18				6.75	88	T-4
19				7	97	P-433
20				9	94	P-213

Figure 3.A.5: Shoulder Height vs Age graph for tigers at PTR



(vi) **Neck Girth:** Neck Girth data for male and female tigers is given in ***Table 3.A.6***. Neck Girth curves have been drawn against Age as shown in ***Figure 3.A.6***.

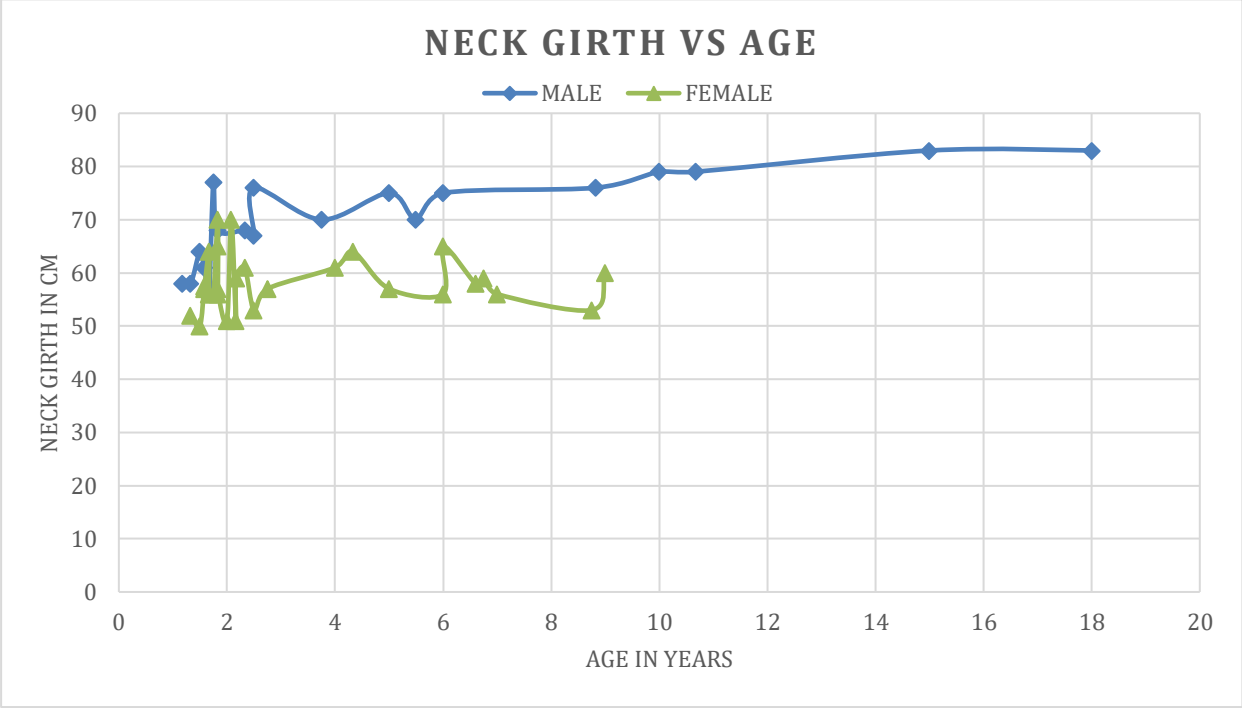
The result shows that the Neck Girth of the male tiger is more compare to the female tiger in all the stages of its life. Graph shows that the male tiger Neck Girth keeps on increasing at a gentle pace from around 70 cm at 2 years of age to 80 cm at the age of 10 years. Female tiger Neck Girth remains stable at around 60 cm from the age of 2 years till the older age.

Table 3.A.6

NECK GIRTH

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Neck girth cm	Age (in years)	Neck girth cm	Tiger ID
1	P-234 (31)	1.17	58	1.33	52	P-222
2	P-213 (21)	1.33	58	1.5	50	P-433
3	P-211	1.5	64	1.58	57.5	P-213
4	P-212	1.58	61	1.58	57	P-214
6	P-121	1.67	57.3	1.67	64	P-141
7	P-111	1.75	77	1.67	56	P-142
8	P-121	1.83	68	1.75	56	P-521
9	P-211	2.33	68	1.83	70	P-234
10	BT-1	2.5	67	1.83	56	P-233
11	P-111	2.5	76	1.83	65	P-213 (22)
12	SP-212	3.75	70	1.83	57	P-213 (23)
13	T-7	5	75	2	51	P-213 (33)
14	P-111	5.5	70	2.08	70	P-234
16	T-7	6	75	2.167	51	P-213 (33)
17	P-111	8.83	76	2.17	59	P-213 (63)
18	T-3	10	79	2.33	61	P-151
19	P-111	10.67	79	2.5	53	P-213
21	T-3	15	83	2.75	57	P-213 (23)
22	T-3	18	83	4	61	P-213 (32)
23				4.33	64	P-142
24				5	57	P-213
25				6	56	P-222
26				6	65	P-213 (22)
27				6.6	58	T-1
28				6.75	59	T-4
29				7	56	P-433
30				8.75	53	T-4
31				9	60	P-213

Figure 3.A.6: Neck Girth vs Age graph for tigers at PTR



(vii) Chest Girth: Chest Girth data for male and female tigers is given in ***Table 3.A.7***. Chest Girth curves have been drawn against Age as shown in ***Figure 3.A.7***.

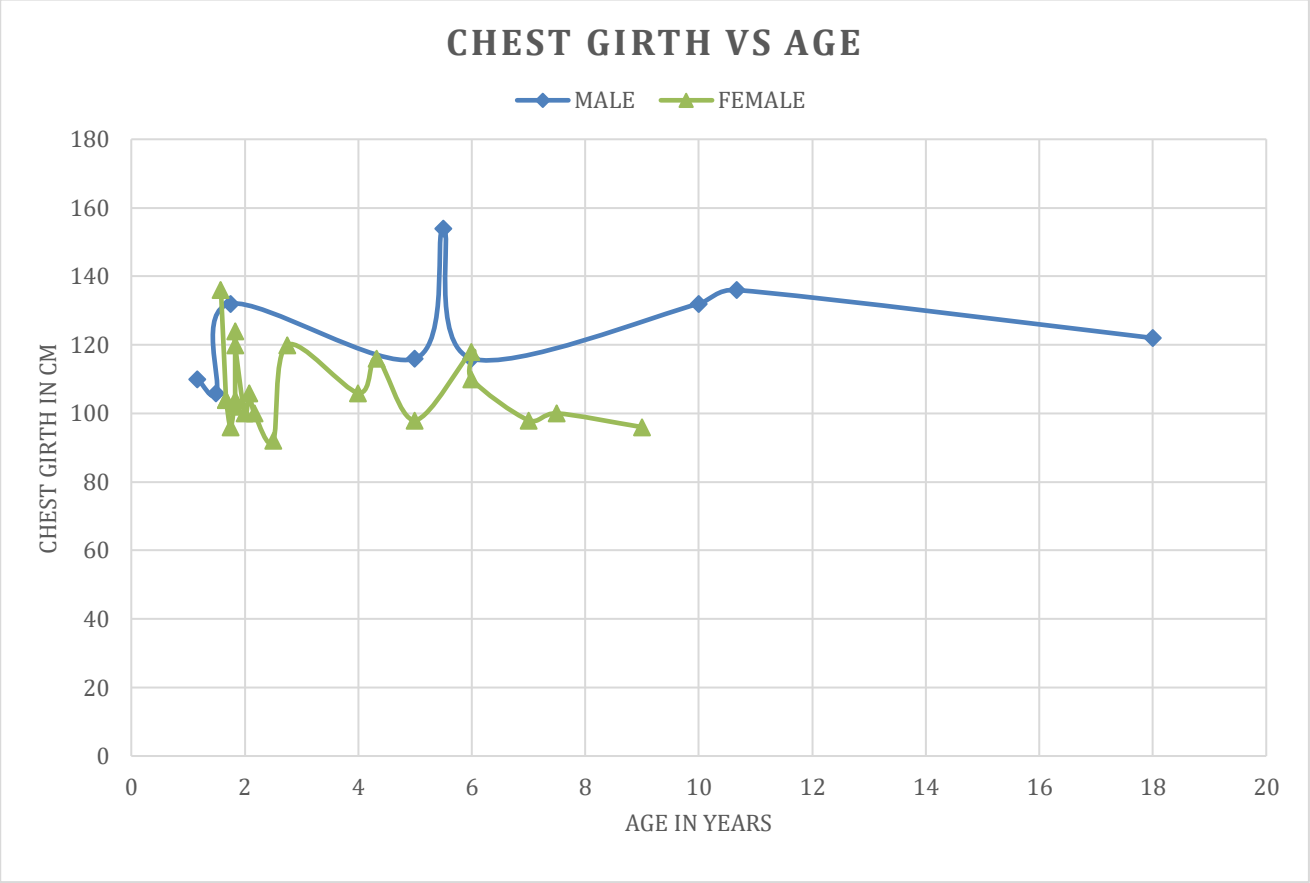
The result shows that Chest Girth of the male tiger is more compare to the female tiger in all the stages of its life. The graph shows that the male tiger Chest Girth remains stable at around 130 cm once it attains this at the age of 2 years. The female tiger Chest Girth remains at around 110 cm from the age of 2 years till 7 years of age. Graph shows that it drops to around 100 cm beyond 7 years age.

Table 3.A.7

CHEST GIRTH

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Chest girth cm	Age (in years)	Chest girth cm	Tiger ID
1	P-234 (31)	1.17	110	1.58	136	P-213
2	P-211	1.5	106	1.67	104	P-141
3	P-111	1.75	132	1.67	104	P-142
4	T-7	5	116	1.75	96	P-521
5	P-111	5.5	154	1.83	104	P-234
6	T-7	6	116	1.83	102	P-233
7	T-3	10	132	1.83	124	P-213 (22)
8	P-111	10.67	136	1.83	120	P-213 (23)
9	T-3	18	122	2	100	P-222
10				2.08	106	P-234
11				2.17	100	P-213 (63)
12				2.5	92	P-213
13				2.75	120	P-213 (23)
14				4	106	P-213 (32)
15				4.33	116	P-142
16				5	98	P-213
17				6	118	P-222
18				6	110	P-213 (22)
19				7	98	P-433
20				7.5	100	T-2
21				9	96	P-213

Figure 3.A.7: Chest Girth vs Age graph for tigers at PTR



(viii) Abdomen Girth: Abdomen Girth data for male and female tigers is given in ***Table 3.A.8***. Abdomen Girth curves have been drawn against Age as shown in ***Figure 3.A.8.***

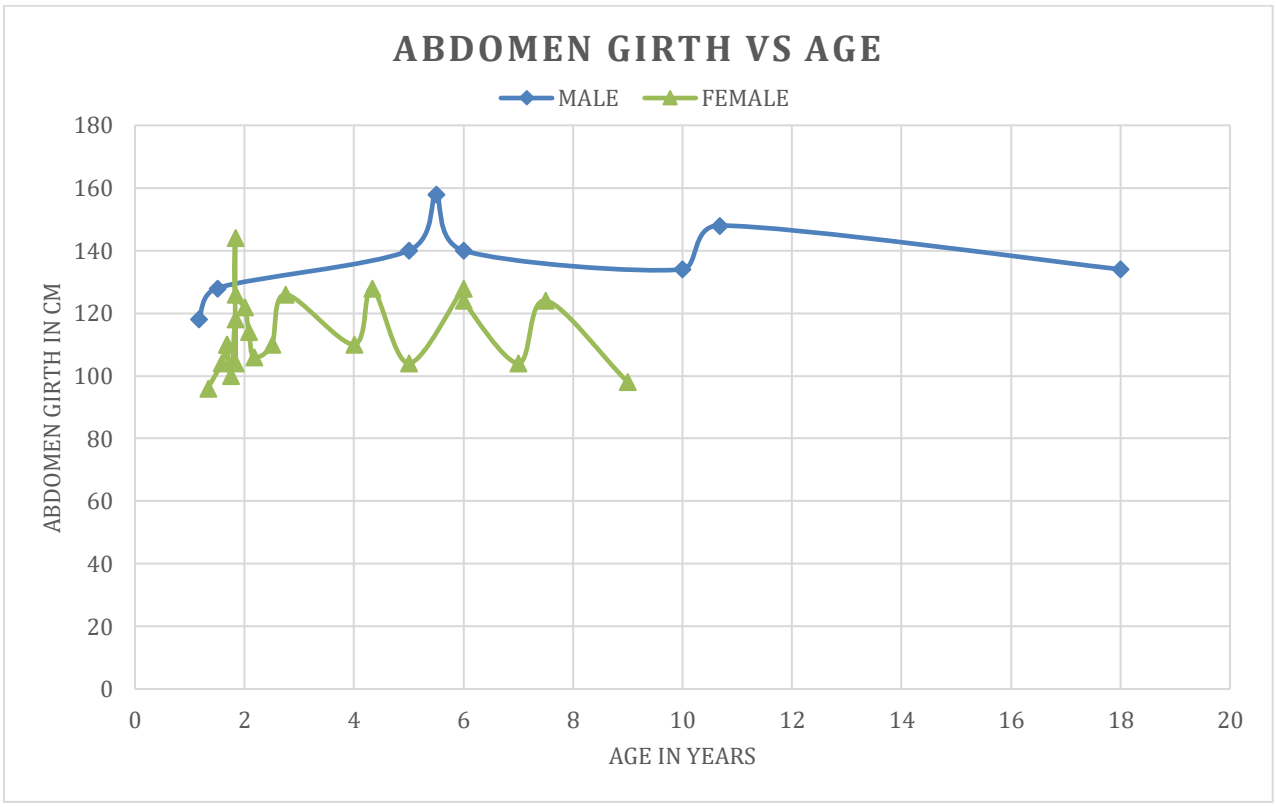
The result shows that Abdomen Girth of the male tiger is more compare to the female tiger in all the stages of its life. The graph shows that the male tiger Abdomen Girth remains stable at around 140 cm once it is attained at the age of 2 years. The female tiger Abdomen Girth remains stable at around 110-115 cm once it is attained at the age of 2 years.

Table 3.A.8

ABDOMEN GIRTH

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Abdomen girth cm	Age (in years)	Abdomen girth cm	Tiger ID
1	P-234 (31)	1.17	118	1.33	96	P-222
2	P-211	1.5	128	1.58	104	P-213
3	T-7	5	140	1.67	110	P-141
4	P-111	5.5	158	1.67	110	P-142
5	T-7	6	140	1.75	100	P-521
6	T-3	10	134	1.83	118	P-234
7	P-111	10.67	148	1.83	104	P-233
8	T-3	18	134	1.83	144	P-213 (22)
9				1.83	126	P-213 (23)
10				2	122	P-222
11				2.08	114	P-234
12				2.17	106	P-213 (63)
13				2.5	110	P-213
14				2.75	126	P-213 (23)
15				4	110	P-213 (32)
16				4.33	128	P-142
17				5	104	P-213
18				6	128	P-222
19				6	124	P-213 (22)
20				7	104	P-433
21				7.5	124	T-2
22				9	98	P-213

Figure 3.A.8: Abdomen Girth vs Age graph for tigers at PTR



(ix) Canine Length: There are four canine teeth in a tiger; two in the upper jaw and two in the lower jaw. In each jaw one is on the right side and the other is on the left side. Canines length data viz. upper right, upper left, lower right, and lower left, for male and female is given in ***Table 3.A.9, Table 3.A.10,Table 3.A.11, and Table 3.A.12*** respectively. Canine Length curves have been drawn against Age as shown in ***Figure 3.A.9***, ***Figure 3.A.10***, ***Figure 3.A.11***, and ***Figure 3.A.12*** respectively.

The results show that all canines follow the same pattern. Length of all canine teeth increases till the age of 2 years and stabilizes after that till the age of 8 years and falls after that. The size of male canine teeth is more compare to female canine teeth. The graph shows that size of the male upper right canine is maximum at around 6 cm in length while rest of the canines are of an average length of about little more than 5 cm after the age of 2 years. For females, the average length of all canine teeth is about equal to or a little less than 5 cm after the age of 2 years. For both male and female tigers after 8-9 years of age, the canine size starts reducing due to wear and tear.

Table 3.A.9

CANINE LENGTH - UPPER RIGHT

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Upper Canine R cm	Age (in years)	Upper Canine R cm	Tiger ID
1	P-234 (31)	1.17	2.5	1.67	5	P-142
2	P-213 (21)	1.33	2.8	1.83	4.5	P-234
5	P-121	1.67	5.6	1.83	4	P-233
6	P-121	1.83	5.6	1.83	5	P-213 (22)
7	T-7	5	6.5	1.83	5	P-213 (23)
9	P-111	5.5	5.2	2.08	4	P-234
10	T-7	6	6.5	2.17	4	P-213 (63)
11	P-111	8.83	6	2.5	4	P-213
12	P-111	10.67	3	2.75	5	P-213 (23)
13	T-3	15	4	4	4.5	P-213 (32)
14	T-3	18	3	5	5	P-213
15				6	5	P-213 (22)
16				7	5	P-433
17				7.5	5	T-2
18				9	4.5	P-213

***Figure 3.A.9*: Canine Length (upper right) vs Age graph for tigers at PTR**

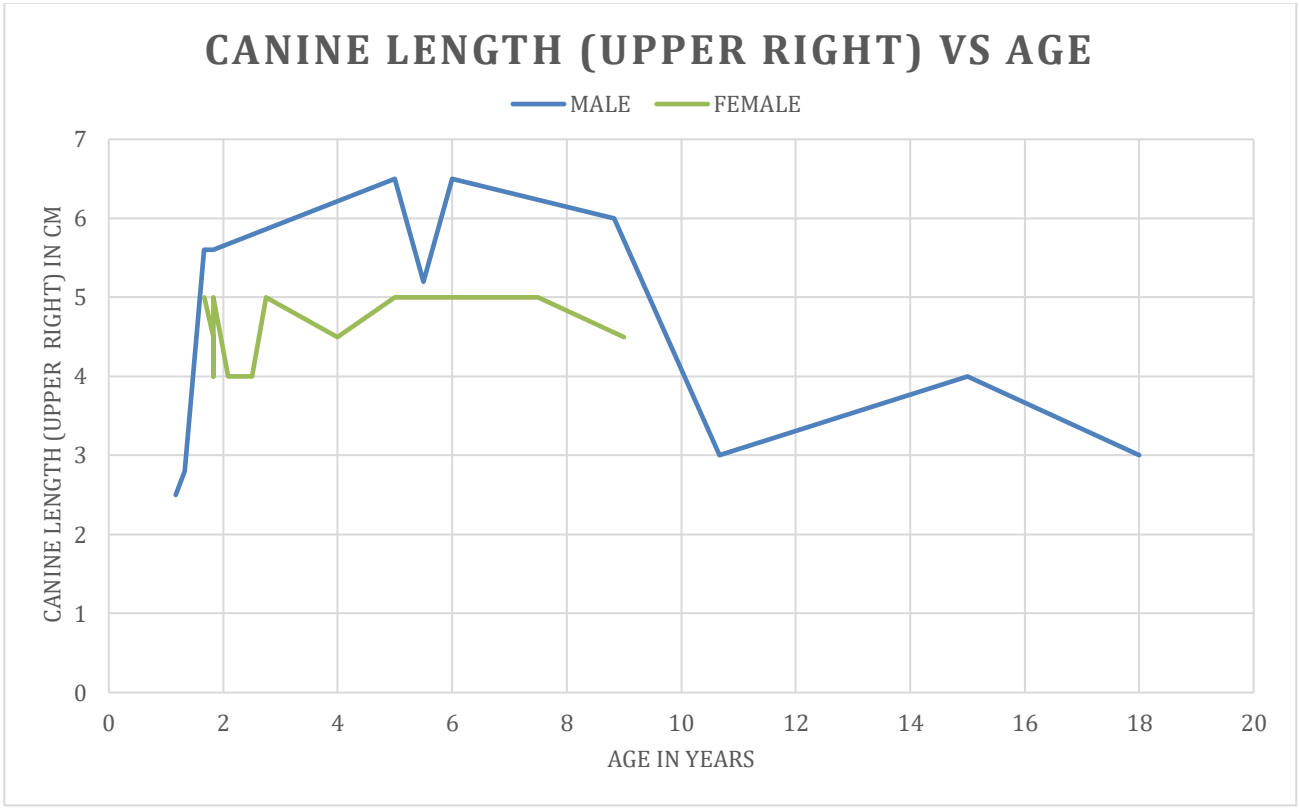


Table 3.A.10

CANINE LENGTH - UPPER LEFT

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Upper Canine L cm	Age (in years)	Upper Canine L cm	Tiger ID
1	P-234 (31)	1.17	2.5	1.67	4.5	P-142
2	P-213 (21)	1.33	3	1.83	4.5	P-234
5	P-121	1.67	5.7	1.83	4	P-233
6	P-121	1.83	5.7	1.83	5	P-213 (22)
7	T-7	5	5	1.83	4.7	P-213 (23)
9	P-111	5.5	5	2.08	4.5	P-234
10	T-7	6	5	2.17	4	P-213 (63)
11	P-111	8.83	4	2.5	4	P-213
12	P-111	10.67	3.5	2.75	4.7	P-213 (23)
13	T-3	15	3.5	4	5	P-213 (32)
14	T-3	18	3	5	5	P-213
15				6	5	P-213 (22)
16				7	4.5	P-433
17				7.5	5	T-2
18				9	4.5	P-213

Figure 3.A.10: Canine Length (upper left) vs Age graph for tigers at PTR

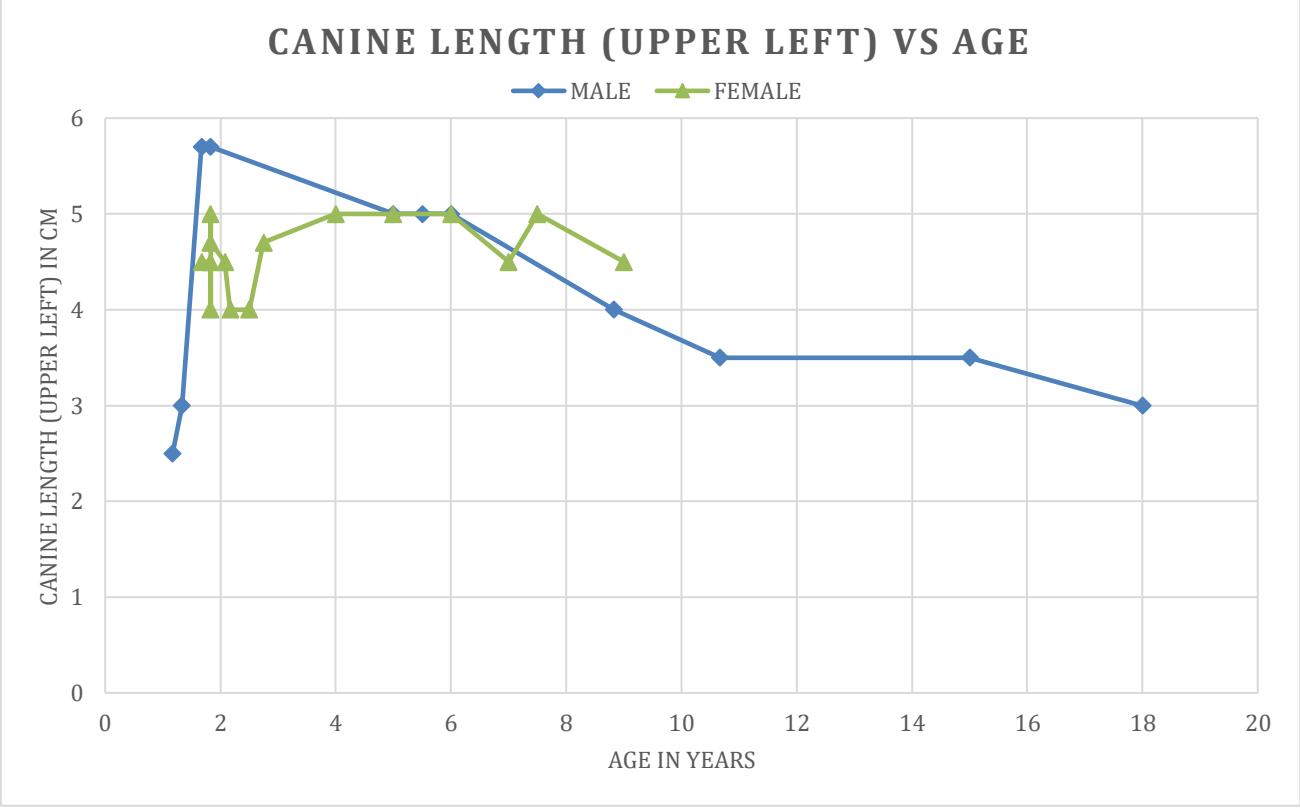


Table 3.A.11

CANINE LENGTH - LOWER RIGHT

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Lower Canine R cm	Age (in years)	Lower Canine R cm	Tiger ID
1	P-234 (31)	1.17	2	1.67	4.5	P-142
2	P-213 (21)	1.33	2.5	1.83	3.5	P-234
5	P-121	1.67	4.5	1.83	3.5	P-233
6	P-121	1.83	4.5	1.83	4	P-213 (22)
7	T-7	5	6.5	1.83	4.5	P-213 (23)
9	P-111	5.5	5	2.08	4	P-234
10	T-7	6	5.5	2.17	3.5	P-213 (63)
11	P-111	8.83	5	2.5	5	P-213
12	P-111	10.67	3	2.75	4.5	P-213 (23)
13	T-3	15	2.5	4	5	P-213 (32)
14	T-3	18	1.5	5	4	P-213
15				6	4	P-213 (22)
16				7	5	P-433
17				9	2	P-213

***Figure 3.A.11*: Canine Length (lower right) vs Age graph for tigers at PTR**

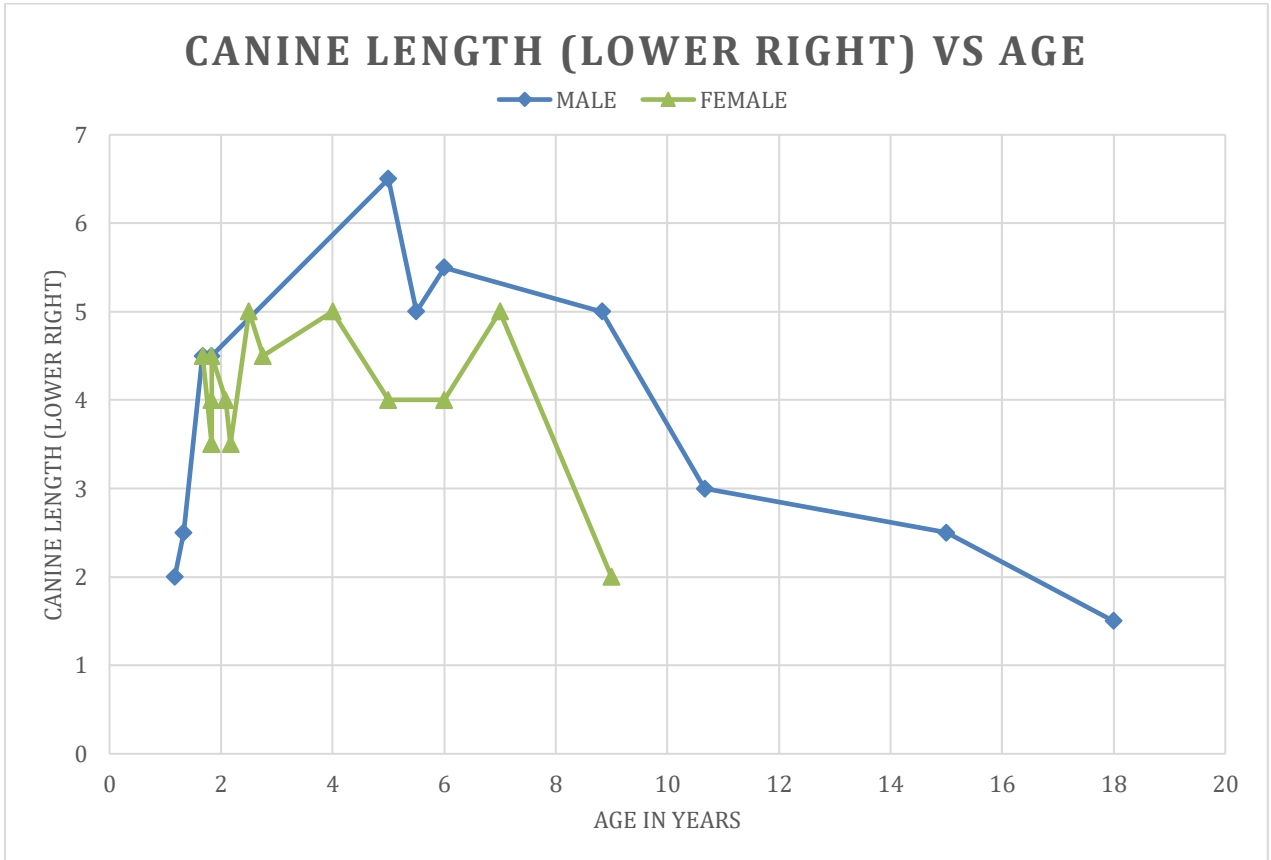
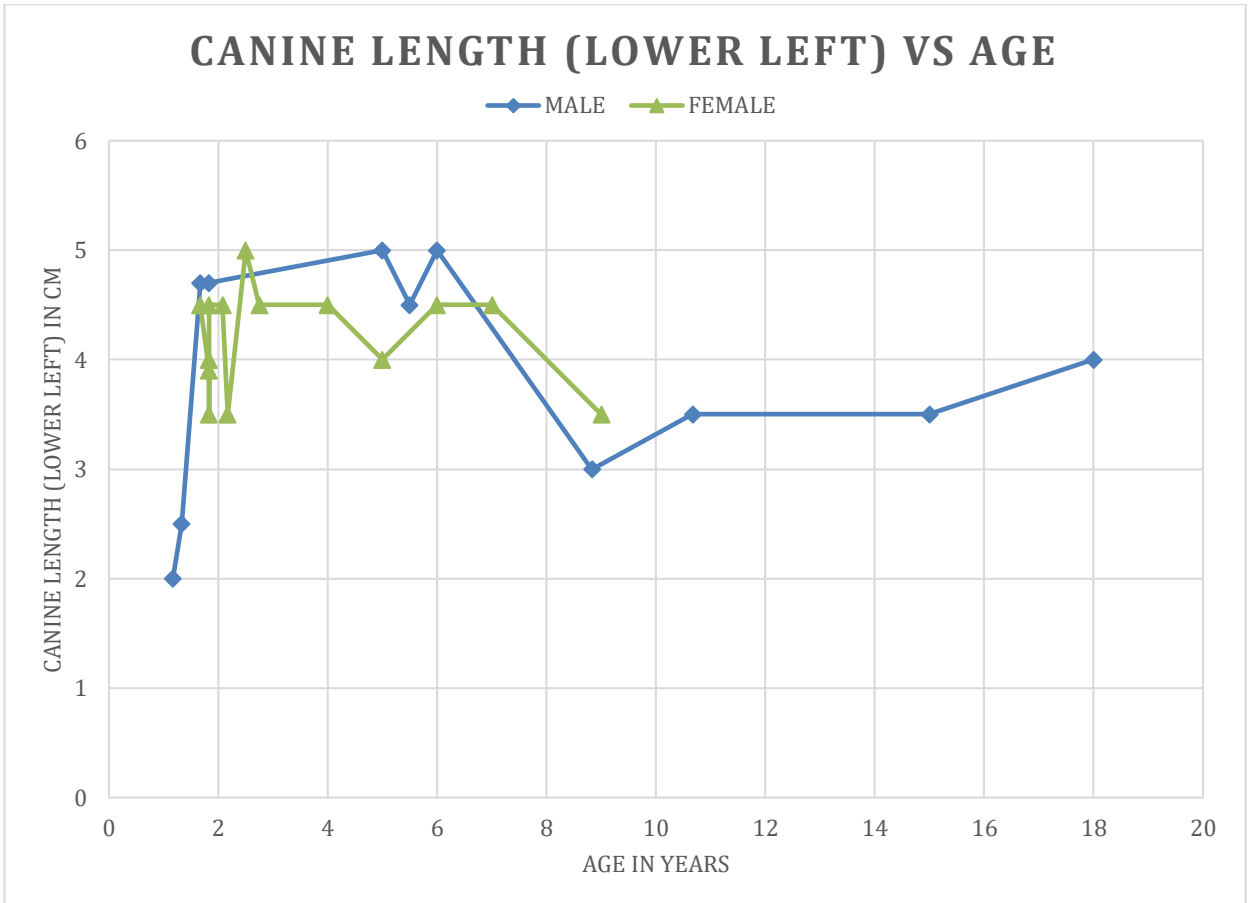


Table 3.A.12

CANINE LENGTH - LOWER LEFT

S.No.	MALE			FEMALE		
	Tiger ID	Age (in years)	Lower Canine L cm	Age (in years)	Lower Canine L cm	Tiger ID
1	P-234 (31)	1.17	2	1.67	4.5	P-142
2	P-213 (21)	1.33	2.5	1.83	3.9	P-234
5	P-121	1.67	4.7	1.83	3.5	P-233
6	P-121	1.83	4.7	1.83	4	P-213 (22)
7	T-7	5	5	1.83	4.5	P-213 (23)
9	P-111	5.5	4.5	2.08	4.5	P-234
10	T-7	6	5	2.17	3.5	P-213 (63)
11	P-111	8.83	3	2.5	5	P-213
12	P-111	10.67	3.5	2.75	4.5	P-213 (23)
13	T-3	15	3.5	4	4.5	P-213 (32)
14	T-3	18	4	5	4	P-213
				6	4.5	P-213 (22)
				7	4.5	P-433
				9	3.5	P-213

***Figure 3.A.12*: Canine Length (lower left) vs Age graph for tigers at PTR**



⇒ **Data collection from outside PTR:**

The tranquilization team of Panna under the leadership of veterinarian Dr. Sanjeev K Gupta has also performed eight tranquilization operations in other Tiger Reserves (five in Bandhavgarh Tiger Reserve, two in Nauradehi Sanctuary, and one in Sanjay Tiger Reserve) since the year 2012 till now and has collected data of physical characteristics of these eight tigers. Out of 8 tigers tranquilized two are female and six are male tigers. Details of this collected data are given in ***Table 3.A.13***. Physical characteristics data of these eight tigers spread in three different places mostly concur with the results obtained of these physical characteristics for the tigers in PTR as detailed above.

Table 3.A.13

MEASUREMENT OF PHYSICAL CHARACTERISTICS OF TIGER In other TIGER RESERVE

S.No.	Tranquilizing date	Tiger ID	Sex	Age	Body Measurement												
					Weight	Nose tip to Tail base cm	Tail base to tail tip cm	Total length cm	Neck girth cm	Collar girth cm	Shoulder height cm	Chest girth cm	Abdomen girth cm	Upper Canine R cm	Upper Canine L cm	Lower Canine R cm	Lower Canine L cm
1	07.06.2014	BT-04. (Bandhavgarh)	F	4 yrs 4 months	-	163	87	250	53	60	-	108	112	5	5	-	-
2	04.06.2020	N-01 N.W.S. Sagar (M.P.)	F	5 yrs 6 months	-	180	92	272	56	60	93	116	124	-	-	-	-
3	27.06.2012	BT-1 (Bandhavgarh)	M	2 yrs 6 months	120 kgs	-	66	-	67	-	-	-	-	-	-	-	-
4	02.01.2014	BT-1 (Bandhavgarh)	M	3 yrs 10 months	166 kgs	169	94	263	-	-	42	122	142	-	5	-	4
5	30.07.2014	SP-212 Satpura TR	M	3 yrs 9 months	199 kgs	151	90	241	70	-	-	124 .2	-	-	-	-	-
6	27.10.2014	T-01 (Bandhavgarh)	M	1 yr 6 months	158 kgs	190	91.8	281.8	76	-	-	106 .4	-	4.5	4.4	-	-
7	27.10.2014	T-02 (Bandhavgarh)	M	1 yr 6 months	164.9 kgs	187.5	101	288.5	74	-	-	124	-	4.9	4.3	-	-
8	11.11.2019	N-02 N.W.S. Sagar (M.P.)	M	5 yrs	-	200	100	300	74. 5	77	125	128	148	-	-	-	-

3. RESULTS AND DISCUSSION

B) Tranquilization Procedure: Tranquilization drugs, Induction time, Reversal time

The amount of tranquilization drugs required for tranquilization procedure depends on the purpose for which tranquilization is to be performed as different occasions will demand different duration of tranquilization. As for the purpose of rescue or surgery, the amount of tranquilization drugs required varies depending on the nature of rescue or surgery, but duration of tranquilization is normally more than compare to the purpose of Radio Collaring. Whatever may be the purpose of tranquilization procedure, the initial process of downing the animal is same for all the purposes, be it collaring or rescue or surgery. Analysis of different tranquilization drugs required for initial process of downing the animal and recovery drugs, has been done separately for two different purposes namely (i)Collaring (ii)Rescue / Surgery or both.

In PTR, for the purpose of performing tranquilization procedure on the tiger, tranquilizers drug Xylazine 100mg (1 ml volume contains 100mg of Xylazine) is used along with Dissociative anaesthetic drug Ketamine 100mg (1 ml volume contains 100mg of Ketamine). During the initial years, for Tranquilization Procedure, amount of Ketamine drug use was more than Xylazine but later since 2015, gain of experience has led to change in quantity of drugs used. Since 2015, a mixture of Xylazine and Ketamine in a proportion of 1.25 : 1 known as 'Hellabrunn mixture' has been effectively used in PTR. For reversal of tranquilizers and anaesthetic drugs, 'Yohimbine HCL 10mg' (1 ml volume contains 10mg of Yohimbine HCL) has been used as antagonist (antidote) drug. The tranquilizers and anaesthetic drugs have been administered by remote darting system by means of a 'Dan Inject' and a plastic syringe called 'Dart'. The well muscled area is commonly selected for darting. Antagonist drugs are administered through intramuscular injections to provide rapid recovery.

It has been observed that in every next tranquilization procedure performed on the same animal, amount of drugs used is more compare to last tranquilization of the same animal. Hence analysis has been done for the amount of drugs used, Induction time and Reversal time under two different conditions for male and female tiger separately:

(i) When all tranquilization procedures, irrespective of the fact whether animal has been tranquilized before or not, have been included. It has been referred as 'Repeats included'.

(ii) When repeat tranquilization of the same animal is not included, referred as 'Repeats are not included'.

Based on the purpose of performing tranquilization procedure on the tiger, following Paras discuss the results obtained for male and female tiger separately:

I. Tranquilization done for Collaring Purpose:

Starting from 22/09/2011, 60 times tiger tranquilization procedures have been performed on 30 individual tigers in PTR till now. Few tigers have been tranquilized more than once (5 times for tiger P111) at different age. 44 times tranquilizations have been performed for the purpose of radio-collaring/ de-collaring. Out of these 44 tranquilization procedures, 18 procedures have been performed on male tigers (7 individuals) and 26 procedures have been performed on female tigresses (14 individual). Analysis of tranquilization procedure has been done separately for male and female tiger, which is as following:

1. General Analysis

A) MALE TIGER

1. When repeats are included-

a) **From 2011 to 2014 (I Period)**: Average amount of Xylazine 100mg used (286.081 mg) was lower than Ketamine 100mg (351.583 mg) keeping other factors constant. Average Induction time was 31.6 minutes. Average amount of Reversal drug Yohimbine HCL 10mg was 58 mg (0.384 mg per kg body weight) with an average Reversal time of 23.9 minutes. Average weight of tranquilized tiger was 151.2 kg. Hence per unit body weight of tiger, Xylazine 100mg used was 1.89mg per kg and Ketamine 100mg used was 2.325 mg per kg. Hence ratio of Xylazine 100mg to Ketamine 100mg used was 1:1.22. Details are given in ***Table 3.B.1.***

b) From 2015 to 2021 (II Period): Average amount of Xylazine 100mg used (477.665 mg) was higher than Ketamine 100mg (390.9 mg) keeping other factors constant. Average Induction time was 35.6 minutes. Average amount of Reversal drug Yohimbine HCL 10mg was 107.5 mg (0.514 mg per kg body weight) with an average Reversal time of 16.75 minutes. Average weight of tranquilized tiger was 209.33 kg. Hence per unit body weight of tiger, Xylazine 100mg used was 2.281 mg per kg and Ketamine 100mg used was 1.867 mg per kg. Hence ratio of Xylazine 100mg to Ketamine 100mg used was 1.22 :1, which is close to 'Hellabrunn Mixture'. Details are given in ***Table 3.B.2.***

Analysis: following points emerge from above discussion:

i. **During I period,** average amount of Xylazine 100mg used was lower than Ketamine 100mg, their ratio based on average amount per unit body weight was = [Xylazine 100mg : Ketamine 100mg :: 1 : 1.22].**During II period, average** amount of Xylazine 100mg used was lower than Ketamine 100mg, their ratio

based on average amount per unit body weight was = [Xylazine 100mg :Ketamine 100mg :: 1.22: 1].

ii. **During I period,** per unit body weight of tiger, Xylazine 100mg used was 1.89 mg per kg and Ketamine 100mg used was 2.325 mg per kg. **During II period,** per unit body weight of tiger, Xylazine 100mg used was 2.281 mg per kg and Ketamine 100mg used was 1.867 mg per kg. which concludes that **total amount of drugs used per unit body weight (Xylazine 100mg + Ketamine 100mg), average around 4.181 mg, has remained same over the period of time**.

iii. **Induction time, nearly 33 minutes, remained more or less same in both the Periods.**

iv. Average amount of Reversal drug Yohimbine HCL 10mg used per unit body weight was nearly 50% more during II Period.

v. Use of 50% more Reversal drug Yohimbine HCL 10mg has led to 50% reduction in Reversal time. It reduced from 23.9 minutes to 16.7 minutes.

Table 3.B.1

Details of Tranquilization & Reversal Drugs used before Year 2014 (Male)

S.No.	Tranquilizing date	Tiger ID	Age	Ambient Temp.	Estimated Weight (in kg)	Xylazine 100 mg (in mg)	Ketamine 100 mg (in mg)	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
1	2	3	4	5	6	7	8	9	10	11
1	03.11.2011	T-3	9 yrs	22^0C	200	250	300	10	50	28
2	13.01.2012	P-111	1 yr 9 months	19^0C	130	180	370	45	45	43
3	23.03.2012	P-211	1 yr 6 months	24^0C	110	166.68	233.32	17	25	36
4	13.05.2012	P-212	1 yr 7 months	36^0C	113	194.45	155.56	10	40	13
5	30.09.2012	P-111	2 yrs 6 months	30^0C	140	250	350	24	50	16
6	03.11.2012	P-112	2 yrs 6 months	21^0C	180	444.56	606	60	80	21
7	13.01.2013	T-3	10 yrs	21^0C	200	444.56	556.46	73	90	22
8	22.03.2013	P-212	2 yrs 6 months	30^0C	120	277.75	222.2	11	60	21
9	12.11.2013	P-121	1 yr 8 months	24^0C	159	402.81	422.29	47	80	21
10	08.01.2014	P-121	1 yr 10 months	19^0C	160	250	300	19	60	18
Average					**151.2**	**286.081**	**351.583**	**31.6**	**58**	**23.9**
Per unit body weight (mg/kg body weight)						**1.892**	**2.325**			

Table 3.B.2

Details of Tranquilization & Reversal Drugs used from Year 2015 to 2021 (Male)

S.No.	Tranquilizing date	Tiger ID	Age	Ambient Temp.	Estimated Weight (in kg)	Xylazine 100 mg (in mg)	Ketamine 100 mg (in mg)	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
11	20.10.2015	P-111	5 yrs 6 months	27.6^{0}C	226.7	416	334	34	110	12
12	03.11.2015	T-7	5 yrs	28.6^{0}C	180	304	246	23	120	17
13	05.10.2016	T-7	6 yrs	33^{0}C	180	325	325	20	120	32
14	03.03.2019	P-111	8 yrs 10 months	25^{0}C	250	611.16	489	58	100	17
15	07.12.2020	P-111	10 yrs 8 months	28^{0}C	240	721.44	577.68	37	120	15
16	18.12.2020	T-3	18 yrs	20^{0}C	250	610.36	488.76	36	120	7
17	06.01.2021	P-234 (31)	1 yr 2 months	20^{0}C	120	333.36	266.76	45	70	13
18	20.05.2021	P-243	6 yrs	36^{0}C	228	500	400	32	100	21
Average					**209.34**	**477.665**	**390.9**	**35.6**	**107.5**	**16.7**
Per unit body weight (mg/kg body weight)						**2.281**	**1.867**			

2. **When Repeats are not included-** Data of 7 male tigers are available when they were tranquilized for the first time. As total amount of tranquilized drugs per unit weight (Xylazine 100mg + Ketamine 100mg) used remains constant irrespective of the fact whether Xylazine is more or Ketamine is more in the mixture, total amount of drugs used can be compared when repeats are included and when repeats are not included. Following results can be concluded:
   i. When tigers were tranquilized for the first time, total amount of drugs (Xylazine 100mg + Ketamine 100mg) used per unit weight is 3.4376 mg/kg (1.6216 mg/kg of Xylazine 100mg + 1.816 mg/kg of Ketamine 100mg), which is nearly 20% lower compared to when Repeats have been included (4.181 mg).
   ii. Induction time (28 minutes) is also slightly lower compare to when repeats are included (average around 32-33 minutes Induction time).
   iii. Average amount of Reversal drug Yohimbine HCL 10mg used per unit body weight was 0.311 mg, which is much lower compare to when Repeats were taken.
   iv. Use of less Reversal drug Yohimbine HCL 10mg has led to slight increase in Reversal time. It is around 19 minutes.

Table 3.B.3 gives detail of tranquilizer drugs used when a particular tiger was tranquilized for the first time.

Table 3.B.3

Details of Tranquilization & Reversal Drugs used (Male- no Repeat)

S.No.	Tiger ID	Age (in years)	Ambient Temp (in C)	xylazine per Kg body wt	Ketamine per Kg body wt	TOTAL Drug (col 5 + col 6)	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	P-111	1.75	19	1.385	2.846	**4.231**	45	45	43
2	P-112	2.5	21	2.470	3.367	**5.836**	60	80	21
3	P-121	1.66	24	2.533	2.656	**5.189**	47	80	21
4	P-211	1.5	24	1.515	2.121	**3.636**	17	25	36
5	P-212	1.58	36	1.721	1.377	**3.097**	10	40	13
6	P-234 (31)	1.17	20	2.778	2.223	**5.001**	45	70	13
7	P-243	6	36	2.193	1.754	**3.947**	32	100	21
Average		**3.35**		**1.6216**	**1.816**	**3.438**	**28**	**49**	**19**

3. **<u>Repeat tigers:</u>** Repeat Tranquilization data of 5 male tigers have been collected and analyzed. These five tigers have been tranquilized at different age for collaring/de-collaring purpose. ***Table 3.B.4*** gives detail of tranquilizer drugs used when a particular tiger was tranquilized for more than one time. Following can be concluded from data obtained:
    i. It can easily be seen that there is an increase in the amount of drugs used in every next attempt. The total amount of drugs used (Xylazine 100mg + Ketamine 100mg) is also higher than the average total drugs used (4.181 mg/kg).
    ii. Increase in amount of tranquilization drugs (Xylazine 100mg + Ketamine 100mg) leads to more amount of Reversal drug.

Table 3.B.4

Details of Tranquilization & Reversal Drugs used

(Male- Repeat Tigers)

S.No.	Tiger ID	Age (in years)	xylazine per Kg body wt	Ketamine per Kg body wt	TOTAL Drug (col 4 + col 5)	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
1	2	3	4	5	6	7	8	9
1	T-3	9	1.250	1.500	2.750	10	50	28
2	T-3	10	2.223	2.782	5.005	73	90	22
3	T-3	18	2.441	1.955	4.396	36	120	7
4	P-111	1.75	1.385	2.846	4.231	45	45	43
5	P-111	2.5	1.786	2.500	4.286	24	50	16
6	P-111	5.6	1.835	1.473	3.308	34	110	12
7	P-111	8.83	2.445	1.956	4.401	58	100	17
8	P-111	10.66	3.006	2.407	5.413	37	120	15
9	T-7	5	1.689	1.367	3.056	23	120	17
10	T-7	6	1.806	1.806	3.611	20	120	32
11	P-212	1.58	1.721	1.377	3.097	10	40	13
12	P-212	2.5	2.315	1.852	4.166	11	60	21
13	P-121	1.83	1.563	1.875	3.438	19	60	18
14	P-121	1.66	2.533	2.656	5.189	47	80	21

B) **FEMALE TIGRESS**

1. <u>When repeats are included-</u>

a) **From 2011 to 2015 (I Period)**: Average amount of Xylazine 100mg used (259.333 mg) was lower than Ketamine 100mg (283.251 mg) keeping other factors constant. Average Induction time was 27.6 minutes. Average amount of Reversal drug Yohimbine HCL 10mg was 53.571 mg (0.455 mg per kg body weight) with an average Reversal time of 19.9 minutes. Average weight of tranquilized tiger was 117.64 kg. Hence per unit body weight of tiger, Xylazine 100mg used was 2.205 mg per kg and Ketamine 100mg used was 2.410 mg per kg. Hence ratio of Xylazine 100mg to Ketamine 100mg used was 1 : 1.09. Details are given in ***Table 3.B.5.***

b) **From 2016 to 2021 (II Period):** Average amount of Xylazine 100mg used (361.17 mg) was higher than Ketamine 100mg (296.698 mg) keeping other factors constant. Average Induction time was 27.2 minutes. Average amount of Reversal drug Yohimbine HCL 10mg was 72.917 mg (0.622 mg per kg body weight) with an average Reversal time of 11.2 minutes. Average weight of tranquilized tiger was 117.25 kg. Hence per unit body weight of tiger, Xylazine 100mg used was 3.080 mg per kg and Ketamine 100mg used was 2.530 mg per kg. Hence ratio of Xylazine 100mg to Ketamine 100mg used was 1.22 : 1, which is close to 'Hellabrunn Mixture'. Details are given in ***Table 3.B.6.***

Analysis: following points emerge from above discussion:

i. **During I period,** average amount of Xylazine 100mg used was lower than Ketamine 100mg, their ratio based on average amount per unit body weight was = [Xylazine 100mg : Ketamine 100mg :: 1 : 1.09]. **During II period, average** amount of Xylazine 100mg used was lower than Ketamine 100mg, their ratio based on average amount per unit body weight was = [Xylazine 100mg : Ketamine 100mg :: 1.22: 1].

ii. **During I period,** per unit body weight of tiger, Xylazine 100mg used was 2.205 mg per kg and Ketamine 100mg used was 2.410 mg per kg. **Total amount of drugs (Xylazine 100mg + Ketamine 100mg) used per unit body weight, average around 4.615 mg.**

During II period, per unit body weight of tiger, Xylazine 100mg used was 3.080 mg per kg body weight and Ketamine 100mg used was 2.530 mg per kg

body weight. **Total amount of drugs used per unit body weight (Xylazine 100mg + Ketamine 100mg), average around 5.611 mg per kg body weight.**

Average total amount of drugs (Xylazine 100mg + Ketamine 100mg) used per unit body weight for both the periods is 5.112 mg/kg body weight.

Total amount of drugs used per unit body weight is nearly 20% more when HBM is used. The increase in amount is mainly on account of increased quantity of Xylazine 100mg, which is nearly 40% more compare to period I, while used quantity of Ketamine 100mg is more or less remained same (only 4% increase in Period II).

iii. **Induction time, nearly 27minutes, remained same in both the Periods.**

iv. Average amount of Reversal drug Yohimbine HCL 10mg used per unit body weight was nearly 36% more during II Period.

v. Use of 36% more Reversal drug Yohimbine HCL 10mg has led to nearly 45% reduction in Reversal time. It reduced from 19.9 minutes to 11.2 minutes.

Table 3.B.5

Details of Tranquilization & Reversal Drugs used before Year 2016 (Female)

S.No.	Tranquilizing date	Tiger ID	Age (in years)	Ambient Temp. 0C	Estimated Weight. (in Kg)	Xylazine 100 mg (in mg)	Ketamine 100 mg (in mg)	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
1	22.09.2011	T-1	5	25	140	200	350	27	40	48
2	23.09.2011	T-2	6	27	150	225	300	22	45	48
3	17.05.2012	P-213	1.58	41	87	166.68	183.35	10	40	18
4	21.05.2012	P-214	1.58	39	85	180.57	194.42	12	40	22
5	24.06.2012	T-4	6.75	37	106	222.23	327.78	17	45	20
6	31.01.2013	T-1	6.5	21	140	416.33	433.66	68	85	11
7	25.03.2013	P-213	2.4	34	100	222.2	277.76	10	45	17
8	10.03.2013	T-2	7.5	32	133	416.65	433.32	44	85	18
9	25.05.2014	P-222	2	42	110	225	225	8	45	16
10	03.06.2014	T-4	8.75	42	112.7	325	325	55	70	7
11	14.10.2015	P-213 (22)	1.83	30.3	129.5	278	222	24	55	11
12	16.10.2015	P-213 (23)	1.83	27.1	124.7	278	222	40	55	8
13	15.05.2015	P-234	1.83	39.9	126	275	275	43	60	25
14	24.05.2015	P-233	1.83	41	103	200	200	7	40	10
average					**117.636**	**259.333**	**283.521**	**27.6**	**53.571**	**19.9**
per unit body weight						**2.205**	**2.410**		**0.455**	

Table 3.B.6

Details of Tranquilization & Reversal Drugs used from Year 2016 to 2021 (Female)

S.No.	Tranquilizing date	Tiger ID	Age (in years)	Ambient Temp. 0C	Estimated Weight. (in Kg)	Xylazine 100 mg (in mg)	Ketamine 100 mg (in mg)	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
15	02.06.2016	P-141	1.67	40	85	389.12	311.92	60	90	15
16	03.06.2016	P-142	1.67	36	118	250	250	23	60	10
17	11.01.2017	P-521	1.75	16	94	200	200	2	40	17
18	06.12.2017	T-1	11	24	141	417.75	333.25	12	100	12
19	02.12.2018	P-151	2.33	23	126	304.78	244.23	18	65	9
20	25.11.2019	P-213	9	25	104	443.67	355.38	41	70	14
21	05.03.2019	P-142	4.33	26	152	388.12	310.92	33	70	15
22	15.03.2019	P-222	6	25	131	388.12	310.92	36	70	7
23	13.12.2020	P-213 (63)	2.16	24	116	388.12	310.92	29	80	12
24	11.02.2020	P-213 (32)	4	21	110	388.12	311	18	80	7
25	14.02.2020	P-213 (22)	6	21	130	388.12	310.92	28	80	8
26	19.09.2020	P-433	7	36	100	388.12	310.92	26	70	8
average					**117.25**	**361.17**	**296.698**	**27.2**	**72.917**	**11.2**
per unit body weight						**3.080**	**2.530**		**0.622**	

2. **When Repeats are not included-** Data of 14 female tigresses are available when they were tranquilized for the first time. Average amount of Xylazine 100mg used per unit body weight of tigress is 2.152 mg/kg and of Ketamine 100mg is 1.913 mg/kg. Total amount of tranquilized drugs (Xylazine 100mg + Ketamine 100mg) per unit weight used is 4.065 mg/kg. Average Induction time was 18.8 minutes. Average amount of Reversal drug Yohimbine HCL 10mg is 0.542 mg per kg body weight with an average Reversal time of 11 minutes. Average weight of tranquilized tiger was 89 kg. Ratio of Xylazine 100mg to Ketamine 100mg used was 1 :0.889. Following results can be concluded:

   i. When tigers were tranquilized for the first time, total amount of drugs (Xylazine 100mg + Ketamine 100mg) used per unit weight is 4.065 mg/kg (2.152 mg/kg of Xylazine 100mg + 1.913 mg/kg of Ketamine 100mg), which is 20% lower compared to when Repeats have been included (5.112 mg/kg).
   ii. Induction time (18.8 minutes) is nearly 33% lower compared to when Repeats have been included (27 minutes).
   iii. Average amount of Reversal drug Yohimbine HCL 10mg used per unit body weight is 0.541 mg/kg, which is nearly same compare to when Repeats were taken.
   iv. Reversal time of 11 minutes is slightly less even though same amount of Reversal drug Yohimbine HCL 10mg has been used.

Table 3.B.7 gives detail of tranquilizer drugs used when a particular tiger was tranquilized for the first time

Table 3.B.7

Details of Tranquilization & Reversal Drugs used (Female- no Repeat)

S.No.	Tiger ID	Age (in years)	Ambient temp.	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	TOTAL Drug in mg per Kg body wt (col 5 + col 6)	Induction time (in hrs)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	P-213	1.58	41	1.9159	2.1075	4.0233	0.167	40	18
2	P-214	1.58	39	2.1244	2.2873	4.4116	0.200	40	22
3	P-141	1.67	40	4.5779	3.6696	8.2475	1.000	90	15
4	P-142	1.67	36	2.1186	2.1186	4.2373	0.383	60	10
5	P-521	1.75	16	2.1277	2.1277	4.2553	0.033	40	17
6	P-213 (22)	1.83	30.3	2.1467	1.7143	3.8610	0.400	55	11
7	P-213 (23)	1.83	27.1	2.2294	1.7803	4.0096	0.667	55	8
8	P-233	1.83	41	1.9417	1.9417	3.8835	0.117	40	10
9	P-234	1.83	39.9	2.1825	2.1825	4.3651	0.717	60	25
10	P-222	2	42	2.0455	2.0455	4.0909	0.133	45	16
11	P-213 (63)	2.16	24	3.3459	2.6803	6.0262	0.483	80	12
12	P-151	2.33	23	2.4189	1.9383	4.3572	0.300	65	9
13	P-213 (32)	4	21	3.5284	2.8273	6.3556	0.300	80	7
14	P-433	7	36	3.8812	3.1092	6.9904	0.433	70	8
average		**2.99**		**2.15203**	**1.91354**	**4.06557**	**0.314 (18.8min)**	**48.24**	**11.06**

3. **<u>Repeat tigers:</u>** Repeat Tranquilization data of 11female tigresses have been collected and analyzed. These eleven tigresses have been tranquilized at different age for collaring/de-collaring purpose. ***Table 3.B.8*** gives detail of tranquilizer drugs used when a particular tigress was tranquilized for more than one time. Following can be concluded from data obtained:
    i. It can easily be seen that there is an increase in the amount of drugs used in every next attempt. The total amount of drugs (Xylazine 100mg + Ketamine 100mg) used in next attempt is also higher than the average total drugs used (5.112 mg/kg).
    ii. Increase in amount of tranquilization drugs (Xylazine 100mg + Ketamine 100mg) leads to more amount of Reversal drug

Table 3.B.8

Details of Tranquilization & Reversal Drugs used (Female- Repeat Tigers)

S.No.	Tiger ID	Age (in years)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	TOTAL Drug (col 4 + col 5)	Induction time (in min)	Yohimbine HCL 10 mg (in mg)	Reversal time (in min)
1	2	3	4	5	6	7	8	9
1	P-213	1.58	1.9158621	2.107471	4.023333	10	40	18
2	P-213	2.4	2.222	2.7776	4.9996	10	45	17
3	P-213	5	3.1619048	2.552381	5.714286	39	70	9
4	P-213	9	4.2660577	3.417115	7.683173	41	70	14
5	T-1	5	1.4285714	2.5	3.928571	27	40	48
6	T-1	6.5	2.9737857	3.097571	6.071357	68	85	11
7	T-1	11	2.962766	2.363475	5.326241	12	100	12
8	T-2	6	1.5	2	3.5	22	45	48
9	T-2	7.5	3.1327068	3.258045	6.390752	44	85	18
10	P-142	1.67	2.1186441	2.118644	4.237288	23	60	10
11	P-142	4.33	2.5534211	2.045526	4.598947	33	70	15
12	P-234	1.83	2.1825397	2.18254	4.365079	43	60	25
13	P-234	2.08	5.2419355	6.048387	11.29032	20	50	10
14	P-213 (22)	1.83	2.1467181	1.714286	3.861004	24	55	11
15	P-213 (22)	6	2.9855385	2.391692	5.377231	28	80	8
16	P-213 (23)	1.83	2.2293504	1.780273	4.009623	40	55	8
17	P-213 (23)	2.75	1.7857143	1.785714	3.571429	20	50	17
18	P-222	1.33	2.032561	2.236341	4.268902	21	33	8
19	P-222	2	2.0454545	2.045455	4.090909	8	45	16
20	P-222	6	2.9627481	2.373435	5.336183	36	70	7
21	T-4	6.75	2.0965094	3.092264	5.188774	17	45	20
22	T-4	8.75	2.8837622	2.883762	5.767524	55	70	7
23	P-433	1.5	2.5735294	2.573529	5.147059	8	40	12
24	P-433	7	3.8812	3.1092	6.9904	26	70	8
25	P-213 (33)	2	3.6619091	2.930364	6.592273	180	80	7
26	P-213 (33)	2.16	2.3083333	1.85	4.158333	8	70	13

C) **Comparing Female and Male Tiger:**

1. **<u>When repeats are included-</u>**

a) **From 2011 to 2014 (I Period)**:

⇒ **Drugs:**

Male tiger-Xylazine 100mg used per unit body weight is 1.89 mg per kg and Ketamine 100mg is 2.325 mg per kg. Average total amount of drugs used per unit body weight (Xylazine 100mg + Ketamine 100mg) is 4.181 mg per kg,

Female Tigress- Xylazine 100mg used per unit body weight is 2.205 mg per kg and Ketamine 100mg is 2.410 mg per kg. Average total amount of drugs (Xylazine 100mg + Ketamine 100mg) used per unit body weight is 4.615 mg, which is more compare to Male Tiger.

⇒ **Average Induction time**:

Male tiger- 31.6 minutes

Female Tigress- 27 minutes

⇒ **Reversal drug Yohimbine HCL 10mg:**

Male tiger- 0.384 mg per kg body weight

Female Tigress- 0.455 mg per kg body weight, which is more compare to Male Tiger.

⇒ **Reversal time**:

Male tiger- 23.9 minutes

Female Tigress- 19.9 minutes

b) From 2015 to 2021 (II Period):

⇒ **Drugs:**

Male tiger- Xylazine 100mg used per unit body weight is 2.281 mg per kg and Ketamine 100mg is 1.867 mg per kg. Average total amount of drugs used per unit body weight (Xylazine 100mg + Ketamine 100mg) is 4.181 mg per kg,

Female Tigress- Xylazine 100mg used per unit body weight is 3.080 mg per kg and Ketamine 100mg is 2.530 mg per kg. Average total amount of drugs (Xylazine 100mg + Ketamine 100mg) used per unit body weight is 5.611 mg, which is more compare to Male Tiger.

⇒ **Average Induction time**:

Male tiger- 35.6 minutes

Female Tigress- 27 minutes

⇒ **Reversal drug Yohimbine HCL 10mg:**

Male tiger- 0.514 mg per kg body weight

Female Tigress- 0.622 mg per kg body weight, which is more compare to Male Tiger.

⇒ **Reversal time**:

Male tiger- 16.75 minutes

Female Tigress- 11.2 minutes

2. **<u>When Repeats are not included-</u>**

⇒ **Drugs:**

Male tiger- Xylazine 100mg used per unit body weight is 1.6216 mg per kg and Ketamine 100mg is 1.816 mg per kg. Average total amount of drugs used per unit body weight (Xylazine 100mg + Ketamine 100mg) is 3.4376 mg per kg,

Female Tigress- Xylazine 100mg used per unit body weight is 2.152 mg per kg and Ketamine 100mg is 1.913 mg per kg. Average total amount of drugs (Xylazine 100mg + Ketamine 100mg) used per unit body weight is 4.065 mg, which is more compare to Male Tiger.

⇒ **Average Induction time**:

Male tiger- 28 minutes

Female Tigress- 18.8 minutes

⇒ **Reversal drug Yohimbine HCL 10mg:**

Male tiger- 0.311 mg per kg body weight

Female Tigress- 0.541 mg per kg body weight, which is more compare to Male Tiger.

⇒ **Reversal time**:

Male tiger- 19 minutes

Female Tigress- 11 minutes

2. Analysis of Effect of Ambient Temperature and Age on Required Quantity of Tranquilization Drugs and on Induction Time

In this section we will discuss the effect of ambient temperature at the time of tranquilization procedure and age of the tiger tranquilized on the requirement of tranquilization drugs, reversal drugs, Induction time and Reversal time, separately on male and female tigers. Again, the analysis has been done for the amount of drugs used, Induction time and Reversal time under two different conditions:

(i) When all tranquilization procedures, irrespective of the fact whether animal has been tranquilized before or not, have been included. It has been referred as 'Repeats included'.

(ii) When repeat tranquilization of the same animal is not included, referred as 'Repeats are not included'.

Detail analysis is as following:

I. EFFECT OF 'AMBIENT TEMERATURE'

A) MALE TIGER

(i) **Repeats included:** The effect of ambient temperature on amount of tranquilization drugs used is shown in ***Figure 3.B.1*** and ***Table 3.B.9***. It can be observed that increasing ambient temperature is leading to slightly decrease in quantity of both the tranquilization drugs i.e. Xylazine and Ketamine and hence decrease in use of total amount of drugs. Similarly, there is a drop in Induction time as ambient temperature increases. Though the drop in quantity or Induction time is not very much, but it can be concluded that increase in ambient temperature will lead to drop in required quantity of tranquilization drugs as well as Induction time.

Figure 3.B.1: Ambient Temperature vs Xylazine, Ketamine and Induction time (Male-with Repeat)

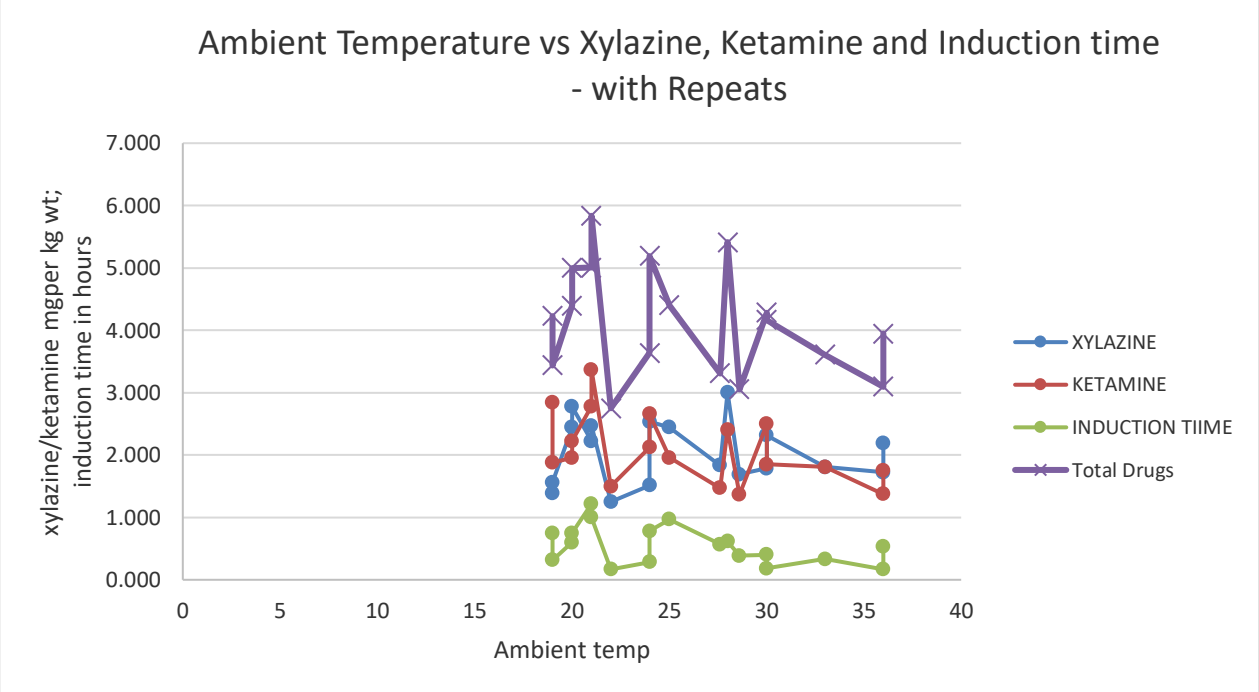


Table 3.B.9

Ambient Temperature vs Xylazine, Ketamine and Induction time (Male-with Repeat)

S.No.	Ambient Temp (in °C)	Age (in years)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total drugs in mg per kg body wt	Induction time (in hrs)
1	19	1.75	1.385	2.846	4.231	0.75
2	19	1.83	1.563	1.875	3.438	0.32
3	20	18	2.441	1.955	4.396	0.60
4	20	1.17	2.778	2.223	5.001	0.75
5	21	10	2.223	2.782	5.005	1.22
6	21	2.5	2.470	3.367	5.836	1.00
7	22	9	1.250	1.500	2.750	0.17
8	24	1.5	1.515	2.121	3.636	0.28
9	24	1.66	2.533	2.656	5.189	0.78
10	25	8.83	2.445	1.956	4.401	0.97
11	27.6	5.6	1.835	1.473	3.308	0.57
12	28	10.66	3.006	2.407	5.413	0.62
13	28.6	5	1.689	1.367	3.056	0.38
14	30	2.5	1.786	2.500	4.286	0.40
15	30	2.5	2.315	1.852	4.166	0.18
16	33	6	1.806	1.806	3.611	0.33
17	36	1.58	1.721	1.377	3.097	0.17
18	36	6	2.193	1.754	3.947	0.53

(ii) **Repeats not included:** The effect of ambient temperature on amount of tranquilization drugs used is shown in ***Figure 3.B.2*** and ***Table 3.B.10***. It can be observed that increasing ambient temperature is leading to slightly decrease in quantity of both the tranquilization drugs i.e. Xylazine and Ketamine and hence decrease in use of total amount of drugs. Similarly, there is a drop in Induction time as ambient temperature increases. It can be concluded that increase in ambient temperature will lead to drop in required quantity of tranquilization drugs as well as Induction time.

Figure 3.B.2: Ambient Temperature vs Xylazine, Ketamine and Induction time (Male- No Repeat)

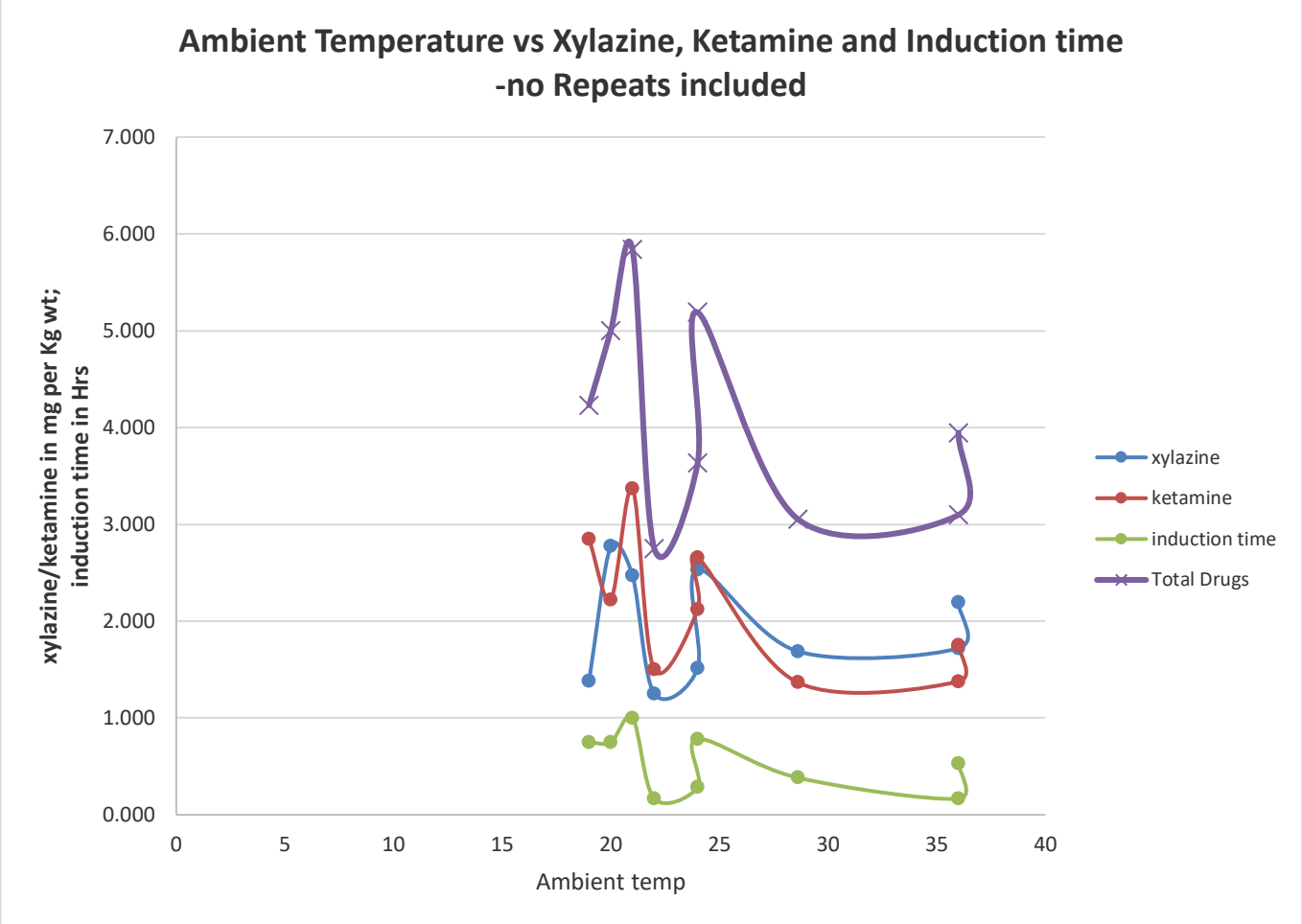


Table 3.B.10

Ambient Temperature vs Xylazine, Ketamine and Induction time (Male- No Repeat)

S.No.	Tiger ID	Age (in years)	Ambient Temp (in °C)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total drugs in mg per kg body wt	Induction time (in hrs)
1	P-111	1.75	19	1.385	2.846	4.231	0.750
2	P-234 (31)	1.17	20	2.778	2.223	5.001	0.750
3	P-112	2.5	21	2.470	3.367	5.836	1.000
4	T-3	9	22	1.250	1.500	2.750	0.167
5	P-211	1.5	24	1.515	2.121	3.636	0.283
6	P-121	1.66	24	2.533	2.656	5.189	0.783
7	T-7	5	28.6	1.689	1.367	3.056	0.383
8	P-212	1.58	36	1.721	1.377	3.097	0.167
9	P-243	6	36	2.193	1.754	3.947	0.533

B) FEMALE TIGRESS

(i) **Repeats included:** The effect of ambient temperature on amount of tranquilization drugs used is shown in ***Figure 3.B.3*** and ***Table 3.B.11***. It can be observed that increasing ambient temperature is having no significant effect on quantity of both the tranquilization drugs i.e. Xylazine and Ketamine. Similarly, there is a no significant effect on Induction time as ambient temperature increases. It can be concluded that increase in ambient temperature will have no significant effect on required quantity of tranquilization drugs as well as Induction time.

Figure 3.B.3: Ambient Temperature vs Xylazine, Ketamine and Induction time (Female-with Repeats)

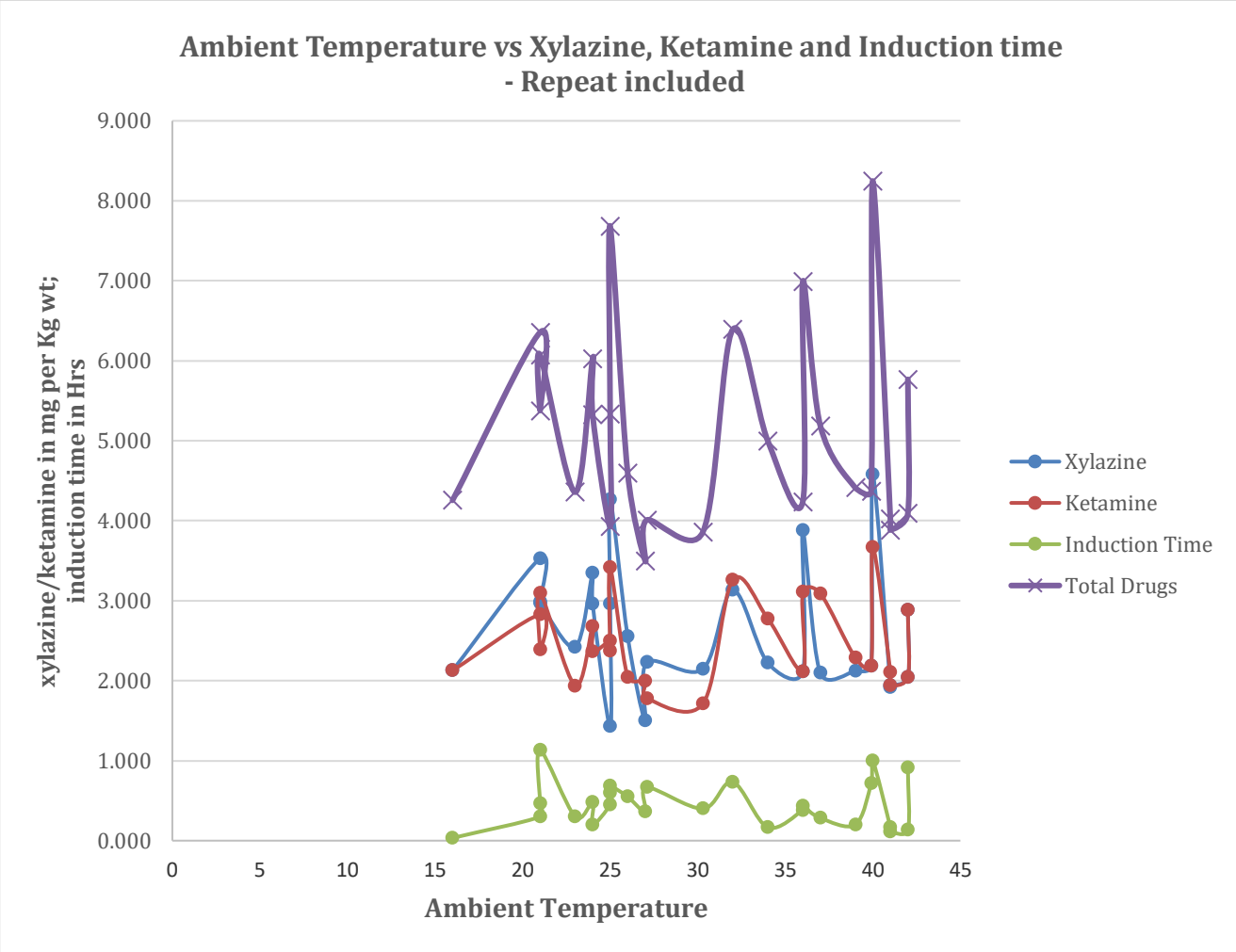


Table 3.B.11

Ambient Temperature vs Xylazine, Ketamine and Induction time (Female-with Repeat)

S.No.	Ambient temperature (in °c)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total drugs in mg per Kg body wt	Induction time (in Hrs)
1	16	2.128	2.128	4.255	0.03
2	21	3.528	2.827	6.356	0.30
3	21	2.986	2.392	5.377	0.47
4	21	2.974	3.098	6.071	1.13
5	23	2.419	1.938	4.357	0.30
6	24	3.346	2.680	6.026	0.48
7	24	2.963	2.363	5.326	0.20
8	25	1.429	2.500	3.929	0.45
9	25	2.963	2.373	5.336	0.60
10	25	4.266	3.417	7.683	0.68
11	26	2.553	2.046	4.599	0.55
12	27	1.500	2.000	3.500	0.37
13	27.1	2.229	1.780	4.010	0.67
14	30.3	2.147	1.714	3.861	0.40
15	32	3.133	3.258	6.391	0.73
16	34	2.222	2.778	5.000	0.17
17	36	2.119	2.119	4.237	0.38
18	36	3.881	3.109	6.990	0.43
19	37	2.097	3.092	5.189	0.28
20	39	2.124	2.287	4.412	0.20
21	39.9	2.183	2.183	4.365	0.72
22	40	4.578	3.670	8.248	1.00
23	41	1.916	2.107	4.023	0.17
24	41	1.942	1.942	3.883	0.12
25	42	2.045	2.045	4.091	0.13
26	42	2.884	2.884	5.768	0.92

(ii) **Repeat not included:** The effect of ambient temperature on amount of tranquilization drugs used is shown in ***Figure 3.B.4*** and ***Table 3.B.12***. It can be observed that increasing ambient temperature is having no significant effect on quantity of both the tranquilization drugs i.e. Xylazine and Ketamine. Similarly, there is a no significant effect on Induction time as ambient temperature increases. It can be concluded that increase in ambient temperature will have no significant effect on required quantity of tranquilization drugs as well as Induction time.

Figure 3.B.4: Ambient Temperature vs Xylazine, Ketamine and Induction time (Female-No Repeats)

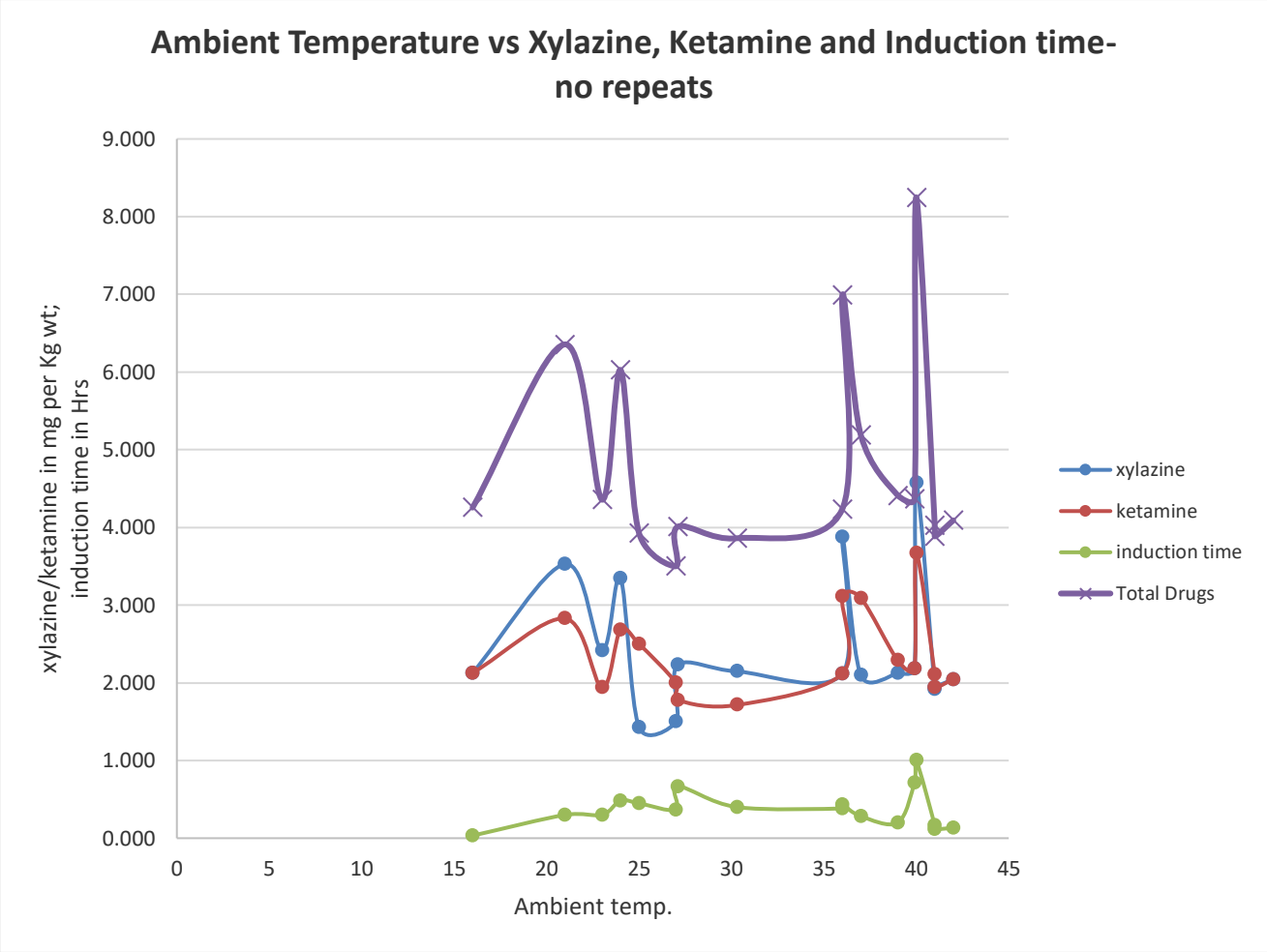


Table 3.B.12

Ambient Temperature vs Xylazine, Ketamine and Induction time (Female-No Repeat)

S.No.	Tiger ID	Age (in years)	Ambient temp. (in ° C)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total Drugs in mg per Kg body wt	Induction time (in hrs)
1	P-521	1.75	16	2.128	2.128	4.255	0.033
2	P-213 (32)	4	21	3.528	2.827	6.356	0.300
3	P-151	2.33	23	2.419	1.938	4.357	0.300
4	P-213 (63)	2.16	24	3.346	2.680	6.026	0.483
5	T-1	5	25	1.429	2.500	3.929	0.450
6	T-2	6	27	1.500	2.000	3.500	0.367
7	P-213 (23)	1.83	27.1	2.229	1.780	4.010	0.667
8	P-213 (22)	1.83	30.3	2.147	1.714	3.861	0.400
9	P-142	1.67	36	2.119	2.119	4.237	0.383
10	P-433	7	36	3.881	3.109	6.990	0.433
11	T-4	6.75	37	2.097	3.092	5.189	0.283
12	P-214	1.58	39	2.124	2.287	4.412	0.200
13	P-234	1.83	39.9	2.183	2.183	4.365	0.717
14	P-141	1.67	40	4.578	3.670	8.248	1.000
15	P-213	1.58	41	1.916	2.107	4.023	0.167
16	P-233	1.83	41	1.942	1.942	3.883	0.117
17	P-222	2	42	2.045	2.045	4.091	0.133

II. EFFECT OF 'AGE'

A) MALE TIGERS

(i) **Repeats included-**The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.5*** and ***Table 3.B.13***. It can be observed that increase in age of animal is having no significant effect on quantity of both the tranquilization drugs i.e. Xylazine and Ketamine. Similarly, there is a no significant effect on Induction time as age of animal increases. It can be concluded that increase in age will have no significant effect on required quantity of tranquilization drugs as well as Induction time.

Figure 3.B.5: Age vs Xylazine, Ketamine and Induction time (Male-with Repeat)

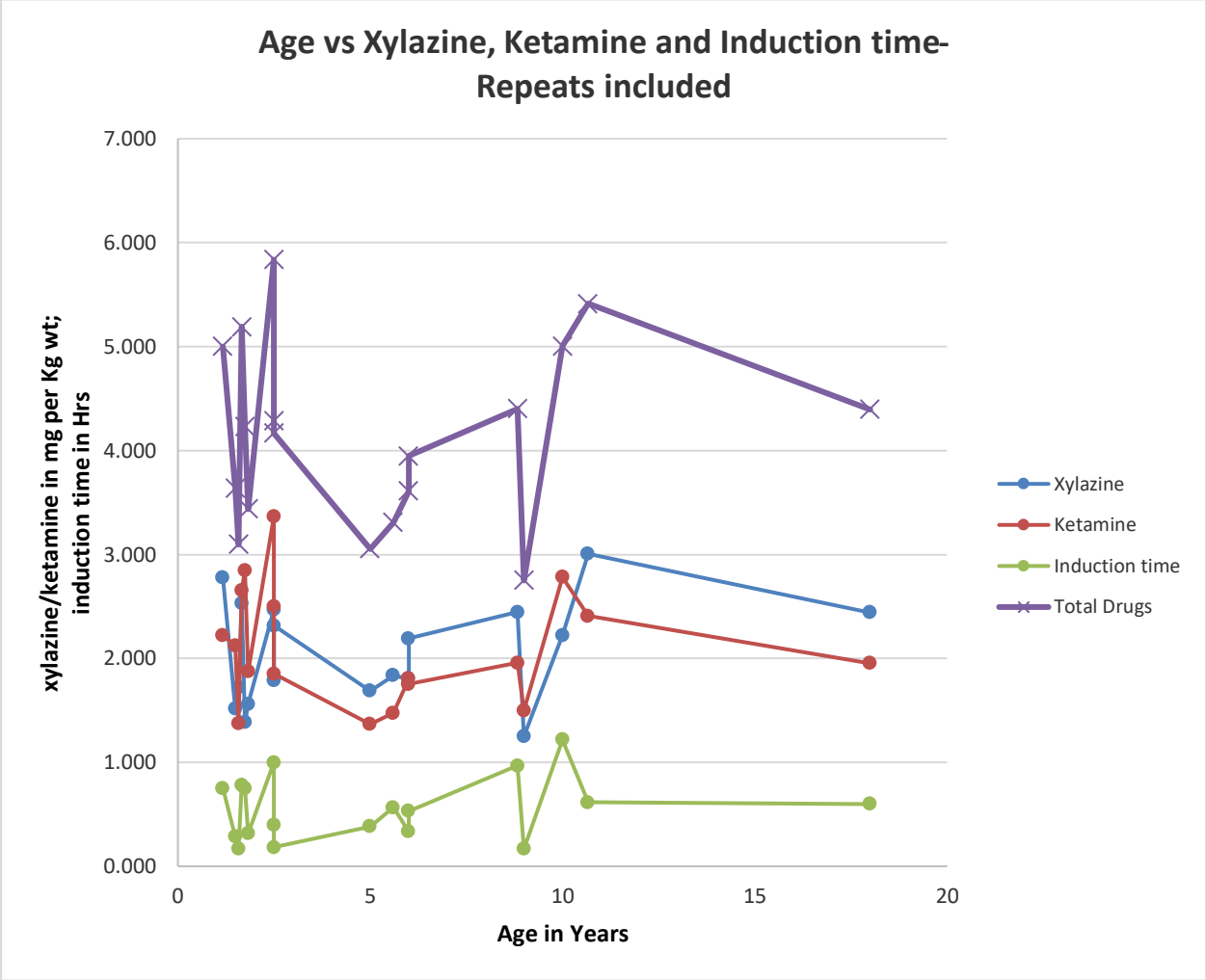


Table 3.B.13

Age vs Xylazine, Ketamine and Induction time (Male-with Repeat)

S.No.	Age (in years)	Xylazine in mg per Kg body wt	Ketamine in mgper Kg body wt	Total Drugs in mgper Kg body wt	Induction time (in hrs)
1	1.17	2.778	2.223	5.001	0.75
2	1.5	1.515	2.121	3.636	0.28
3	1.58	1.721	1.377	3.097	0.17
4	1.66	2.533	2.656	5.189	0.78
5	1.75	1.385	2.846	4.231	0.75
6	1.83	1.563	1.875	3.438	0.32
7	2.5	2.470	3.367	5.836	1.00
8	2.5	1.786	2.500	4.286	0.40
9	2.5	2.315	1.852	4.166	0.18
10	5	1.689	1.367	3.056	0.38
11	5.6	1.835	1.473	3.308	0.57
12	6	1.806	1.806	3.611	0.33
13	6	2.193	1.754	3.947	0.53
14	8.83	2.445	1.956	4.401	0.97
15	9	1.250	1.500	2.750	0.17
16	10	2.223	2.782	5.005	1.22
17	10.66	3.006	2.407	5.413	0.62
18	18	2.441	1.955	4.396	0.60

(ii) **Repeats not included-**The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.6*** and ***Table 3.B.14***. It can be observed that for the first timers, animal with more age requires less quantity of both the tranquilization drugs i.e. Xylazine and Ketamine. Similarly, animal with more age has less Induction time.

Figure 3.B.6: Age vs Xylazine, Ketamine and Induction time (Male- No Repeats)

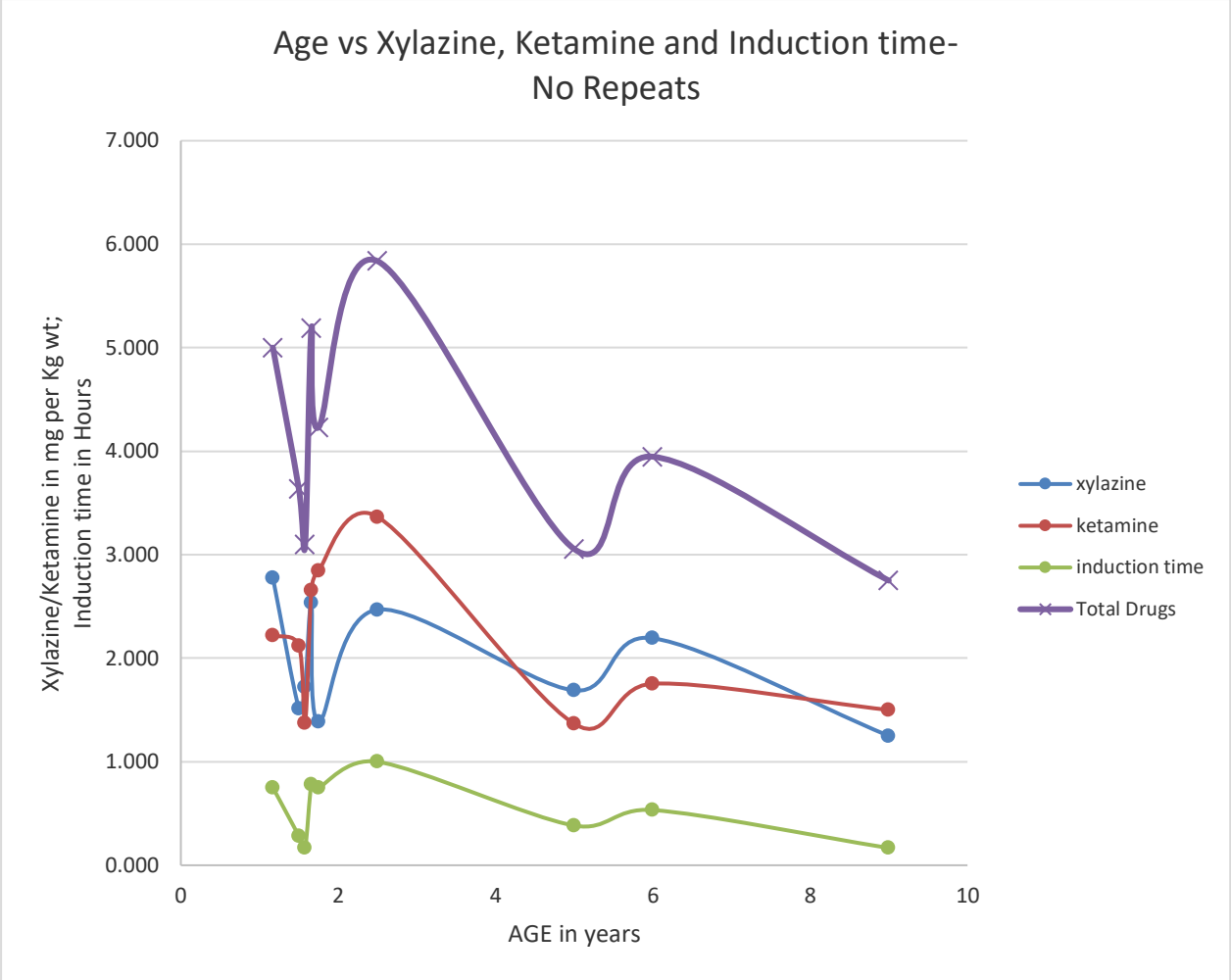


Table 3.B.14

Age vs Xylazine, Ketamine and Induction time (Male-No Repeat)

S.No.	Tiger ID	Age (in years)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total Drugs in mg per Kg body wt	Induction time (in min)
1	P-234 (31)	1.17	2.778	2.223	5.001	0.750
2	P-211	1.5	1.515	2.121	3.636	0.283
3	P-212	1.58	1.721	1.377	3.097	0.167
4	P-121	1.66	2.533	2.656	5.189	0.783
5	P-111	1.75	1.385	2.846	4.231	0.750
6	P-112	2.5	2.470	3.367	5.836	1.000
7	T-7	5	1.689	1.367	3.056	0.383
8	P-243	6	2.193	1.754	3.947	0.533
9	T-3	9	1.250	1.500	2.750	0.167

B) FEMALE TIGRESSES

(i) **Repeats included:** The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.7*** and ***Table 3.B.15***. It can be observed that increase in age of animal is having no significant effect on quantity of both the tranquilization drugs i.e. Xylazine and Ketamine. Similarly, there is a no significant effect on Induction time as age of animal increases. It can be concluded that increase in age will have no significant effect on required quantity of tranquilization drugs as well as Induction time.

Figure 3.B.7: Age vs Xylazine, Ketamine and Induction time (Female- with Repeats)

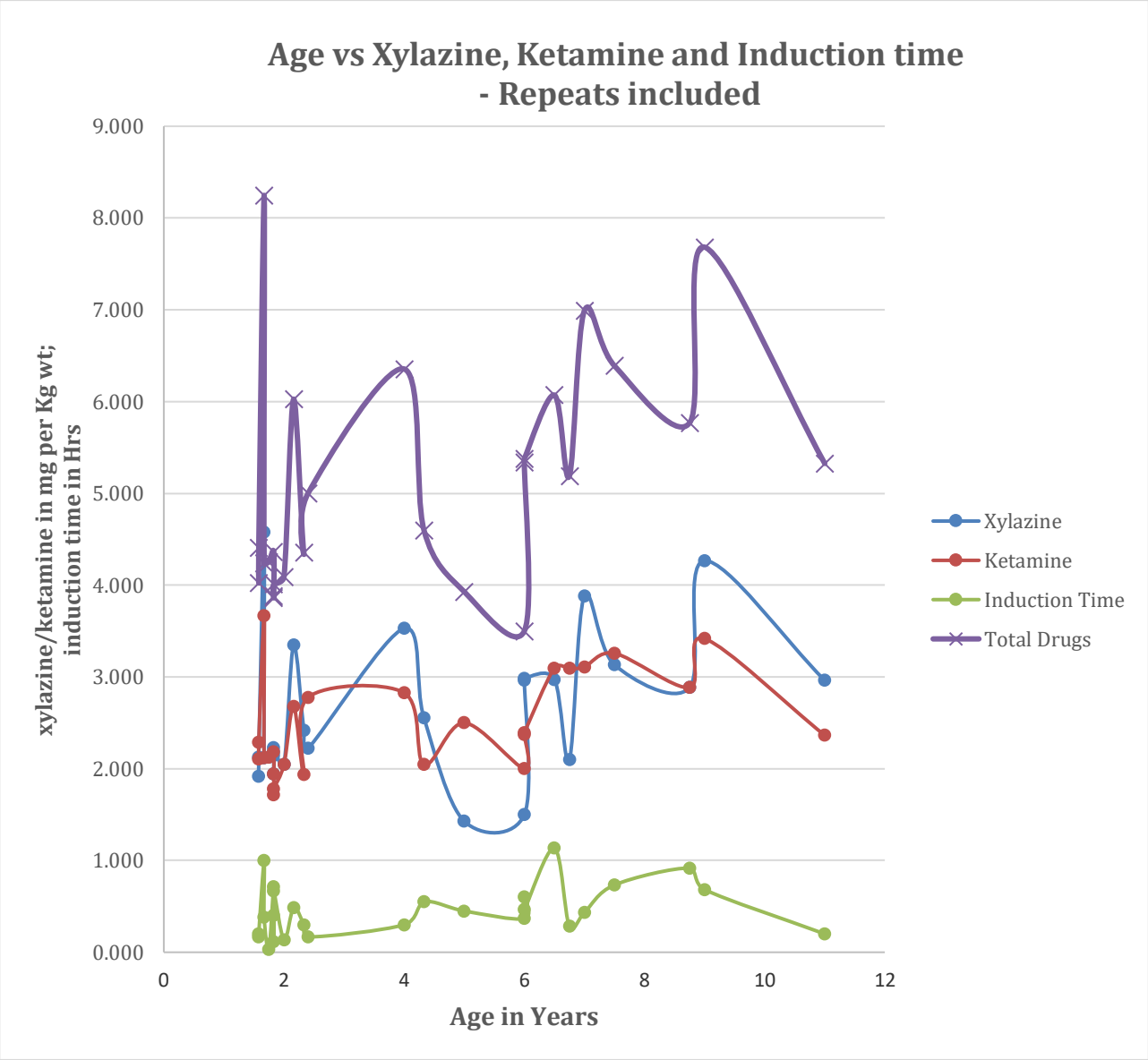


Table 3.B.15

Age vs Xylazine, Ketamine and Induction time (Female-with Repeat)

S.No.	Age 9 (in years)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total Drugs in mg per Kg body wt	Induction time (in Hrs)
1	1.58	1.916	2.107	4.023	0.17
2	1.58	2.124	2.287	4.412	0.20
3	1.67	4.578	3.670	8.248	1.00
4	1.67	2.119	2.119	4.237	0.38
5	1.75	2.128	2.128	4.255	0.03
6	1.83	2.183	2.183	4.365	0.72
7	1.83	1.942	1.942	3.883	0.12
8	1.83	2.147	1.714	3.861	0.40
9	1.83	2.229	1.780	4.010	0.67
10	2	2.045	2.045	4.091	0.13
11	2.16	3.346	2.680	6.026	0.48
12	2.33	2.419	1.938	4.357	0.30
13	2.4	2.222	2.778	5.000	0.17
14	4	3.528	2.827	6.356	0.30
15	4.33	2.553	2.046	4.599	0.55
16	5	1.429	2.500	3.929	0.45
17	6	1.500	2.000	3.500	0.37
18	6	2.963	2.373	5.336	0.60
19	6	2.986	2.392	5.377	0.47
20	6.5	2.974	3.098	6.071	1.13
21	6.75	2.097	3.092	5.189	0.28
22	7	3.881	3.109	6.990	0.43
23	7.5	3.133	3.258	6.391	0.73
24	8.75	2.884	2.884	5.768	0.92
25	9	4.266	3.417	7.683	0.68
26	11	2.963	2.363	5.326	0.20

(ii) **Repeats not included-**The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.8*** and ***Table 3.B.16***. It can be observed that increase in age of animal is having no significant effect on quantity of both the tranquilization drugs i.e. Xylazine and Ketamine. Similarly, there is a no significant effect on Induction time as age of animal increases. It can be concluded that increase in age will have no significant effect on required quantity of tranquilization drugs as well as Induction time.

Figure 3.B.8: Age vs Xylazine, Ketamine and Induction time (Female- No Repeats)

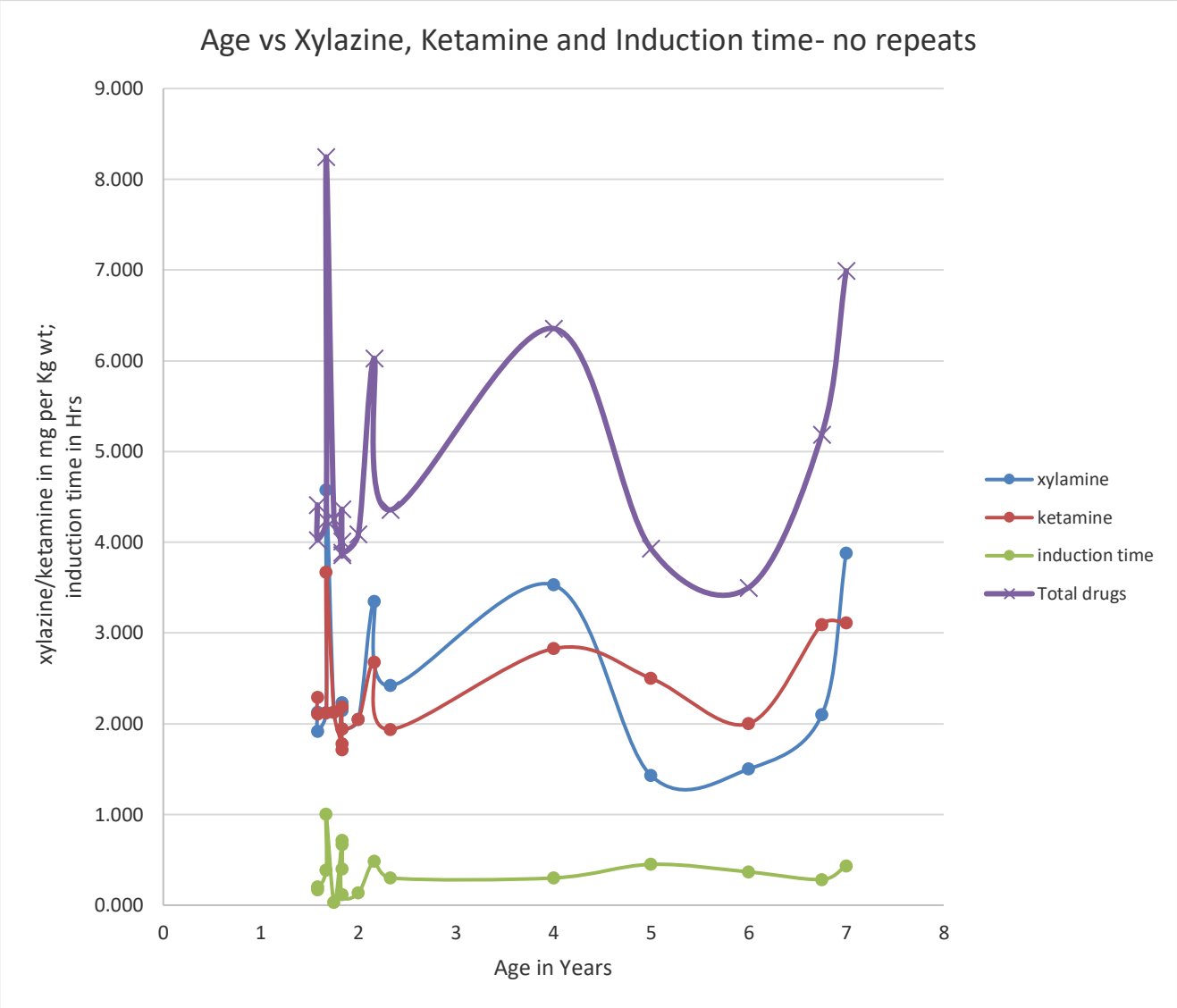


Table 3.B.16

Age vs Xylazine, Ketamine and Induction time (Female-No Repeat)

S.No.	Tiger ID	Age (in years)	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total Drugs in mg per Kg body wt	Induction time (in hrs)
1	P-214	1.58	2.124	2.287	4.412	0.200
2	P-213	1.58	1.916	2.107	4.023	0.167
3	P-142	1.67	2.119	2.119	4.237	0.383
4	P-141	1.67	4.578	3.670	8.248	1.000
5	P-521	1.75	2.128	2.128	4.255	0.033
6	P-213 (23)	1.83	2.229	1.780	4.010	0.667
7	P-213 (22)	1.83	2.147	1.714	3.861	0.400
8	P-234	1.83	2.183	2.183	4.365	0.717
9	P-233	1.83	1.942	1.942	3.883	0.117
10	P-222	2	2.045	2.045	4.091	0.133
11	P-213 (63)	2.16	3.346	2.680	6.026	0.483
12	P-151	2.33	2.419	1.938	4.357	0.300
13	P-213 (32)	4	3.528	2.827	6.356	0.300
14	T-1	5	1.429	2.500	3.929	0.450
15	T-2	6	1.500	2.000	3.500	0.367
16	T-4	6.75	2.097	3.092	5.189	0.283
17	P-433	7	3.881	3.109	6.990	0.433

3. Analysis of Effect of Age on Quantity required of Reversal Drugs and on Reversal Time

➢ **REVERSAL DRUGS:**

Reversal or Antagonistic drugs are useful to reverse the aneaesthetic effects of tranquilizers after completion of procedures on tigers. The drug should be able to antagonize the anaesthetic effects, suitable to tiger and return the tiger more quickly to physiological normalcy. It should help to recover from anaesthesia as and when required. There are several antagonist drugs but PTR has used alpha 2-adrenergic antagonist Yohimbine HCL 10 mg (1 ml volume contains 10 mg of Yohimbine HCL). Antagonist drugs are administered through intramuscular injections to provide rapid recovery. Effect of age of tiger on amount of Reversal (or Antagonist) drugs has been analyzed for male and female tiger separately in following Paras:

I. AGE VS REVERSAL DRUG AND REVERSAL TIME

A) MALE TIGER:

i. With Repeats: The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.9*** and ***Table 3.B.17***. Though there seems to be an inverse relation between amount of reversal drugs and reversal time (more reversal drug leading to less reversal time), there is no clear relation between age and amount of reversal drug or reversal time.

Figure 3.B.9: Age vs Reversal drug and Reversal time (Male-with Repeats)

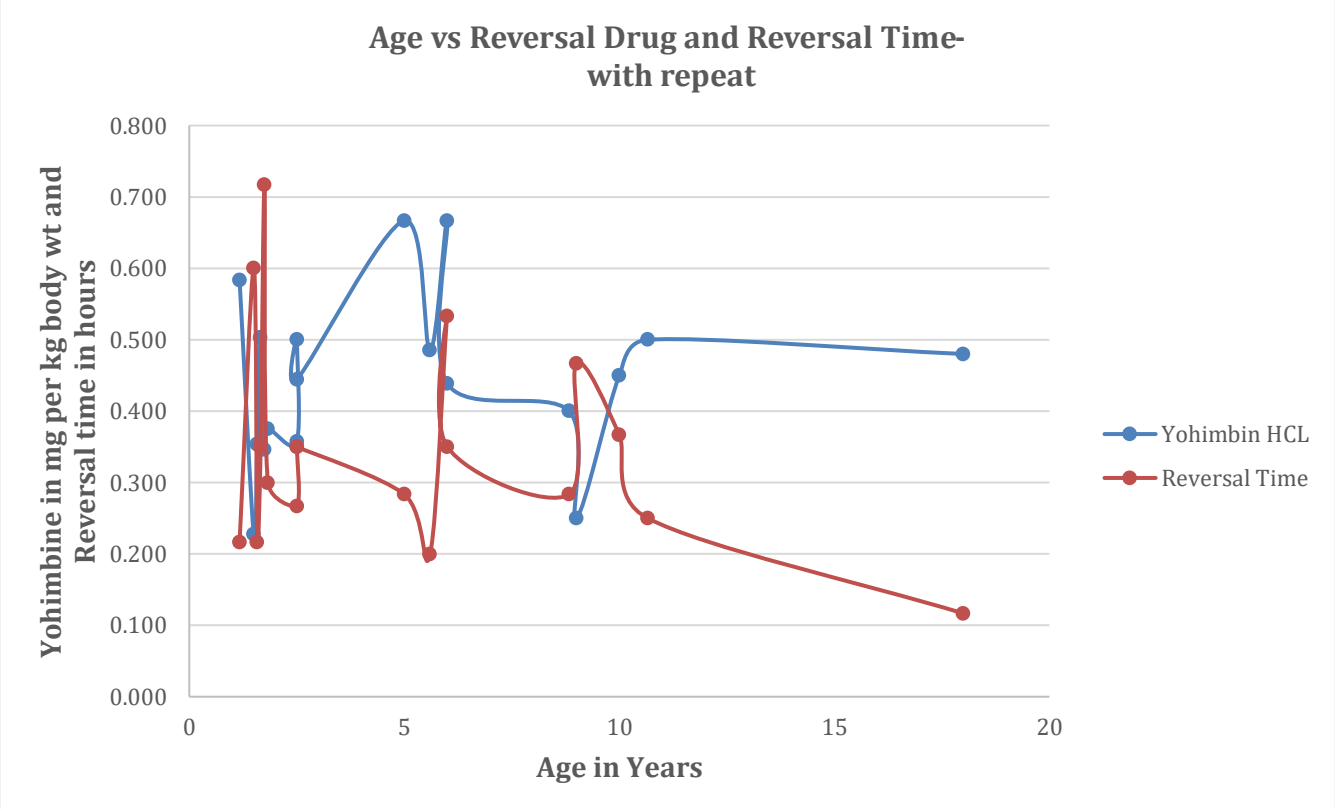


Table 3.B.17

Age vs Reversal Drug and Reversal time (Male-with Repeat)

S.No.	Tiger ID	Age (in years)	Yohimbine HCL 10 mg (in mg/kg body wt)	Reversal time (in hr)	Ambient Temp (in °C)
1	P-234 (31)	1.17	0.583	0.22	20
2	P-211	1.5	0.227	0.60	24
3	P-212	1.58	0.354	0.22	36
4	P-121	1.66	0.503	0.35	24
5	P-111	1.75	0.346	0.72	19
6	P-121	1.83	0.375	0.30	19
7	P-111	2.5	0.357	0.27	30
8	P-212	2.5	0.500	0.35	30
9	P-112	2.5	0.444	0.35	21
10	T-7	5	0.667	0.28	28.6
11	P-111	5.6	0.485	0.20	27.6
12	T-7	6	0.667	0.53	33
13	P-243	6	0.439	0.35	36
14	P-111	8.83	0.400	0.28	25
15	T-3	9	0.250	0.47	22
16	T-3	10	0.450	0.37	21
17	P-111	10.66	0.500	0.25	28
18	T-3	18	0.480	0.12	20

ii. **No Repeats:** The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.10*** and ***Table 3.B.18***. Again there seems to be an inverse relation between amount of reversal drugs and reversal time (more reversal drug leading to less reversal time), but there is no clear relation between age and amount of reversal drug or reversal time.

Figure 3.B.10: Age vs Reversal drug and Reversal time (Male-No Repeats)

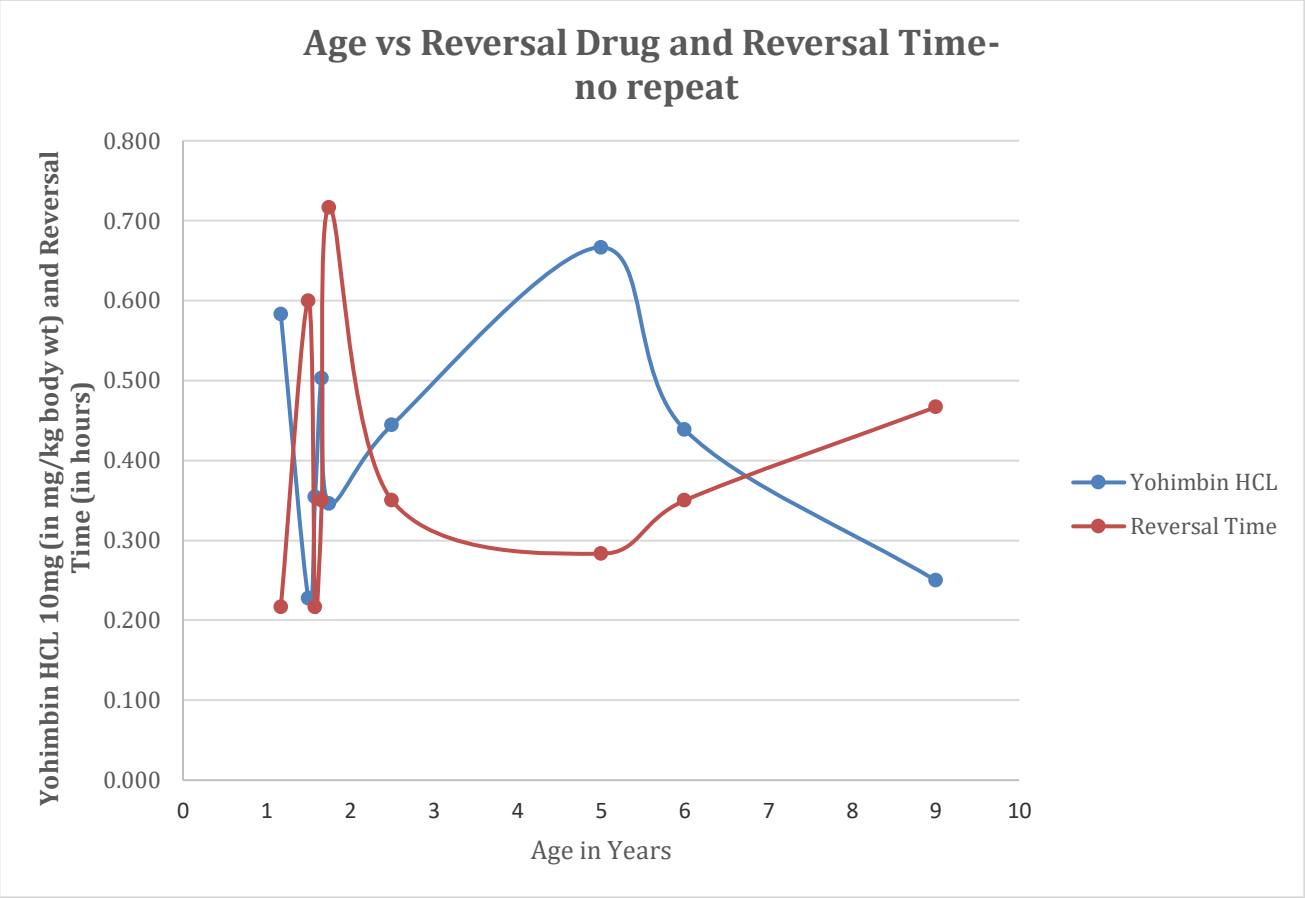


Table 3.B.18

Age vs Reversal Drug and Reversal time (Male-No Repeat)

S.No.	Tiger ID	Age (in years)	yohimbine HCL 10 mg (in mg/kg body wt)	Reversal time (in hours)	Ambient Temp (in °C)
1	P-234 (31)	1.17	0.583	0.22	20
2	P-211	1.5	0.227	0.60	24
3	P-212	1.58	0.354	0.22	36
4	P-121	1.66	0.503	0.35	24
5	P-111	1.75	0.346	0.72	19
6	P-112	2.5	0.444	0.35	30
7	T-7	5	0.667	0.28	28.6
8	P-243	6	0.439	0.35	36
9	T-3	9	0.250	0.47	22

B) FEMALE TIGER-

i. **With Repeats:** The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.11*** and ***Table 3.B.19***. Though there seems to be an inverse relation between amount of reversal drugs and reversal time (more reversal drug leading to less reversal time), there is no clear relation between age and amount of reversal drug or reversal time.

Figure 3.B.11: Age vs Reversal drug and Reversal time (Female- with Repeats)

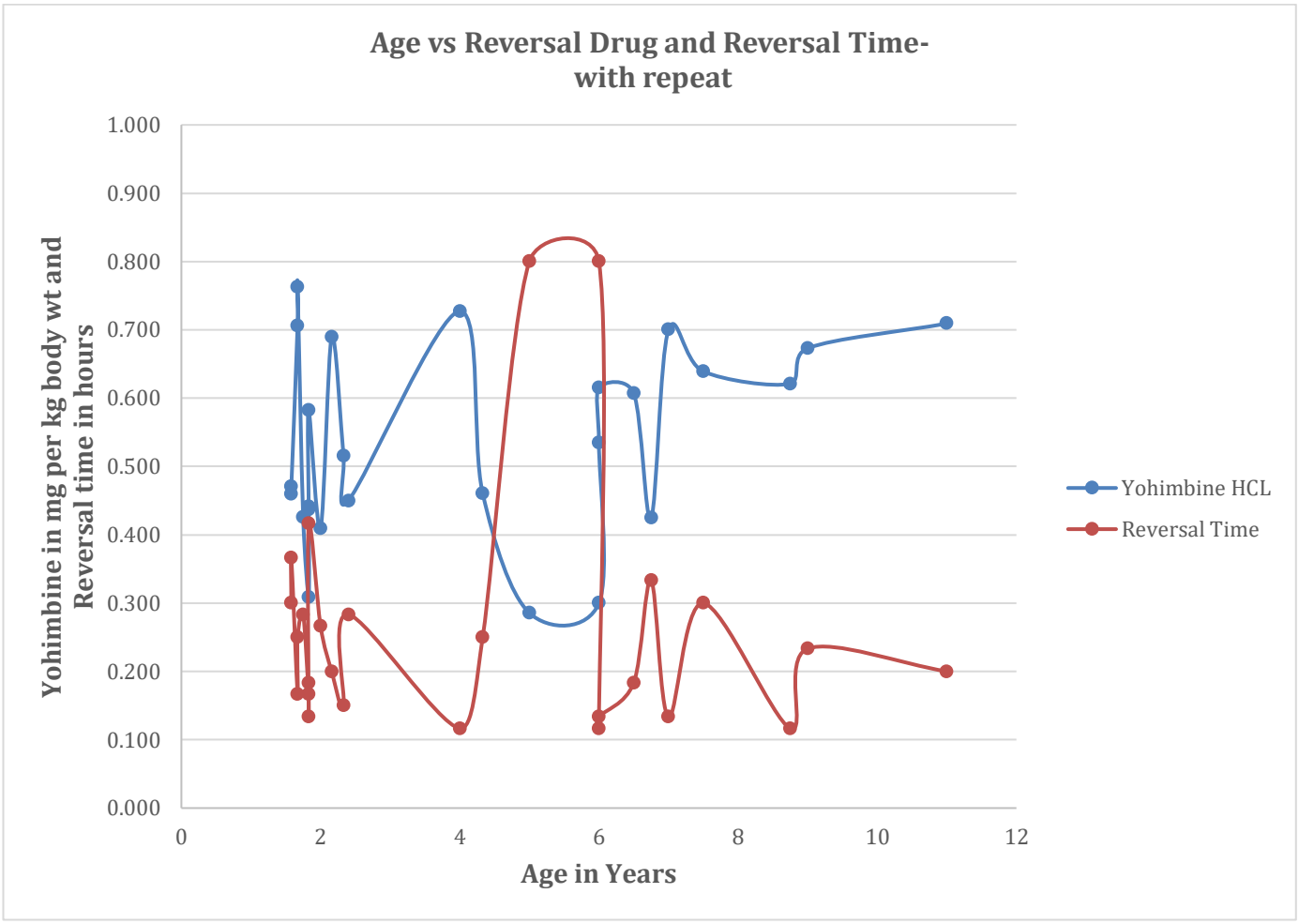


Table 3.B.19

Age vs Reversal Drug and Reversal Time (Female- with Repeat)

S.No.	Tiger ID	Age (in years)	Yohimbine HCL 10 mg (in mg/kg body wt))	Reversal time (in hrs)	Ambient Temp. (in °C)
1	P-213	1.58	0.460	0.30	41
2	P-214	1.58	0.471	0.37	39
3	P-141	1.67	0.706	0.17	40
4	P-142	1.67	0.763	0.25	36
5	P-521	1.75	0.426	0.28	16
6	P-213 (22)	1.83	0.309	0.17	30.3
7	P-213 (23)	1.83	0.441	0.18	27.1
8	P-234	1.83	0.437	0.13	39.9
9	P-233	1.83	0.583	0.42	41
10	P-222	2	0.409	0.27	42
11	P-213 (63)	2.16	0.690	0.20	24
12	P-151	2.33	0.516	0.15	23
13	P-213	2.4	0.450	0.28	34
14	P-213 (32)	4	0.727	0.12	21
15	P-142	4.33	0.461	0.25	26
16	T-1	5	0.286	0.80	25
17	T-2	6	0.300	0.80	27
18	P-222	6	0.534	0.12	25
19	P-213 (22	6	0.615	0.13	21
20	T-1	6.5	0.607	0.18	21
21	T-4	6.75	0.425	0.33	37
22	P-433	7	0.700	0.13	36
23	T-2	7.5	0.639	0.30	32
24	T-4	8.75	0.621	0.12	42
25	P-213	9	0.673	0.23	25
26	T-1	11	0.709	0.20	24

ii. **No Repeats:** The effect of age on amount of tranquilization drugs used is shown in ***Figure 3.B.12*** and ***Table 3.B.20***. Again, there seems to be an inverse relation between amount of reversal drugs and reversal time (more reversal drug leading to less reversal time), but there is no clear relation between age and amount of reversal drug or reversal time.

Figure 3.B.12: Age vs Reversal drug and Reversal time (Female- No Repeats)

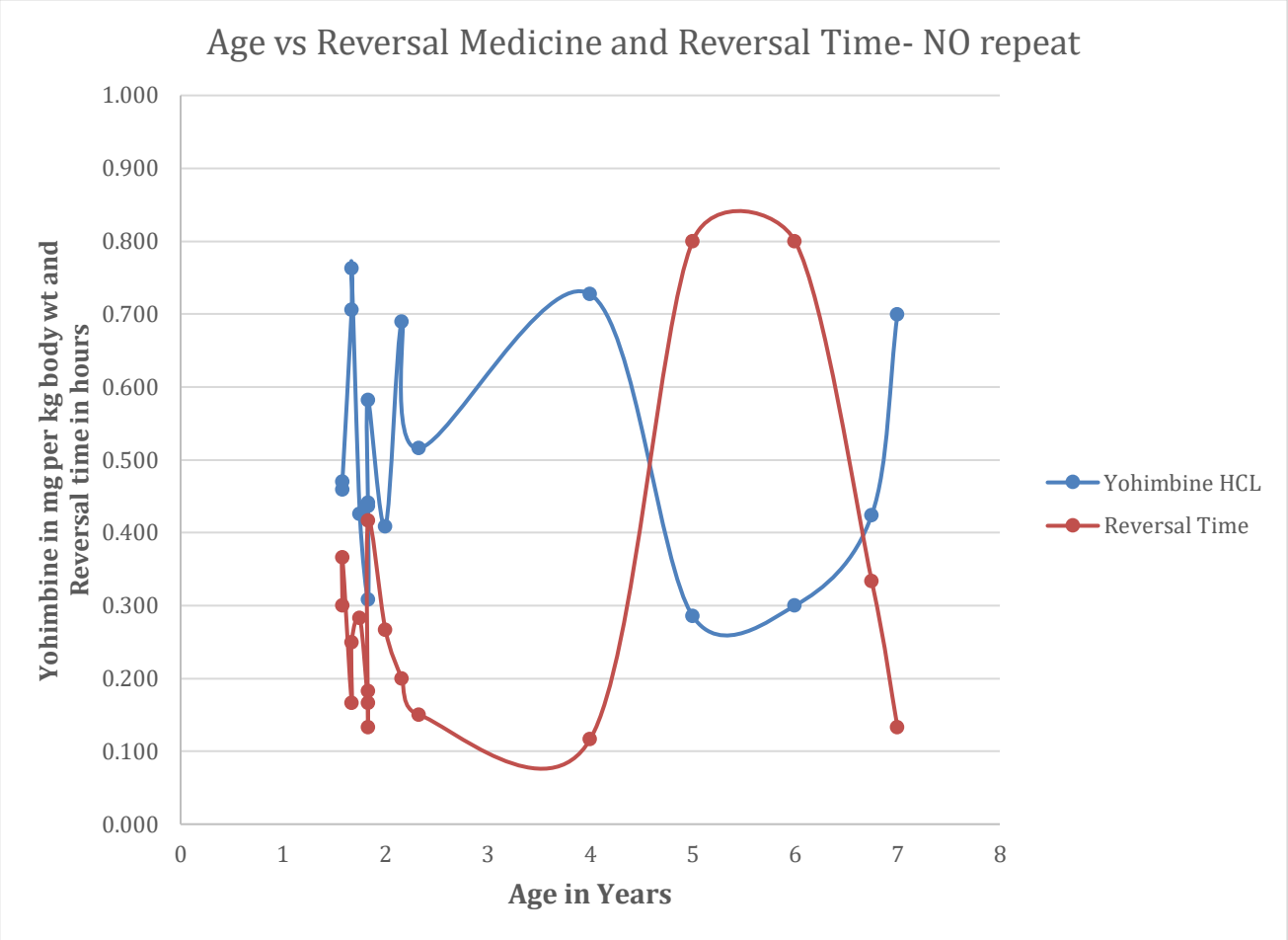


Table 3.B.20

Age vs Reversal Drug and Reversal Time (Female- No Repeat)

S.No.	Tiger ID	Age 9 (in years)	Yohimbine HCL 10 mg (in mg/kg body wt))	Reversal time (in hrs)	Ambient Temp. 0C
1	P-213	1.58	0.460	0.30	41
2	P-214	1.58	0.471	0.37	39
3	P-141	1.67	0.706	0.17	40
4	P-142	1.67	0.763	0.25	36
5	P-521	1.75	0.426	0.28	16
6	P-213 (22)	1.83	0.309	0.17	30.3
7	P-213 (23)	1.83	0.441	0.18	27.1
8	P-234	1.83	0.437	0.13	39.9
9	P-233	1.83	0.583	0.42	41
10	P-222	2	0.409	0.27	42
11	P-213 (63)	2.16	0.690	0.20	24
12	P-151	2.33	0.516	0.15	23
13	P-213 (32)	4	0.727	0.12	21
14	T-1	5	0.286	0.80	25
15	T-2	6	0.300	0.80	27
16	T-4	6.75	0.425	0.33	37
17	P-433	7	0.700	0.13	36

II. REVERSAL DRUG VS REVERSAL TIME

A) MALE TIGER –

i. **With Repeats:** The relation between Reversal drug and Reversal time is shown in ***Figure 3.B.13*** and ***Table 3.B.21***.

Figure 3.B.13: Reversal drug vs Reversal time (Male- with Repeats)

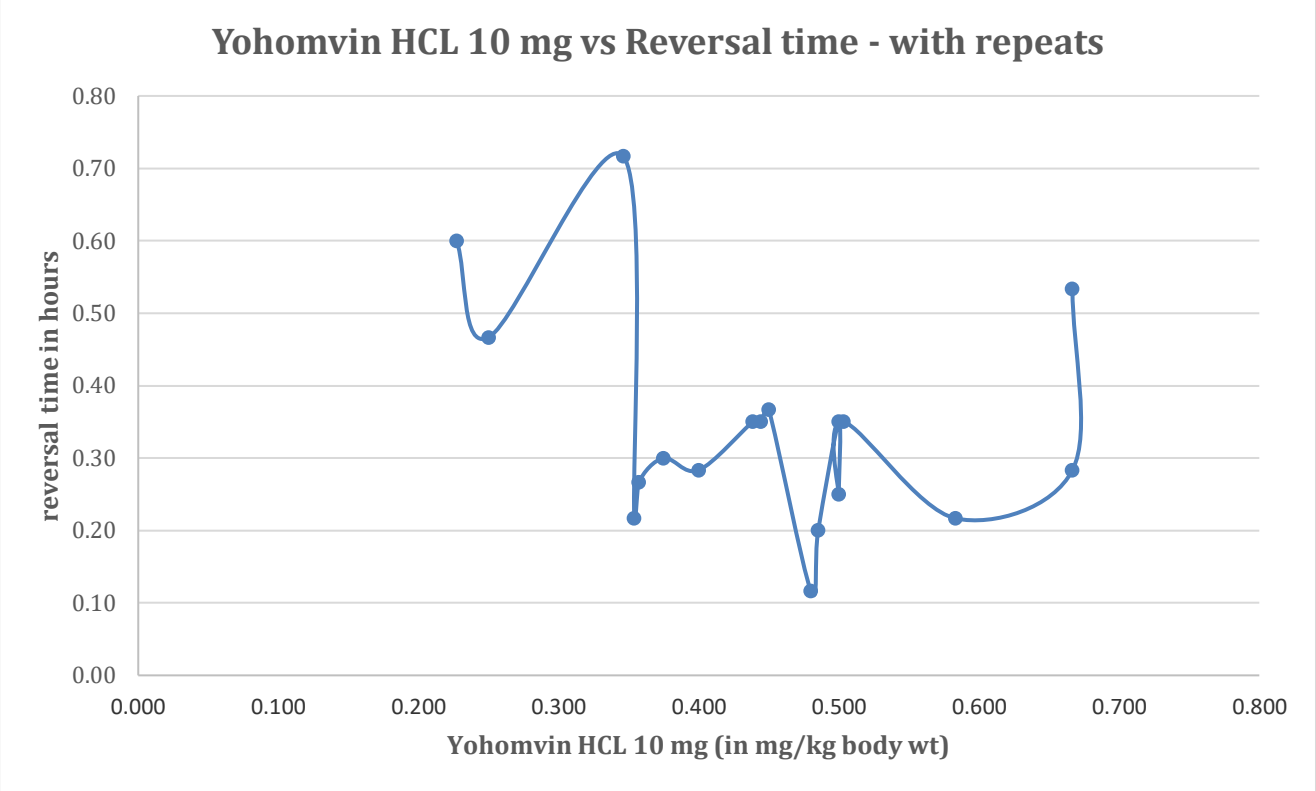


Table 3.B.21

Reversal Drug vs Reversal Time(Male- with repeat)

REVERSAL MEDICINE VS REVERSAL TIME (WITH repeats)			
S.No.	**Age (in years)**	**Yohomvin HCL 10 mg (in mg/kg body wt)**	**Reversal time (in hours)**
1	1.5	0.227	0.60
2	1.58	0.250	0.47
3	1.75	0.346	0.72
4	2.5	0.354	0.22
5	9	0.357	0.27
6	1.83	0.375	0.30
7	2.5	0.400	0.28
8	1.17	0.439	0.35
9	1.66	0.444	0.35
10	2.5	0.450	0.37
11	10	0.480	0.12
12	6	0.485	0.20
13	8.83	0.500	0.35
14	5.6	0.500	0.25
15	5	0.503	0.35
16	6	0.583	0.22
17	10.66	0.667	0.28
18	18	0.667	0.53

ii. **No Repeats:** The relation between Reversal drug and Reversal time is shown in ***Figure 3.B.14*** and ***Table 3.B.22***.

Figure 3.B.14: Reversal drug vs Reversal time (Male - No Repeats)

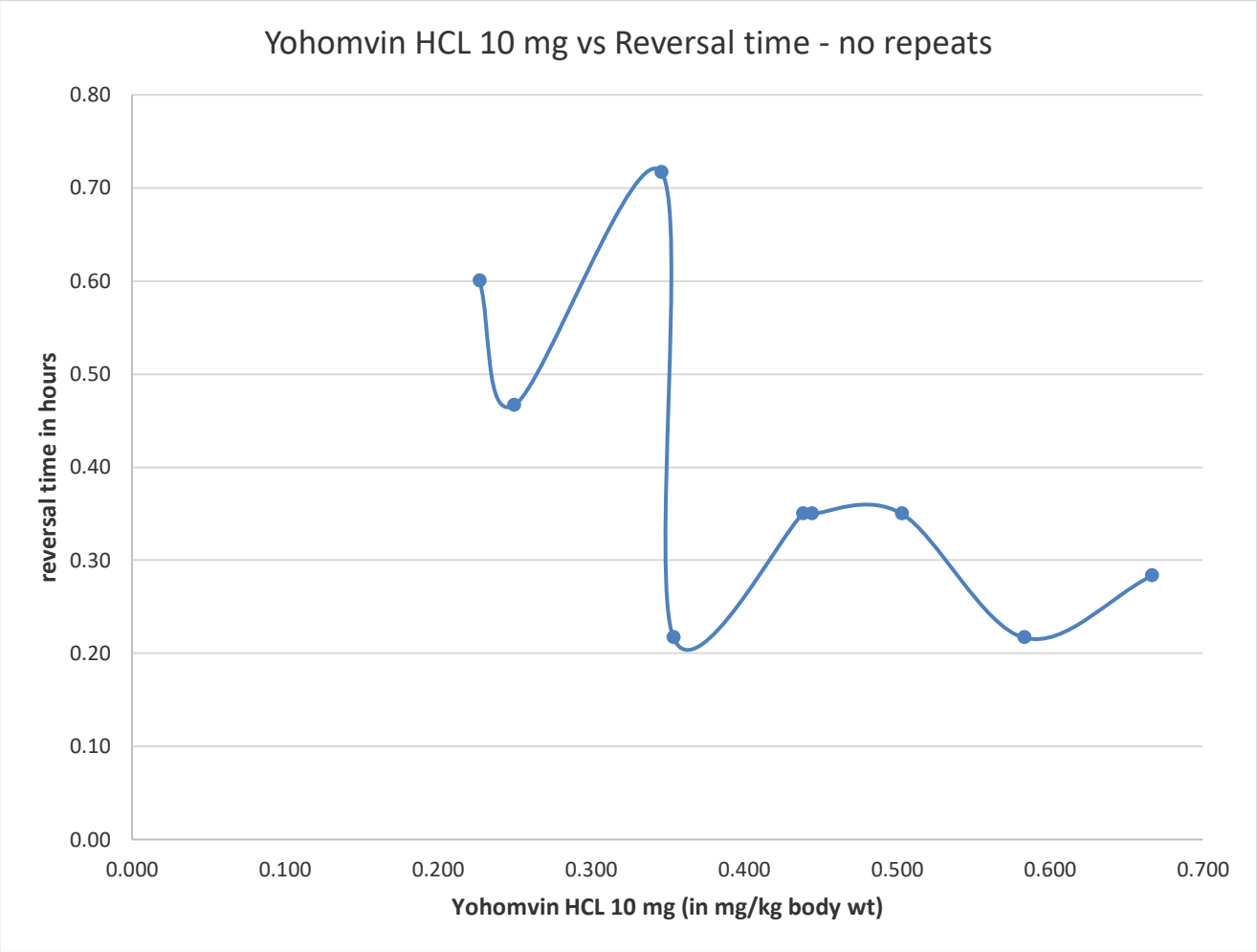


Table 3.B.22

Reversal Drugvs Reversal Time (Male- No Repeat)

REVERSAL MEDICINE VS REVERSAL TIME (NO repeats)			
S.No.	**Age (in years)**	**Yohomvin HCL 10 mg (in mg/kg body wt)**	**Reversal time (in hours)**
1	1.5	25	36
2	9	40	13
3	1.75	45	43
4	1.58	50	28
5	6	70	13
6	2.5	80	21
7	1.66	80	21
8	1.17	100	21
9	5	120	17

B) FEMALE TIGER

i. **With Repeats:** The relation between Reversal drug and Reversal time is shown in ***Figure 3.B.15*** and ***Table 3.B.23***.

Figure 3.B.15: Reversal drug vs Reversal time (Female- With Repeats)

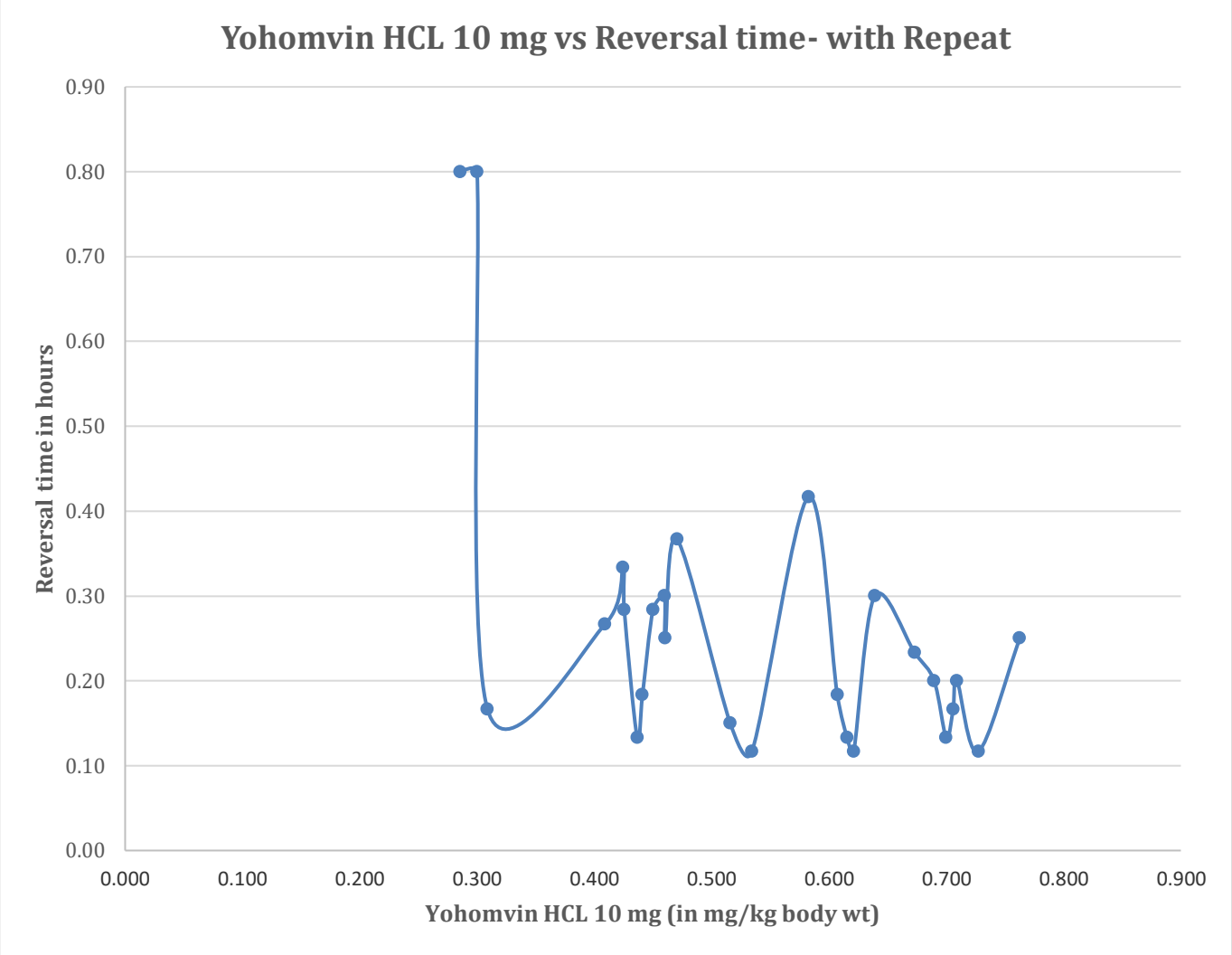


Table 3.B.23

Reversal Drug vs Reversal Time (Female- with Repeat)

S.No.	Age (in years)	Yohomvin HCL 10 mg (in mg/kg body wt)	Reversal time (in hours)
1	5	0.286	0.80
2	6	0.300	0.80
3	1.83	0.309	0.17
4	2	0.409	0.27
5	6.75	0.425	0.33
6	1.75	0.426	0.28
7	1.83	0.437	0.13
8	1.83	0.441	0.18
9	2.4	0.450	0.28
10	1.58	0.460	0.30
11	4.33	0.461	0.25
12	1.58	0.471	0.37
13	2.33	0.516	0.15
14	6	0.534	0.12
15	1.83	0.583	0.42
16	6.5	0.607	0.18
17	6	0.615	0.13
18	8.75	0.621	0.12
19	7.5	0.639	0.30
20	9	0.673	0.23
21	2.16	0.690	0.20
22	7	0.700	0.13
23	1.67	0.706	0.17
24	11	0.709	0.20
25	4	0.727	0.12
26	1.67	0.763	0.25

ii. **No Repeats:** The relation between Reversal drug and Reversal time is shown in ***Figure 3.B.16*** and ***Table 3.B.24***.

Figure 3.B.16: Reversal drug vs Reversal time (Female - No Repeats)

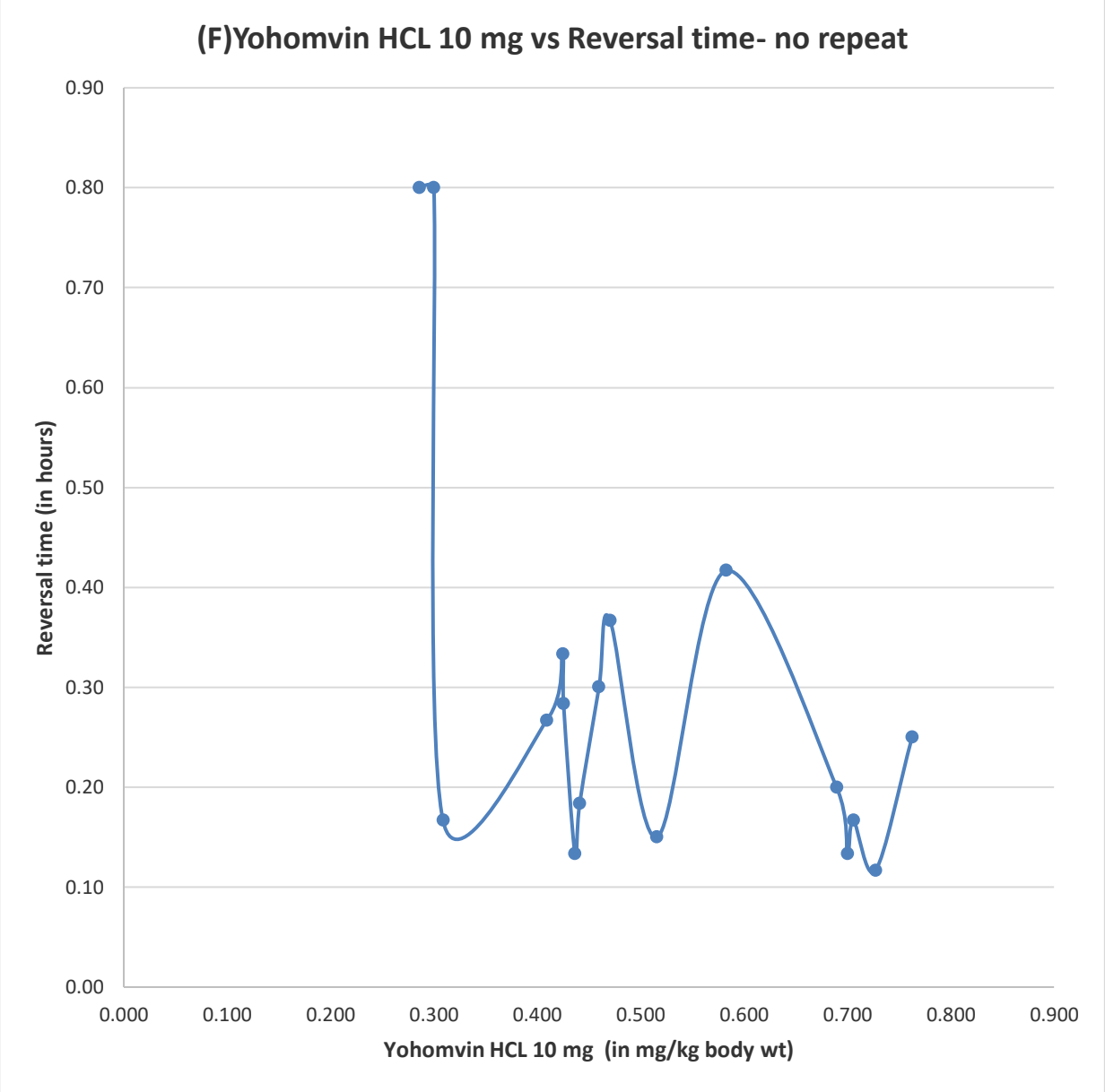


Table 3.B.24

Reversal Drug vs Reversal Time (Female- No Repeat)

S.No.	Age (in years)	Yohomvin HCL 10 mg (in mg/kg body wt)	Reversal time (in hours)
1	5	0.286	0.80
2	6	0.300	0.80
3	1.83	0.309	0.17
4	2	0.409	0.27
5	6.75	0.425	0.33
6	1.75	0.426	0.28
7	1.83	0.437	0.13
8	1.83	0.441	0.18
9	1.58	0.460	0.30
10	1.58	0.471	0.37
11	2.33	0.516	0.15
12	1.83	0.583	0.42
13	2.16	0.690	0.20
14	7	0.700	0.13
15	1.67	0.706	0.17
16	4	0.727	0.12
17	1.67	0.763	0.25

II. Tranquilization For the purpose of Rescue or Surgery or Both:

Out of 60 times tiger tranquilization procedures performed on 30 individual tigers in PTR till now, 16 times tranquilizations have been performed for the purpose of rescue/surgery/transportation. Out of these 16 tranquilization procedures, 8 procedures have been performed on male tigers (5 individuals) and 8 procedures have been performed on female tigresses (7 individual). Analysis of tranquilization procedure has been done separately for male and female tiger, which is as following:

A) ***MALE TIGER:***

Average total amount of drugs used per unit body weight (Xylazine 100mg + Ketamine 100mg) is 4.644 mg per kg body weight which is more than drugs used for collaring purpose which is 4.181 mg per kg body weight. It is clear that tranquilization drugs used in rescue/surgery is more compare to collaring operation as tranquilization duration is more in rescue/surgery procedures.

Induction time is nearly 27 minutes, which is lower compare to Induction time of 33 minutes for collaring purpose.

Details are given in ***Table 3.B.25.***

B) ***FEMALE TIGRESS:***

Average total amount of drugs used per unit body weight (Xylazine 100mg + Ketamine 100mg) is 5.527 mg per kg body weight which is more than drugs used for collaring purpose which is 5.112 mg per kg body weight. It is clear that tranquilization drugs used in rescue/surgery is more compare to collaring operation as tranquilization duration is more in rescue/surgery procedures.

Induction time is nearly 42 minutes, which is more compare to Induction time of 27 minutes for collaring purpose.

Details are given in ***Table 3.B.26.***

Table 3.B.25

Details of Tranquilization & Reversal Drugs used for the purpose of rescue/surgery/transportation (Male)

S. No.	Tiger ID	Purpose	Age (in years)	Estimated Weight (in kg)	xylazine (in mg/body wt)	Ketamine (in mg/body wt)	TOTAL DRUGS (in mg/body wt)	Induction time (in min)	Yohimbine HCL 10 mg (in mg/body wt)	Reversal time (in min)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	T-3	Re-collaring &Surgeory	15	202	2.088	1.650	3.738	15	0.495	13
2	P-212	Rescue	1.83	120	1.852	1.898	3.750	15	0.333	19
3	P-221	Rescue & Collaring	1.42	99	1.824	1.965	3.789	49	0.364	11
4	P-211	Rescue & Re-collaring	2.33	150	1.852	1.815	3.666	10	0.367	13
5	P-213 (21)	Treatment	1.33	110	2.727	3.182	5.909	47	0.545	11
6	P-212	Treatment & Isolation	2.91	179	2.793	3.073	5.866	16	0.559	15
7	P-212	Treatment &Surgeory	2.5	180	2.778	2.222	5.000	37	0.500	39
8	P-212	Treatment &Surgeory	2.5	184	3.019	2.415	5.435	28	0.543	8
AVERAGE			**4**	**153**	**2.367**	**2.277**	**4.644**	**27**	**0.463**	**16**

Table 3.B.26

Details of Tranquilization & Reversal Drugs used for the purpose of rescue/surgery/transportation (Female)

S. No.	Tiger ID	Purpose	Age (in years)	weight in kg	xylazine in mg per Kg body wt	Ketamine in mg per Kg body wt	Total drug in mg per kg of body wt	Induction time (in min)	Yohimbine HCL 10 mg (in mg per kg body wt)	Reversal time (in min)
1	**2**	**4**	**3**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	P-213 (23)	Collaring & Relocation	2.75	140	1.786	1.786	**3.571**	20	0.3571	17
2	P-234	De-collaring &Surgeory	2.08	124	5.242	6.048	**11.290**	20	0.4032	10
3	P-213	Re-collaring &Surgeory	5	105	3.162	2.552	**5.714**	39	0.6667	9
4	P-213 (33)	Relocation	2.16	120	2.308	1.850	**4.158**	8	0.5833	13
5	T-6	Rescue	3.5	144	1.736	1.736	**3.472**	38	0.4514	23
6	P-222	Rescue & Collaring	1.33	82	2.033	2.236	**4.269**	21	0.4024	8
7	P-433	Rescue & Collaring	1.5	68	2.574	2.574	**5.147**	8	0.5882	12
8	P-213 (33)	Rescue & Collaring	2	110	3.662	2.930	**6.592**	180	0.7273	7
AVERAGE			**2.54**	**112**	**2.813**	**2.714**	**5.527**	**41.75**	**0.522**	**12.4**

References

1. Sreenivasa Murthy, R and Ramesh, K (2013).*Tiger Reintroduction and Recovery Programme for Panna Tiger Reserve and Landscape Complex,* Phase II(2014-2019) Project Document, Wildlife Institute of India.
2. Standard Operating Procedure/Guidelines, November 2019, National Tiger Conservation Authority, MoEF&CC, Government of India.
3. A Manual on Chemical Immobilization of Wild Animals 2017, Central Zoo Authority & Laboratory for the Conservation of Endangered Species (LaCONES), CSIR-Centre for Cellular and Molecular Biology, Hyderabad.

DAN INJECT and DART

TRANQUILIZATION and REVERSAL DRUGS

Preparation for Tranquilization Procedure

Tranquilized Tiger with Dart

Collaring and Measurement of Tiger

Surgery/ Measurement of Tiger

Team After a Successful Day