Section A
Keynote Addresses

Wonderful World of Insects

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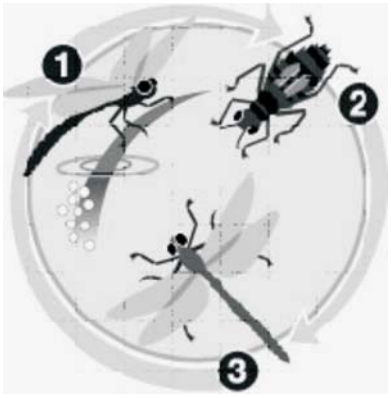
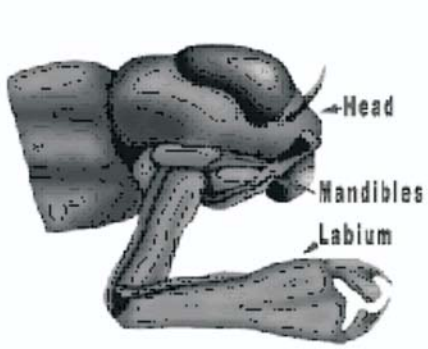
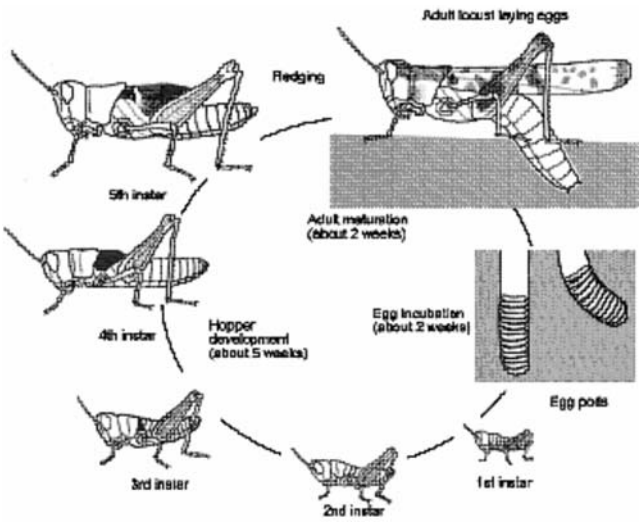
- Insects have a really a wonderful world!
- Though we know about some insects, there are certain misconceptions about them. For example, many people feel that spiders are insects. But spiders have 8 legs, hence they are not insects!
- We know about honey bees but do not know about how their bodies are modified for nectar and pollen collection; wax production etc.
- We often see grasshoppers but do not know about their life cycle. e.g. We are not aware that grasshopper female lays eggs in soil. From the eggs hatch out the nymphs which look similar to the adult. Some grasshopper types grow too much in number and lead to Locust swarms causing so much damage to vegetation that it leads to Famine.
- Many are not aware that the young stages of Dragonfly and Damselfly live in water.
- Do we know the interesting arrangement of the mouthparts of larval stage of Dragonfly?
- They have a protruding and long lower jaw which helps them to capture their prey such as mosquito larvae.



Life cycle of Dragonfly



Protruding lower jaw of dragonfly nymph.

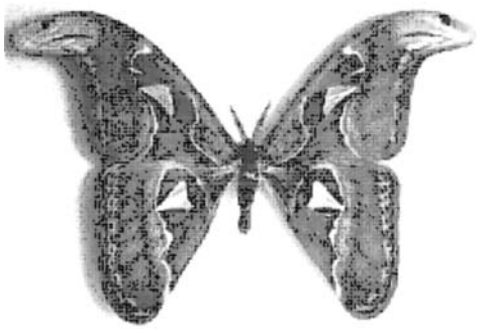


Life cycle of grasshopper

There are many such fascinating things about the insects.

- They have likes and dislikes.
- They show wonderful social life. For example — Bees,wasps,ants,termites etc.
- They know to show disapproval by non co-operation! (This has been proved in case of paper wasps; in a study conducted at Institute of Science, Bangalore.)
- They know to command and demand. e.g. some ants make other ants their slaves.
- They know to communicate. (They communicate by chemicals, sound, light, dances etc.)
- They won't talk to us, but they very well understand our intensions and are very clever. (They know why we use insecticides and find newer methods of survival.)
- They have so much in them that we really know very little about them.
- A lot of information on the most common insects is available, but it has not reached us.

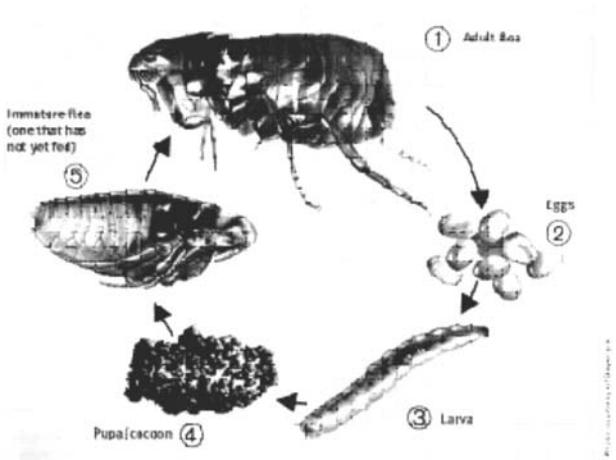
For example



***Attacus atlas* - male "Atlas Moth" Family: Saturniidae**

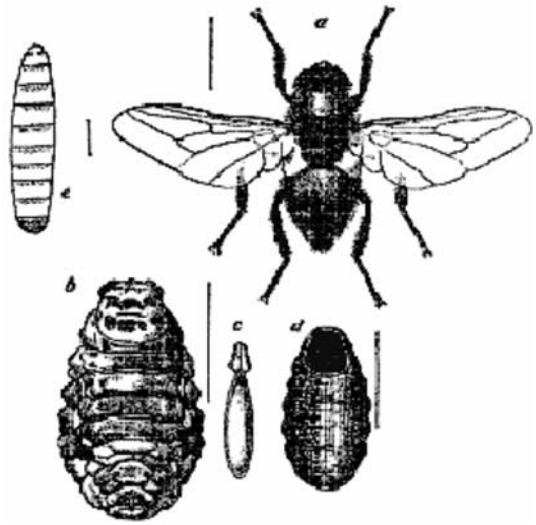
- The Atlas Moth is the largest moth in the world with a wingspan of approximately 20 cm (8 inches.)
- **Spring tail —** A very small insect gwoing in oraganic dabris has a spring like jumping device

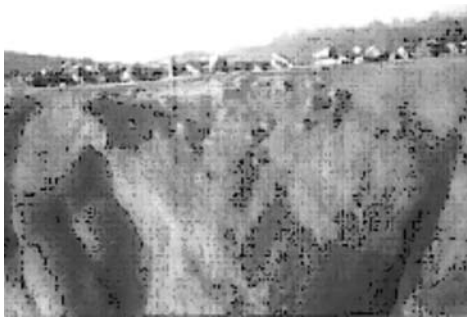
The life stages of fleas develop in organic debris. The adult after feeding on blood drops to ground and lays eggs in soil. The larvae feed on organic
debris, pupate in soil to finally develop to adult flea.



Life cycle of flea

Hypoderma fly—
Larvae feed below the skin of cow and other cattle. They then drop to ground and pupate in soil.

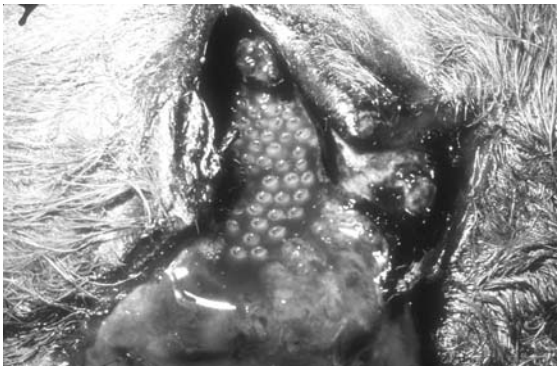




Nodules on the skin formed by Hypoderma larvae. The damage reduces the quality of the hide / leather

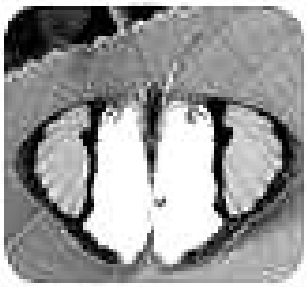
- **Screw worm flies** lay eggs on all types of wounds of animals and man. Their larvae bore inside and cause very serious damage. In sheep the larvae enter head sinuses ,brain causing death of the animal. In America the flies had caused more than **40 million** dollars loss.

- The larvae are easy to identify.They have screw like appearance, are voracious and burrow deeply into living flesh. They do not infest dead animal matter.



- **The spiracles of the larvae can be seen in this stage of development. Larvae may stay in the wound for about 7 days before they drop and pupate in the soil.**

- We often get attracted to Butterflies and Moths due to the beautiful colour combinations they have.



- But there many more other insects as well which have fascinating characteristics.
- Some times their beauty is beyond our imagination.
- **The present seminar and its two preparatory workshops were arranged to develop awareness about the wonderful world of insects around us. The main theme of the seminar was decided to be observation oriented studies. Hence three sections were decided for participation 1. Insect photography 2. Poster making – based on the information collected on insects and 3. Presentation based on own observations on insects.**
- **It was also decided to publish the "Proceedings of the seminar" including the presentations in the two workshops and the seminar so that the information reaches many individuals. The exhibition of the posters and photos will also increase curiosity about the insects**

कीटकांचे जग : निरीक्षण कीटकांचे ! का आणि कसे?

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प्राणी शास्त्राचे अभ्यासक असे ठामपणे सांगत असतात की या सृष्टीमध्ये जेवढे म्हणून प्राणी आहेत त्यांच्या संख्येच्या सुमारे पंचाहत्तर टक्के प्राणी केवळ कीटक आहेत. उरलेल्या पंचवीस टक्के प्राण्यांमध्ये अमिबापासून थेट देवमाश्यापर्यंत इतर सारे प्राणी सामावले जातात. अमाप संख्येमुळे आणि त्यांच्यातील कमालीच्या विविधतेमुळे असेल. कीटक, जळी, स्थळी, काष्ठी, पाषाणी आणि हवेमध्येसुध्दा आढळून येतात.

त्यांचे निरिक्षण करणे हा एक अतिशय ज्ञानदायी आणि ओतप्रोत आनंद देणारा छंद आहे. हा छंद श्री समर्थांनी दासबोधामध्ये केलेल्या, ''कितीयेक अमोलिके सृष्टीमध्ये'' या विधानाची साक्ष देतो. त्याचबरोबर. कीटक सृष्टीचे त्यांनी केलेल्या निरिक्षणातून त्यांना भावलेले. ''पर्णाळी पाहोन उचले। जीवसृष्टी विवेके चाले॥ आणि पुरूष होऊन भ्रमले। यासी काय म्हणावे'' असे बोध आपल्याला कीटकांच्या निरीक्षणासाठी प्रोत्साहन देत राहतात आणि निरीक्षण करावयाचे ते कशासाठी याचे मार्गदर्शनही करीत राहतात. कीटकांचे निरीक्षण करावयाचे त्यांना इतर प्राण्यांपासून वेगळे कसे ओळखावयाचे? त्यासाठी त्यांची कोणती वैशिष्टये लक्षांत घ्यावयाची हे पाहावयास हवे. सर्वसाधारणपणे लोक ज्याला 'किडा' म्हटले जाते त्याला कीटक समजतात आणि कोळी, गोम, पैसा, गोचीड़, गोगलगाय सारख्या शास्त्रीयदृष्टया कीटक नसलेल्या प्राण्यानांही कीटक समजतात.तेव्हा ही गैरसमजूत दूर करण्यासाठी कीटकांची खास अशी वैशिष्टये कोणती ते जाणून घेतले पाहिजे. ज्या प्राण्याचे शरीर डोके, छाती आणि पोट अशा केवळ तीन भागातच ओळखता येते तो प्राणी आणि ज्याच्या छातीच्या भागामध्ये पायांच्या तीन जोडया आणि पंखांच्या दोन जोडया असतात तो प्राणी म्हणजे कीटक होय असे छातीठोकपणे समजावयास काहीच हरकत नाही. लोकांना परिचीत असणारे झुरळ, डांस, घरमाशी, पतंग, मधमाशी, चतुर, नाकतोडा, रातकिडा, ढेकूण, पिसू, ऊ हे सारे प्राणी शास्त्रीय दृष्टया कीटक आहेत. परंतू त्यांच्यातही जातीनुरूप फरक आहे. झुरळ हे झुरळ म्हणून, नाकतोडा हा नाकतोडा म्हणून, ढेकूण हा ढेकूण म्हणून वेगळा ओळखावयाचा असेल तर त्यांची प्रत्येकाची वेगवेगळी असणारी वैशिष्टये अभ्यावयास हवीत. त्या वैशिष्टयांची एकमेकांशी तुलना करायला हवी. ही वैशिष्टये केवळ शारीरिकच असतात असे नव्हे. परंतू स्थूलमानाने शारीरिक वैशिष्टये त्यांच्यातील योग्य तो फरक सांगू शकतात आणि त्यांच्या सहाय्याने नाकतोडा नाकतोडा म्हणून झुरळ झुरळ म्हणून वेगळे ओळखता येतात. शारीरिक वैशिष्टये अभ्यासत असताना त्यातील फरक चटकन ध्यानात यावा यासाठी एक सूत्रबध्द पध्दत तयार करण्यात आली आहे. तिच्या सहाय्याने निरीक्षण करित असलेला कीटक कोणता आहे हे निश्चित ठरवता येते. या सूत्रबध्द पध्दतीमध्ये कीटकाच्या शरिराचा आकार, आकृतीबंध, त्याचे डोके, स्पर्शा, पाय, पंख, पोट यांच्यात त्यांच्या अधिवासानुरूप झालेले अनुकूलन पंखांचा पोत त्यांचे रंग रंगातील संगतीरंगाचे वेगवेगळे आकृती बंध. इत्यादी गोष्टींवर भर दिलेला असतो. काही अभ्यासक या शारीरिक वैशिष्टयांबरोबर. त्यांच्या जीवन चक्रातील विविध अवस्था. त्यांची जीवन पध्दती. खाद्य अधिवास या गोष्टींचाही त्याची ओळख पटवून घेण्यासाठीच्या अभ्यासांत समावेश करतात. एखादा प्राणी हा कीटकच आहे हे निश्चित झाल्यावर तो नाकतोडा आहे की झुरळ आहे हे शास्त्रीय दृष्टया ठरवण्यासाठी सूत्रबध्द पध्दतीबरोबर अभ्यासावयाचा जिवंत अथवा मृत कीटक, तो ठेवण्यासाठी काचेची पारदर्शी बशी, अुच्च दर्जाचे बर्हिगोल भिंग किंवा द्विनेत्री कीटक हाताळण्यासाठी घडयाळजी वापरतात तसे चिमटे, टांचण्या, कांचपट्टया आणि वैशिष्टयांची नोंद करण्यासाठी वही, पेन वा पेन्सिल जवळ असणे जरूरीचे असते.

कीटकांची शास्त्रीय दृष्टीकोनातून ओळख झाली. त्यांच्यातील भेदकारक वैशिष्टये लक्षांत घेऊन कोणता कीटक कोणता आहे हे सहजपणे ओळखता येऊ लागले की निसर्गामध्ये मुक्तपणे वावरणाऱ्या कीटकांचे जीवन कसे असते? त्यांना जीवन व्यतीत करीत असताना कोण कोणत्या संघर्षांना तोंड द्यावे लागते? त्यात ते कसे यशस्वी अथवा अपयशी ठरतात? याची निरीक्षणे निश्चित कार्यक्रम ठरवून

क्रमाक्रमाने निसर्गाच्या सान्निध्यांत किंवा बंदिस्त प्रयोगशाळेमध्येही करता येतात. या निरीक्षणांत हे कीटक कोठे वारतात, काय खातात,कोठे विश्रांती घेतात, आपल्या संगसाथीसमवेत राहतात की मीलन होताच सोडचिठ्ठी देऊन मोकळे होतात इत्यादी गोष्टींचा समावेश होतो. शिकारी कीटक आपले खाद्य कसे शोधतात, ते सहजपणे पकडतात की त्यासाठी त्यांना डावपेच लढवावे लागतात? मधमाश्या, गांधीलमाश्या, भुंगे, भुंगरे, फुलपांखरे मधूबिंदूंच्या सेवनासाठी कोणकोणत्या फुलांना भेटी देतात? पुष्प मुकुटांत ते कसे शिरतात? हे शिरणे सहजसोपे असते की त्यासाठी त्यांना करामती कराव्या लागतात? या करामतीचे स्वरूप काय असते? ते परागीकरण करतात अस म्हटल जातं. हे परागीकरण त्यांना न कळता होत असते की कीटक पूं केसरास जाणीवपूर्वक भेट देतात? ज्ञानेश्वर महाराजांनी.भुंगा कमळामध्ये पराग केसराला धक्का लागू नये म्हणून किंवा तो कुचंबू नये म्हणून अति हळूवारपणे शिरतो असे म्हटले आहे ती केवळ कवि कल्पना आहे की त्या म्हणण्यात खरोखरीच तथ्य आहे? हे समजावून घ्यावयास सखोल निरिक्षण करावयास हवे नाही कां?

काही गांधीलमाश्या चिखलाची पाळणा घरे बांधतात. त्यांत अंडी घालतात. अंडयातून बाहेर पडणाऱ्या अळयांना वेळेवर खाद्य मिंळावे म्हणून पाळणा घरातच त्यांचे खाद्य असलेल्या कोळयांची किंवा फुलपाखरांच्या अळयांची साठवण करून ठेवतात. आपल्या डोळस ऋषी मुनींनी याची नोंद फार पूर्वी करून ठेविली आहे. त्यातील सत्यता अजमावण्यासाठी आणि त्यांनी केलेल्या निरीक्षणात स्वतःची भर घालण्यासाठी त्या गांधीलमाश्या पाळणा घराचे एक दालन बांधण्यासाठी चिखल आणताना किती खेपा करतात दालनात आणून ठेविलेल्या कोळयांची वा अळयांची संख्या गांधीलमाशीच्या जातीनुसार एकच एक असते की भिन्न भिन्न असते इत्यादी आणि अशाच अनेक बाबींचे निरीक्षण आणि अभ्यास करण्यासाठी घराबाहेरचा अथवा प्रयोगशाळेबाहेरचा परिसर, माळराने, वनक्षेत्र यांचा धांडोळा प्रयत्नपूर्वक न कंटाळता घ्यावयाचा असतो.

रात्री आपण आपल्या घरांमध्ये टयुब लाईट किंवा मर्क्युरी व्हेपर लॅम्प्स् लावतो. त्यांच्यावर किंवा त्यांच्या आसपास काही कीटक घिरटया घालतात हे बहुतेकांनी पाहिले असेल. जेव्हा जेव्हा हे कीटक पाहण्यात येतील तेव्हा तेव्हा त्यांची ते कोणत्या महिन्यात कोणत्या दिवशी किती वाजता पाहिले या गोष्टींची नोंद करता येईल. सवड सापडली की आपण एखादया निसर्ग रमणीय ठिकणी किंवा वनक्षेत्रामध्ये सहलीसाठी जातो तेथे एखादी रात्र मुक्कामही करतो.काही कामानिमित्त आपण दुसऱ्या गावी एखादया नातेवाईकाकडे जातो. तेथे दोन चार दिवस राहतो. सहलीच्या ठिकाणी किंवा नातेवाईकांच्या घरी रात्री यापूर्वी उल्लेख केलेल्या दिव्यांवर कीटक आले आहेत की कसे हे पाहता येईल तेथील दिव्यांवर आलेल्या कीटकांची नोंद करून ठेवावी आणि आपल्या घरी परत आल्यावर आपल्या घरी पूर्वी पाहिलेल्या आणि सहलीच्या ठिकाणी किंवा नातेवाईकांकडे पाहिलेल्या कीटकांची तुलना केली तर हाती येणारी माहिती आपल्या कीटकांविषयीच्या ज्ञानामध्ये भर घातल्याशिवाय राहणार नाही एवढेच नव्हेतर ती माहिती आपल्याला आणखी सविस्तरपणे निरीक्षणे करण्यास प्रवृत्त करील यांत शंका नाही.

आतापर्यंत आपण कोणती निरीक्षणे करावयाची ती कोण कोणत्या ठिकाणी करणे शक्य आहे हे स्थूल मानाने पाहिले आता ही निरीक्षणे कशी करावयाची आणि त्यांची नोंद कोणत्या पध्दतीने लिहावयाची हे पाहू या. आपल्या घराबाहेरच्या परिसर, माळराने, पाणवठे, वनक्षेत्रे यामध्ये आढळणाऱ्या पौढ कीटकांची अथवा त्यांच्या अळयांची निरीक्षणे करावयाची तर ठरवून त्या त्या ठिकाणी नियमितपणे जावयास हवे. त्या ठिकाणची झाडे झुडपे यांच्यावर कोण कोणते कीटक येतात.कोण कोणत्यावेळी येतात आणि त्यांच्यापैकी कोणत्या कीटकांचे प्रमाण इतर कीटकांपेक्षा जास्त आहे इत्यादी गोष्टींची नोंद करण्यासाठी निरीक्षणे करण्याचा उद्देश असेल तर त्या ठिकाणी आपल्याला सोयीची वाटतील अशी दोन तीन झाडे निवडावित. निवडलेली झाडे एकाच जातीची नसावीत. त्याच्यात विविधता असावी. एक झाड मध्यम उंचीचे असंख्य पानांनी विनटलेले आणि आपणास त्याचे नाव माहिती असणारे आणि कोठेही ओळखता येतील असे शंकासूर, पेरू, चिकू यासारखे तर दुसरे घाणेरी क्लेरोडेन्ड्रॉन, पांढरी लिली यासारखे तर तिसरे वर्षभर फुले देणारे गुलाब, जास्वंद, गुलबक्षी यासारखे असावे.

ही सारी झाडे उघडयावर असल्यामुळे दुपारच्या वेळी साहजीकपणे ऊन्हाचा त्रास होणे शक्य आहे. तो होऊ नये यासाठी सावलीची व्यवस्था करता आली तर चांगले. परंतू ती नसेल तरी अडण्याचे कारण नाही. डोके आणि मान झाकले जातील अशी टोपी डोक्यावर असली म्हणजे झाले. साधारणपणे या झाडांवर येणाऱ्या कीटकांच्या वेळा बहुधा ठरलेल्या असतात.

फुलपाखरांसारखे काही सकाळी उन्हे पडतांपडता येतात तर गांधीलमाश्या, मधमाश्यांसारखे काही सरत्या सकाळी किंवा सूर्य डोक्यावर आला असताना येतात.भुंग्यांसारखे काही कलत्या दुपारी येतात पतंग, भुंगेरे यांच्यासारखे काही सूर्य क्षितीजाखाली गेल्यावर येऊ लागतात.या वेळांमध्ये कारणांपरत्वे बदल झालेलाही आढळून आल्यास नवल करण्याचे कारण नाही. निरीक्षणासाठी निश्चित केलेल्या झाडावर कोणते कीटक केव्हा येतात हेच आपल्याला माहिती नसल्याने त्याची माहिती करून घेण्यासाठी प्रथम प्रथम सकाळपासून संध्याकाळपर्यंत झाडाशी बसून राहावे लागते. परंतू ते शक्य नसल्यास निरिक्षण चाचणीच्या पहिल्या अथवा दुसऱ्या आठवडयापर्यंत दिवसाचे सकाळ, मध्यान्ह, कलती दुपार आणि संध्याकाळ असे चार भाग स्थूलमानाने पाडून आठवडयातील सोयीच्या दिवसाआड सकाळी साडे आठ ते दहा, मध्यान्ही साडे अकरा ते एक, कलत्या दुपारी तीन ते पांच आणि संध्याकाळी? ऋतूमानानुसार सहा ते सात किंवा साडे सात यावेळात बसून वा उभे राहून निरीक्षण करावयाचे. प्रत्येक झाडाजवळ ठरलेल्या प्रत्येक दिवशी सलगपणे किमान तीस मिनीटे आपण निरिक्षणास सिध्द असावयास पाहिजे. पहिली दहा मिनीटे एकाग्रतेने आपल्या समोरच्या झाडावर उडत उडत आलेल्या किंवा आधीच येऊन बसलेल्या कीटकाला नीटपणे पाहत तो कोणता कीटक आहे हे ओळखावयाचे ओळख पटली की त्याचे नांव, तो ज्या झाडावर दिसला त्या झाडाचे नाव, कीटक पाहिल्याची वेळ, त्यावेळी ऊन होते की आभाळ होते, पावसाचे थेंब येत होते की येऊन गेले होते या सर्व गोष्टींची आणि ज्या दिवशी निरीक्षणे केली त्याचा दिनांक यांची तपशीलवार नोंद करावयाची. पहिल्या दहा मिनीटांमध्ये कोणताही कीटक आला नाही किंवा दिसला नाही तर काही वेळ थांबून पुन्हा झाडावर दृष्टी केंद्रीत करावयाची. शेवटच्या दहा मिनीटांमध्ये आपण स्वतः झाडाजवळ जावयाचे आणि त्याचे पान अन् पान फूल अन् फूल, फळ आणि फळ, फांद्या, खोड आपल्या तीक्ष्ण नजरेने तपासून पाहावयाचे! तसे केले असता कीटकाच्या मादीने घातलेली अंडी दिसतील झाडाची पाने, ताजी, कोवळी अथवा लुसलुशीत असतील तर तेथे एखाद दुसरी अळी पाने खाताना आढळून येईल. प्रत्यक्षात अळी दिसली नाही तरी तिने विशिष्ट प्रकारे खाल्लेली पाने दिसून येतील. अळयांची पाने खाण्याची पध्दत त्यांच्या जातीनुसार वेगवेगळी असू शकते. त्या पध्दतीवरून कोणत्या अळीने ती पाने खाल्ली असतील याचा अंदाज करता येतो. प्रौढ कीटकही पाने जाती निविष्ट पध्दतीने खातात त्यामुळे ते कोणते असावेत याचा अंदाज येऊ शकतो. ज्या पध्दती निरीक्षण करीत असताना आढळतील त्यांचे वर्णन करून आणि वर्णनाला रेखा चित्रांची जोड देऊन नोंद करून ठेवावी. पानाच्या खालच्या बाजूला अथवा देठावर एखादी कोशावस्था लटकताना आढळेल.तिचे रेखाचित्र काढून ठेवावे झाडाच्या फांदया, खोडावरून कदाचित मुंग्या येताना जाताना दिसून येतील. त्या काळया आहेत. तांबडया आहेत की तपकिरी आहेत याची नोंद करीत असताना त्या मुंग्या जमिनीकडून आकाशाच्या दिशेकडे जात आहेत की आकाशाकडून जमिनीकडे जातात यांचीही नोंद करावी.

घराच्या अथवा प्रयोग शाळेच्या बाहेर असलेल्या दोनतीन झाडांवर निरीक्षणाच्या विशिष्ट कालावधीमध्ये आढळलेल्या कीटकांना ओळखल्यावर त्यांच्याबद्दलच्या कोणत्या नोंदी लिहून ठेवावयास हव्यात ते आपण गेल्यावेळी वानगीदाखल पाहिजे. तशाच नोंदी आणखी काही ठिकाणी जाऊन करावयास हव्यात. उजाड माळरानातील जमिनीवर, जमिनीखाली अथवा तेथे एकट दुकट उभ्या असलेल्या झाडांवरील कीटकांची नोंद नीट निरीक्षण करून ठेवावयाची. येथील कीटक निराळे असल्याचे लक्षात येईल. याच माळरानावरील उघडयावर एखादे जनावर कोणत्या तरी कारणाने मरून पडले असेल. तर त्याची विल्हेवाट लावली जाईपर्यंत तेथे ठिय्या देऊन त्या मृत शरीरावर कोणते कीटक येतात हे पाहून त्याची नोंदही धिटुकल्या अभ्यासकाने करून ठेवायला हवी. येथे दिसणारे कीटक एरवी इतर ठिकाणी दिसणार नाहीत की आढळणार नाहीत. गोडया पाण्याचे तलाव, लहान मोठे डोह, नदीचे वाहते पाणी हे जलचर कीटकांचे आवडते अधिवास आहेत या विविध जलाशयांच्या काठी बसून त्यात असणाऱ्या किंवा त्यांच्या पृष्ठभागावरून उडणाऱ्या कीटकांचा मागोवा घेत त्यांनी वेगवेगळया कारणांसाठी केलेल्या हालचालींची नोंद पूर्वी सांगितलेल्या पध्दतीने करावयास हवीच.

वनक्षेत्रातील दीर्घजीवि उंच आणि विशाल वृक्षांच्या पानांवर,खोडांवर, बेचक्यामध्ये अळया अथवा प्रौढ कीटक वावरताना दिसतील. आकाशाला भिडू पाहणाया फांद्यावर मधमाश्यांचे भलेमोठे मोहोळ किंवा आशियायी गांधील माश्यांची लांब रूंद कागदी वसाहत लटकताना आढळून येईल. या मोहोळांत अथवा वसाहतीमध्ये ये जा करणारे घटक आणि त्यांचे वर्तन निरीक्षकांसाठी कधीही न संपणारा खजिना आहे असे म्हटल्यास वावगे ठरणार नाही. दीर्घ जीवि वृक्षांच्या पायथ्याशी पसरलेल्या

वाळक्या पानांमधून अथवा पानांखालीही वेगवेगळे कीटक दडून बसलेले असतील. पाने चाळवून त्यांची दखल घेणे आवश्यक आहे. अशाच कोणत्या वृक्षाच्या पायथ्याशी किंवा काहीशा दूर अंतरावर भक्कम बांधलेली व्राळवीची वारूळेही निरीक्षकाची वाट पाहात उभी असतील. वनक्षेत्रामध्ये निरीक्षकाच्या वाटयाला येणारा हा दुसरा खजिना होय. जिज्ञासू निरीक्षकाला काय पाहू आणि कोठे पाहू याचे भान राहणार नाही इतकी विविधता आणि विपूलता येथे त्याच्या दृष्टीस पडेल. या विविधतेची आणि विपूलतेची नोंद करावीशी वाटणार नाही असा निरीक्षक शोधून ही सापडणार नाही.

निरनिराळया ठिकाणी अडचणींवर मात करून तास न् तास एका जागी बसून केलेल्या कीटकांच्या अनेक विविध निरिक्षणांच्या नोंदीचा उलगडा त्याच दिवशी करता येईल असे नाही. त्यांचे महत्वही लागलीच ध्यानात येईल असेही नाही. तरी ती खंड न पडता अविरत अनेक वर्षे सलगपणे करीत राहिल्यास त्यातील सलग दोन तीन वर्षांच्या नोंदींचा वेळोवेळी आढावा घेत गेल्यास डोळयासमोर कीटकांविषयीच्या माहितीचे भले मोठे भांडार उभे राहिल. या माहितीच्या अनुषंगाने कीटकांच्या कार्यकारण भावांचा अर्थ लावण्याचा प्रयत्न केला तर असे दिसून येईल की, या माहितीचा कीटकांशी संबंधीत असणाऱ्या प्रत्येक व्यक्तीला उपयोग करून घेता येईल. अन्नधान्य, भाजीपाला, फळफळावर पिकवणारे शेतकरी बंधू, रासायनिक आणि जैविक कीटनाशकांचे उत्पादन करणारे उत्पादक आणि व्यावसायीक, मध, मेण, लाख आणि कीटक जन्य रंग आदी पदार्थांचे उत्पादन करणारे उद्योजक, कीटकशास्त्राच्या विविध शाखांशी संबंधित असणारे विद्यार्थी आणि संशोधक एवढेच नव्हेतर सामान्य माणसाचाही या माहितीच्या उपभोक्त्यांमध्ये समावेश आहे.

माणूस आणि कीटक यांच्यातील संपर्क-संबंध दीर्घ कालाचे आहेत. बाळ पाळण्यात असल्यापासून आजोबा होऊन अवचितपणे रूग्णालयात शस्त्रकियेसाठी जाऊन राहतो तेव्हाही माणूस कीटक हा संपर्कसंबंध कायम असतो. कीटक माणसाचे जसे मित्र नाहीत तसे शत्रूही नाहीत असलेच तर माणसावर प्रत्येक बाबतीत मात करू पाहणारे अटीतटीचे स्पर्धक आहेत. ही गोष्ट सामान्य माणसाच्या गळी उतरविण्यासाठी ही माहिती उपयोगी पडते.

या जनसामान्यांपैकी काही जण हाडाचे कवि असतील काहीजण पट्टीचे चित्रकार असतील. या कलाकारांची कीटकसृष्टी ही प्रेरणास्थान आहे. फुलपाखरे, गांधीलमाश्या, चतुर, नाकतोडे, भुंगेरे, झगमग कुलातील ढेकणे इत्यादी कीटकांचे मनोवेधक रंग त्यातील डोळे दिपवणारी संगती, मनोरम आकृतीबंध इत्यादी गोष्टी काव्याच्या आणि नवनवीन चित्रकृतीच्या निर्मितीचा चिरंतन स्त्रोत आहेत.

कोणीही उठावे आणि कीटकांची निरीक्षणे करावी ती या अवीट आनंदासाठी केवळ अभ्यासासाठी खचितच नव्हे.

Observing the World of Insects

Dr. P. V. Joshi
Gruhakalpa Apartments, Karve Road, Pune

Insects constitute 75% of the animal world. Remaining 25% are all remaining members from amoeba to whales.

How to define an insect?

- Body divisible into 3 parts, head, thorax and abdomen
- 3 pairs of legs attached to thorax
- 2 pairs of wings attached to thorax.

Typical body structure of Insect.

Spider! not an insect.It has 8 legs

Where can we find Insects?

Insects are everywhere

- On land, In water, In air
- Below the stones, Inside the wood
- In the forest, gardens, in the ponds, rivers etc.
- Inside the house, old books, clothes, furniture, carpets, stored grains, fruits and vegetables, around the light etc.

How to study the Insects?

For the beginners……..Select 3 or 4 familiar plants which may include a tree, shrub of common familiar variety such as Guava, Ber, Hibiscus or Rose can be a good choice. One can study the insects on these plants or the insects visiting these plants.

Record the observations at different timings on the same day

- 8.30 am to 10am
- 11.30am to 1 pm
- 3 pm to 5 pm
- 6 pm to 7.30 pm

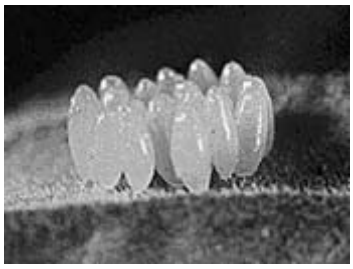
This is because every insect has its own time slot for activity

- Morning sun is good to observe butterflies
- Wasps are active at noon
- Bumble bees prefer afternoons
- Moths love evenings

Observe the host plant carefully

- Underside of leaves…… there may be insect eggs.
- There may be a caterpillar busy in lunch
- A cocoon……or pupa may be seen.
- Predator insect may be seen in action.
- Honey bees visiting flower may be seen.
- The half eaten leaf….the pattern tells you about the visitor insects.

One can enjoy the Beauty of butterflies.



Insect eggs

Caterpillar eating.

Predator eating pray.

Pattern of eating leaf is important.

Beautiful butterfly

Honey bee visiting flower.

How to study insects systematically?

Following observations about the insect are very important. They should be carefully studied.

- Shape of body.
- Adaptations of the body structures.
- Colour and texture of wings.
- Modifications of legs.
- Mode of feeding.
- Habitat.
- Life cycle.

Requirements for the study:

- Live or dead insect for observation
- Watch glass to keep the insect.
- Hand lens or microscope to observe the fine structures and charecteristics.
- Slides, forceps.
- Pins.
- Notepad and pen to note important observations.
- Insect box to keep the insect for longer duration.

Keep the record of the followings –

- The observations on insect. Type of insect
- The place of observation
- The plant on which it was observed.
- Time at which the insect was observed.(Date and time)
- Condition with respect to Sunlight, rains etc.
- Comparison with earlier obsevations or records at other places

The observations are useful to :

- Farmers.
- Bee keepers and Seri culturists.
- Industries in field of insecticides.
- Students.
- Research organizations.
- Common man.

Insects are great wonders of nature. They are our great competitors.
The study of insects is for knowledge as well as enjoyment.

How to Observe and study Butterfly Caterpillars

Isaac Kehimkar, General Manager-Programmes,

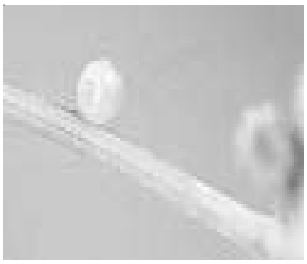
BNHS, Mumbai

Intoduction:

Butterflies, unlike several other creatures, cannot sting or bite to fight back predatory attack. Therefore to escape from predators, butterflies have evolved various protective adaptations, right from the egg to the adult stage. Most species lay only one egg or small batches per plant, while others lay a mass of eggs together. Eggs are often laid hidden on the underside of the leaves. This ensures that some eggs do hatch successfully.

Monarch butterfly egg.

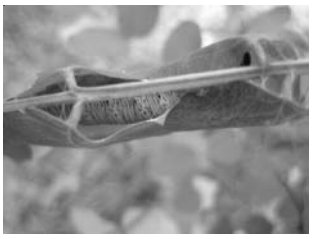
Eggs of *Actinote Pellenea Callyma*



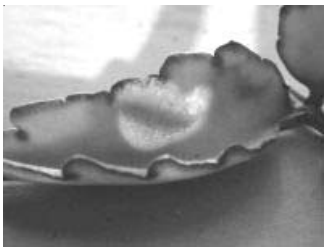
Egg of Swallowtail

Egg mass of Large white butterfly

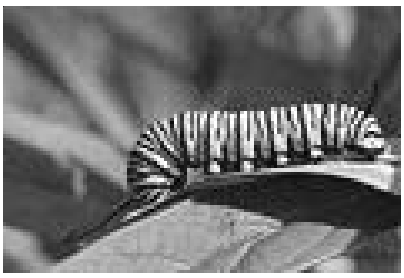
Caterpillars form a major portion of the diet of predators like birds, besides being attacked by wasps, assassin bugs, spiders, frogs and lizards. This is probably the most vulnerable stage in the butterfly's life. To escape predation, caterpillars of Skippers roll leaves around themselves to remain concealed. Leafmining caterpillars of the Red Pierrot feed within the fleshy leaves of *Kalanchoe* to remain unseen while caterpillars of the Milkweed butterflies have bright colours that warn predators of distasteful consequences.



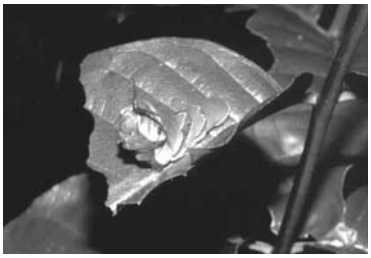
Caterpillar of Silver spotted skipper



Caterpillar of Red Pierrot eating tissue inside the leaf



Caterpillar of milky weed butterfly (Monarch)



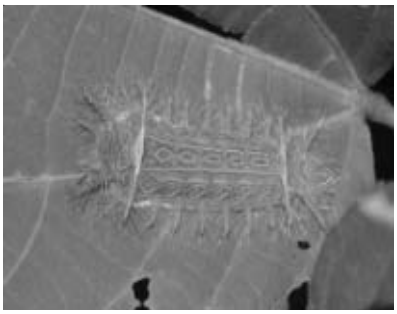
Forked glandular structure in Swallowtail caterpillar.

Swallowtail caterpillars look like fresh birddroppings in their first four instars. After the third moult they are leafgreen with a false eyespot on each side, which gives them a snake--like appearance. If all these protective adaptations fail, the Swallowtail caterpillar curls back towards the predator and from behind its head comes out a bright orange forked organ, called the 'osmeterium' that emits a strong odour.

When alarmed, some caterpillars just drop down on the ground and play dead, merging with the leaf litter, and crawling back on to the food plant after the danger has passed. Most caterpillars come in shades of green and brown, which makes them almost invisible among their food plants. The effect is further enhanced by their being marked with lines very much like the veins of a leaf, or by lateral lines that optically break up their body pattern among the

blades of grass. A classic example is the caterpillar of the Baron butterfly. Not only does its body structure and colour render it invisible on a mango leaf, but it also sits in the middle of the leaf to match the line on its back with the midrib of the leaf, making the camouflage complete. Thus behavioural adaptations aid its survival.

Caterpillar of the Baron butterfly on mango leaf..

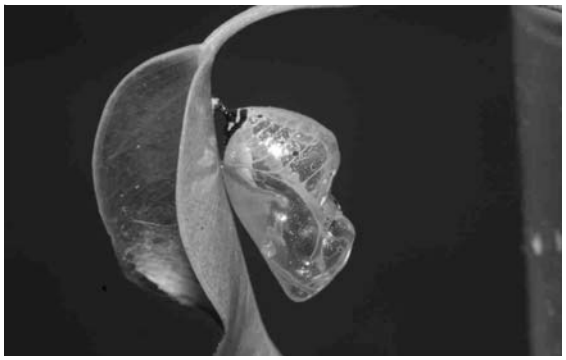


A camouflaged caterpillar.

The caterpillars and even some pupae of some Lycaenids have evolved a very effective strategy to protect them-selves. These caterpillars have a 'honey gland' on the abdomen, which secretes a sweet liquid attractive to ants. The ants feed on the liquid and, in return, they protect the caterpillar, mainly from predatory wasps. The ants also watch over them when they pupate and protect them till the emergence of the adult.

Another vulnerable stage in a butterfly's life is pupation. In this stage, it is completely immobile. To escape predation, most pupae are well camouflaged to look like a leaf or a broken dry twig (e.g. the pupae of the Common Mime) so that detection is difficult. On the other hand, the pupa of the Common Crow shines quite conspicuously. Probably its iridescence warns predators of its distasteful contents. Even in their quiescent stage, some Swallowtail pupae, when disturbed, make snakelike hissing sounds by moving their rear segments to scare away enemies.

Broken dry twiglike Pupa of common mime.



Gold shining pupa of Common crow.

The period during which the insect remains in the pupal stage depends upon the season. If the proper food plant is not available, the pupae go into a hibernationlike stage called diapause and emerge as adults only in the next season when the appropriate weather conditions ensure availability of food plants for the caterpillars.

With all the protective adaptations right from the egg stage to the adult stage, butterflies still fall prey to birds, lizards, frogs and other predators. But each protective adaptation is effective in the sense that by rendering these insects less visible or less digestible or less edible, the attack is, in each case, limited only to a particular type of predator. In the ab-sence of such a process, the destruction would have been wholesale**.**

How to Rear Caterpillars:

Want to witness the miracle of Metamorphosis then try to locate any caterpillar from one of the plants mentioned in the table. You can take whichever caterpillar you come across, but take care that you don't pick up any of the hairy caterpillars of moths as they are not good subjects to start with.

❑ After you get a caterpillar take a clean wide mouthed plastic jar and make holes in the lid for passage of air.

❑ Place your caterpillar inside the jar along with leaves of the same plant from where you had collected it. Feed your caterpillar everyday with fresh leaves and take efforts to clean the jar every day.

❑ Place your jar in a safe, airy, well-lighted and cool place. Take care of ants, which easily find their way into the jar and eat away live caterpillars. Best way is to apply a petroleum jelly at the base of the jar or else you can simply keep it in the centre of a plate containing water.

❑ Avoid overcrowding, the few the caterpillars, the better are the chances of successful rearing.

❑ While putting the food plants, try to get the caterpillars to wander on them. They could be easily persuaded to move by a soft brush, but should never be handled or lifted with fingers as they are easily injured.

❑ Take down regular notes about your caterpillar's growth. You will notice that as they grow they shed their skin (moulting) and this would be the time when your caterpillar does not want to eat and would appear very sluggish, nothing to worry, wait for a day or two. Once it moults your caterpillar will become very active and voracious.

❑ As the caterpillar keeps on growing in size, a day will come when it will stop feeding and it will appear restless. If you find your caterpillar wandering aimlessly, it is an indication that it is about to pupate. Provide some dry twigs and leafy branches so that your caterpillar can choose a suitable place to pupate. Some caterpillar prefers to pupate on branches while some would like hang under the leaf. This pupation habit is exclusively observed for butterflies. In case for moth caterpillars, at the time of pupation the body colour changes from green to muddy brown. For these caterpillars they will either pupate within the leaf foliage or go inside mud. So best thing would be to provide both options.

❑ When butterfly caterpillars pupate they hang upside down on the pupation site for almost 36 hrs. Care should be taken that they should not be disturbed in this stage. Very soon, the upside down hanging caterpillar changes into a beautiful non-feeding stage called pupa. In case of moth caterpillars, one cannot see such changes happening, but they too undergo the same changes with few exceptions. Moth caterpillars weave a structure for pupation called as cocoon and the pupa lies free inside which is not observed in butterflies.

❑ During pupation the caterpillar body is converted into the adult body and this may be any where between 7-15 days depending on the species. At least in the butterfly pupa you can observe the daily development of the pupa as it darkens gradually before the emergence of the adult butterfly, whereas in case of moths you are completely in dark and do not know what is happening inside. Be patient then.

❑ And one fine morning you would be surprised to see your butterfly or moth has emerged from their pupal cases and are hanging upside down in attempt to expand their crumbled wings and also drying them. If the container's size does not allow this kind of movement then you will have crippled butterflies and moths which will be never able to take flight again. So ensure to rear caterpillars in large jars.

An hour after the emergence of the butterfly or moth, the wings harden enough for its first flight. Now carry the container outdoors and enjoy the gratifying and exhilarating experience of watching the lovely creature flutter away.

Name of Food Plants	Name of Butterflies and Moths
1. Cinnamon	Common Mime, Blue Bottle butterfly
2. Lime and Orange plants	Lime , Lime blue, Blue Mormon butterfly
3. Curry leaves plant or k*addipata*)	Common Mormon butterfly
4. Custard Apple	Tailed Jay butterfly, Atlas moth
5. Mast Tree	Tailed Jay, Spot Swordtail butterfly
6.Indian Laburnum Tree	Common Emigrant butterfly
7. Indian Jujube or *Ber*	Common Pierrot butterfly, Tasar moth
8. *Bryophyllum*	Red Pierrot butterfly
9. Bitter Hedge plant	Common Silverline butterfly, Death'head Hawk moth
10. Giant Milkweed (*Calotropis*)	Plain Tiger butterfly
11. Oleander plant	Oleander Hawk moth, Common Crow butterfly
12. Banyan and Peepal	Common Crow butterfly, Common Map butterfly
13. Castor	Common Castor butterfly
14. Mango	Common Baron butterfly
15. Gulmohur	Common Nawab butterfly
16. Tamarind	Black Rajah butterfly
17. Railway Creeper	Convolulus Hawk moth
18. Tabermontana or *Tugor*	Oleander Hawk moth
19. Gardenia plant	Bee-Hawk moth
20. Ipomea carnea or *Besharam*	Death's Head Hawk moth

Data recording: No wonder studying insect now would appear very interesting but without maintaining proper notes your efforts will be wasted. Hence maintaining an Insect Diary would be very essential.

❑ **Location:** Whenever you observe or collect the caterpillar please note the exact locality where the caterpillars were seen e.g name of the place/town.

❑ **Date & Weather:** The date of collection or observed or for reared specimens, the date of emergence should be mentioned. Include the day of the month, the

month and the year and also mention the time of the day. Add a note on weather on that day by checking in the newspaper on the temperature and humidity.

❑ **Name of the host plant:** The name of the host plant on which it was seen. It is important to include how the insect was associated with the host, as it is one of the important life history or ecological data. The fact that the insect was bred from, feeding on, egg-laying on, or even resting on the host is obviously of more value than it was beaten from or swept from the host. Proper identification of the host is a must.

❑ **Habitat:** The type of habitat in which the specimen was observed/collected. If possible the habitat should be indicated with reference to the plant association or to the dominant plant species of the situation in which the insect was observed or collected. E.g. on branch of teak tree, among the leaf litter or on the ground

❑ **Habit:** Any information noted on the habits of the insects, such as found feeding, resting, moulting, pupating, parasitized or being eaten by a predator. Be sure to mention any of these.

❑ **Coding:** If you are rearing any caterpillars, maintaining a code number will be very important. Have a serial number like 1,2,3.. so on with initial alphabets of insect names such as CM 1 i.e. Common Mormon no. 1

Through this study we hope to build a better understanding of the lives and habits of many of these insects and why they have been able to exist for so many centuries on this planet. But remember please **do not collect** unnecessarily. Study them as living components of an ecosystem and not as dead specimens.

Nature Photography

Dr. Amol Patwardhan.
Research Co-ordinator, Conservation Action Trust, Mumbai

Photography and painting are manmade creative ideas which replicate on paper what human eyes see. Following are main differences between these two.

- Painting is Artistic Impression. In painting, a painter can change the contents, background to certain extent.
- Photography is realistic, optic impression with inputs from photographer. Off course now a days with the advent of digital technology in this field any thing is possible.

Following are different Types of photography-

Portrait, Fashion, Nature, Industrial, News, Astro

Basically there are main two types of camera that are available today-

Aim and shoot cameras like Kodak KB10, KE20

-Non professional cameras
-Lens is fixed 35mm, non changeable
-View finder and lens give different angle.
-Settings fixed 1/125 sec., F 5.6
-Films of different ISO can be used
-Good for landscape photography

Now a days compact digital cameras are available which are also basically aim and shoot but the difference is that the film is replaced by digital CCD which captures image.

Single Lens Reflex (SLR) Cameras

-Professional cameras.
-Lenses of desirable specifications can be used as per requirement.
-Settings can be changed as per need of the photograph.
-View through view finder is the same through the lens.
-Films of different ISO can be used. Now a days digital SLR are available
-Any type of photography possible.

In SLR cameras there are four major program modes. They are as follows.

Programmed Auto (P): Camera controls shutter speed and aperture automatically allowing to do settings set by photographer. Settings like ISO, Exposure compensation etc can be adjusted by the photographer as per the requirement.

Shutter priority (S): In this menu the shutter speed is decided by the photographer while aperture is decided by the camera. This mode is useful is when one wants to capture the moving object like running animal or in sports. The shutter can be set from 1/2000 of second to the Bulb where shutter can be kept open for as much time as required. Bulb mode is useful when one is shooting astronomical objects when the shutter is kept open overnight.

In this picture the shutter was open for four and half second. The F was automatically set to 2.3. The effect of opening the shutter for so long is that you can the sun rising in background and also the lights in the building. This gives a feeling of twilight.

Aperture priority (A): Here the photographer decides the aperture value as per his discretion while shutter speed is decided by the camera. The aperture value is normally expressed as F number. It decides the sharpness of the object. F value can be changed between 2.8 to 32. Higher the value higher the sharpness and vice versa.

For the picture on the top the F value was set on F 6.3 at ISO 100. The shutter automatically set on 1/116th of a second by the camera. For the picture below the F was set on 5.6 the shutter set to 1/126th of the camera. The main object is in the centre which is nicely exposed on both the frames however the background in the right frame is dark and diffused while on the upper side is bright and bit sharp.

Manual mode (M): In this mode all the settings are done by the photographer. Camera decides nothing. This mode is normally used when the object to be photographed is still and the photographer can do some experimentation.

The settings for the top photograph were shutter 1/483th of second and F 3.6 while for the right were 1/115th of second and F 5.6. Lowering the shutter speed caused the picture to brighten more. The below picture shows background bit sharper than the upper picture one because the F number is higher in the lower one.

Other than above modes there are some more modes as follows:

All of these modes are almost completely auto and a photographer has just to compose the frame.

Auto: Complete auto. Camera utilizes its own knowledge to get picture. Photographer has only to click.

Landscape: Used outside to capture a landscape.

Portrait: To take a portrait of a person

Night: Picture to be taken in the night. Automatic flash is used.

Close up: Used to take close up photographs of smaller objects.

Exposure compensation can be employed to deliberately offset the F value from measured value. The F value changes + or - in 1/3 or ½ steps. This means that when F value is set for 11 then at exposure compensation -1/2 the F value increases by ½ of the each F value.

White balance

Human vision compensates for variations in the color of normal ambient light so that we see white and gray objects as neutral. Film cameras don't compensate except using films of different ISO and filters. Modern digital cameras try to mimic human eyes by balancing the white and gray as neutral for different ambient light. In digital camera you will different white balance settings as auto, daylight, cloudy, fluorescent, incandescent and flash.

Auto- camera decides the white balance

Daylight- used when you are shooting bright daylight

Cloudy- in cloudy atmosphere. It brightens colors

Fluorescent- when you are using fluorescent light like tube light as a light source

Incandescent- if you are using light source from the bulb

Flash- if you are using flash

Use of flash

Most of the time use of flash is very limited. The flash produces a rapid burst of light thus use becomes very strategic and critical. If not used strategically it blackens the background and gives unnatural feeling of studio setup or a night shot as seen in the following photograph.

Following photographs illustrates how the use of flash is strategic. This common palmfly butterfly was snapped at the same camera setting. Not using the flash causes blackening of the object while flash light causes proper lighting of the object without blackening the background.

without flash

with flash

Using flash light from different direction changes perspective of the photograph which can be seen in the following photograph. This is the mating pair of leaf bug. The light was used from right side which elaborates the dew drops on the leaf.

Composition

If you are technically fit but if the frame is not composed properly then all the efforts taken go in vain. Following is glassy tiger butterfly. The frame on the top shows what the butterfly is but the frame is not properly composed. The one on the lower side is nicely composed where you can identify the species what is; also the flowers and leaves are also admirable.

Important Considerations

- The hobby of photography is expensive therefore consider before investing and also get second and third opinion.
- Even with smaller camera one can get fairly good shots but if you want to focus on birds then you have to get good zoom lens and if you want to photograph small objects then you have to buy macro lenses. Whichever is the option you have to invest fairly large amount of money.
- For nature photography you have to wear camouflaging cloths.
- Patience is the major character one has to acquire because you may not get the object as and where you desire.
- Don't get disheartened if the desired animal, bird, insect cannot be seen. You are in their territory and have to wait till they appear.
- Habit of carefully stalking the object is also most important.
- The organism of the interest should not be disturbed, killed, removed from its habitat before and after the photo session.
- Always carry all the equipment you have. You may not know what will be required when.

Poster Making

by Tejal Vishweshwar
HOPE, Sahayog Mandir, Thane (W)

This is the text version of the 20 min. presentation on 'Poster Making', prepared to guide the participants of the Workshop on 'Wonderful World of Insects' organised by B. N. Bandodkar College of Science, Thane on 16th January 2008

There are different ways of communication and one of them is through posters. Posters are easy for presentation, display & very effective means of communication that can target a large audience and therefore commonly used medium.

Posters can be broadly classified under three categories.

1. **Social Posters** -for mass awareness on social issues/ concern; like posters on keeping surroundings clean or posters for generating funds for affected areas by malaria or posters on planting plants/ trees that attract butterflies.

2. **Educational Posters** -to impart knowledge; like posters on metamorphosis of a caterpillar into a butterfly or posters on various types of butterflies & their host plants or posters on myths and realities surrounding insects

3. **Commercial Posters –** for marketing a product or something new in market that can be bought; like posters on Compost / Organic fertilizer in market or posters on sale of host plants that attract butterflies or posters promoting paid visits to butterfly park.

A Poster should not just be 'GOOD' but it also has to be 'EFFECTIVE'. A good & effective poster is simple in presentation which is clear for the viewer/s to understand. It should connect to the target group & meet the objective effectively i.e. it fulfills the purpose of making the poster.

A Poster is made up of concept, design, material & display. It is necessary to know a few things before starting to make a poster. Get answers to following five questions;

WHAT? WHY? WHERE? TO WHOM? HOW?

Getting answer to these questions will help in developing a poster in an effective way and also make the job easy for proper communication.

What?	The SUBJECT that has to be communicated? Subjects like 'Wonderful World of Insects' is too vast. Be very specific on what you want to communicate.	Once the subject and objective is clear start collecting the required material and information on it. This can be done by group discussions or through books, Internet, etc.
Why?	The OBJECTIVE or the main purpose of communication. There could be many things to convey on an insect. Know the purpose of making the poster & the ultimate goal it should achieve.	
To Whom?	The TARGET AUDIENCE or the people to whom it is to be communicated. Know the people to whom it has to be communicated. The specific group, age, gender, background, language, etc.	Understand the general mindset or psyche of the target group.
Where?	The PLACE where it has to be displayed. Area, rural or urban, indoor or outdoor, one place or various places, etc.	Decide the specific place/s the poster has to be displayed.

Once you get your answers to first four questions, start working on the last question HOW?? How to communicate? Know the idea & presentation. Make use of collected information in a simple manner with right material for effective communication.

How to get the best idea?

Remember 'A IDEA' FIVE LETTERS- **A – I – D – E – A**

A - ATTENTION -Poster should be attractive to grab attention of the viewers

I - INTEREST -It should be interesting to have the viewer/ s glued & know more

D - DESIRE -It should be able create a desire in the viewer/ s to achieve

E - EMOTION -It should be able to arouse the right kind of emotion

A - ACTION -It should make the viewer/s act to get it

Try out a few ideas and select the best one which is clear for your target group to understand & communicates easily. Group discussions certainly help. The best idea unless executed properly is meaningless. Therefore make a good

presentation of the selected idea.

HOW to make a good presentation?

A good presentation comprises of;

1**. Right Material** - Once the idea is decided, select the necessary material that is suitable to execute the idea. It has two main substances;

>Visual – It is either a photograph or an illustration (painting/ sketch/ drawing). It is said that a strong visual can speak thousand words, which means the picture should be such that it can communicate everything that would otherwise require thousand words to convey the message. Selection of a proper visual as per your idea & subject is very important.

>Copy Matter - It is wording, the language – the headline & text matter. Proper use of language with appropriate wordings makes huge difference in conveying the correct message.

Posters can be either be pictorial-with a strong visual OR typographical with strong words-a good punch line OR both used tactfully as a combination. Apart from using fresh material, it can be made extremely cost effective by using various commonly available materials like newspapers, old card boxes, old bed sheets, pictures from magazines or newspapers, old calendars, lettering through stencils. It can be either painted or printed. It can also be made as a collage of cut outs or by using cloth pieces. All depends on the purpose and event for which the posters are made.

2. Good Layout- It is the placement of the visual, headline, text matter in the poster. Proper placement is necessary for the poster to look good & attractive. Try out a few rough layouts with different colour combinations, size of visuals & text matter. Select one that is appealing, well balanced layout & conveys the idea clearly as desired.

3. Appropriate Size & Number - Posters are either made single or in quantity. Some posters are for one time display and some could be printed for distribution. Some are individual posters to give out information like poster on an insect. It could be series of posters giving out information on various types of insects through number of posters. It could be interdependent poster showing stage wise metamorphosis of a caterpillar into a butterfly. Select proper size according to the information that needs to be conveyed.

4. Proper Display – Select a proper place for the poster/s to be displayed so that it is easy for your target group to view it.

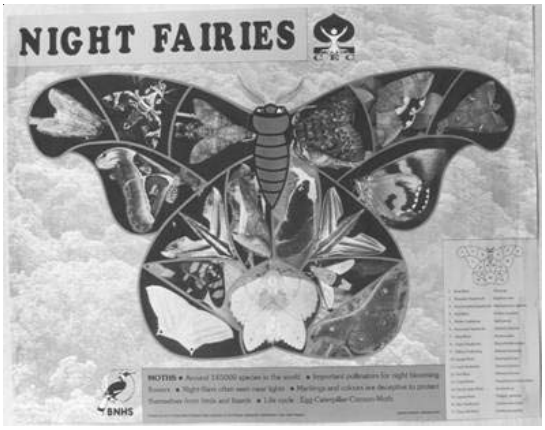
The size, material, display area/s & actual number/s to be used also vary according to available funds & requirement of a poster/s.

Getting a feedback before display is very essential. Before the final submission show the poster to few people from your target group & note their reactions. Make changes in idea or design if there is difficulty in understanding. Positive feedback means the poster would be successful in achieving its objective & ready for display.

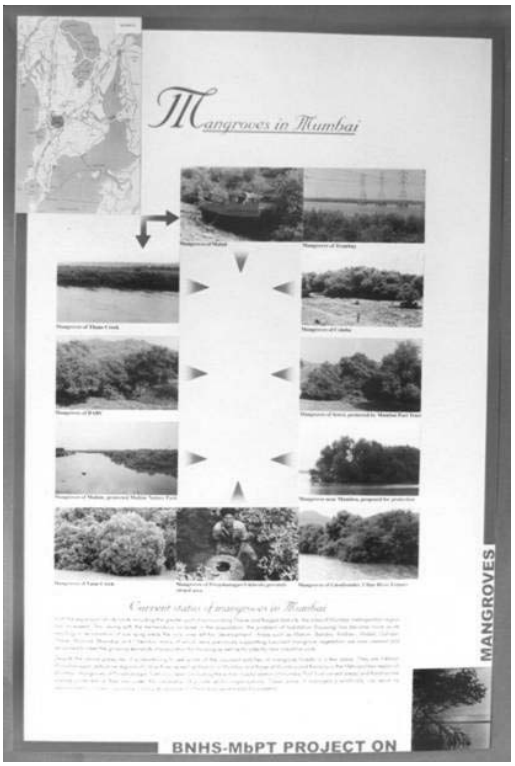
Remember Poster making is fun but the main purpose of making it should not get lost. Enjoy, All the best !!

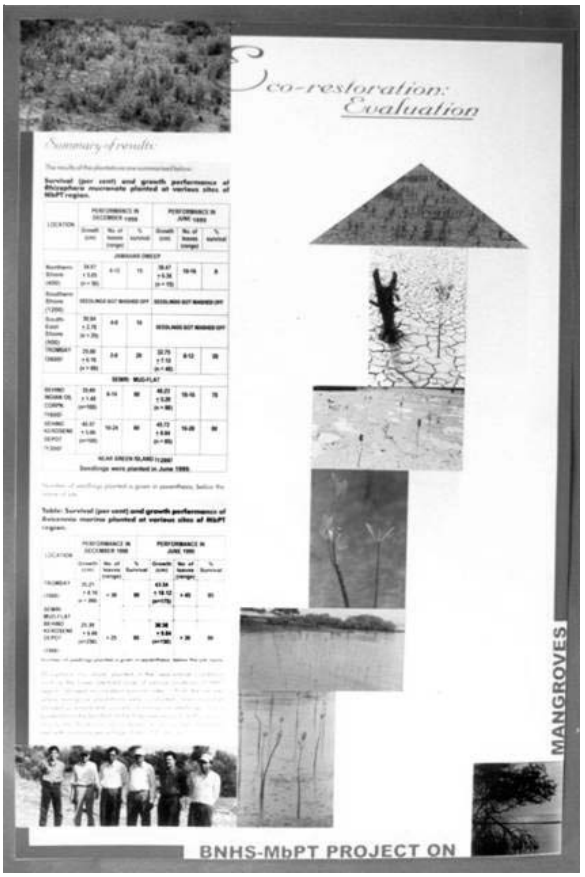
Few examples;

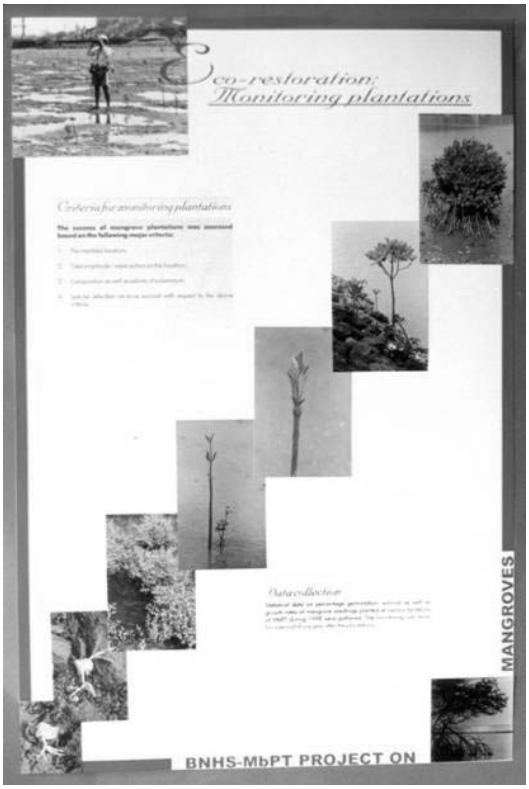
Series of Posters. Objective-to give information on various species. Target Audience-Mainly children.



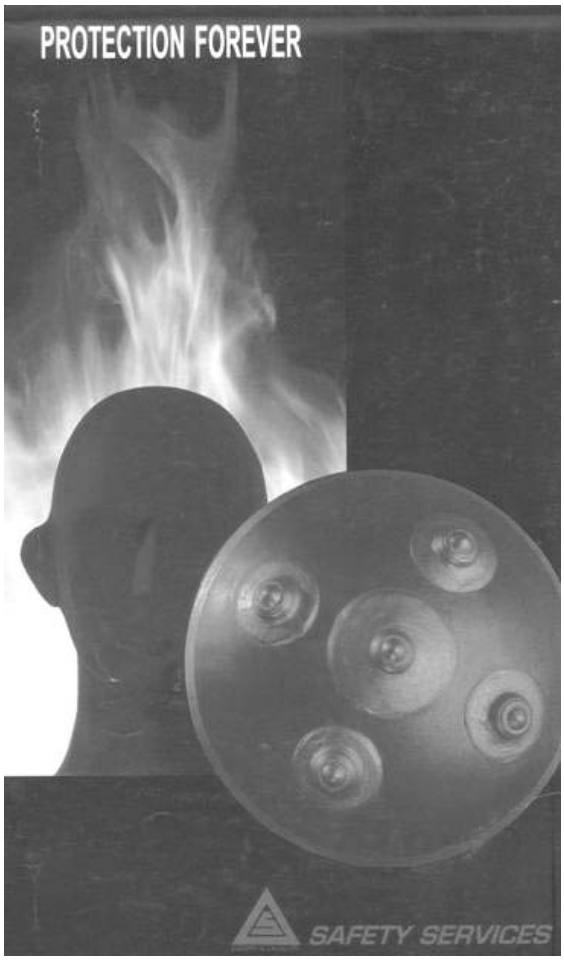
Interdependent Posters on Project work. Objective- to give information on the project work & make aware on the issues related to the problem area. Target Audience: Company members.







Individual Poster/s on Company & its products. Objective- to inform on the company profile & work. Target Audience: Prospective buyers/clients.



Parental Care in Insects

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Parental care – What is it?

- A care taken either by mother or by father of their young ones for their betterment

This phenomenon is shown by many insects. However the extent of parental care taken differs from insect to insect.

Norms of taking care –

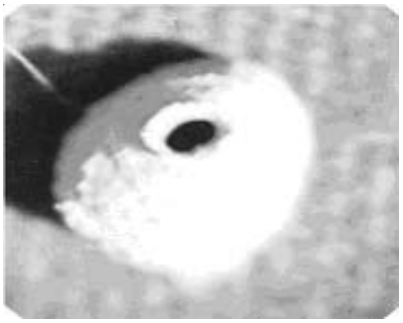
a. Provision of shelter for a stay and protection.
b. Provision of right and adequate food. Ensure availability of food.
c. Feeding young ones.
d. Be with the young ones as far as they need.

How these norms are followed by insects?

Different insects observe these norms in different ways.

- **By constructing shelter i.e. brood chambers –** nests etc. For example many wasps construct brood chamber or earthen nest for their young ones or they use readily available tubular structures or cavities. Some examples are given below

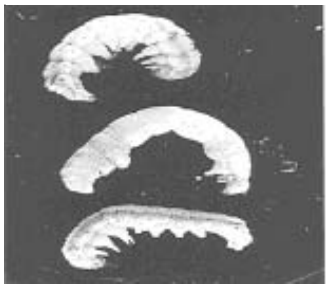
Nest in electric pin hole made by Blue-black wasp which keeps spiders as food for her young.



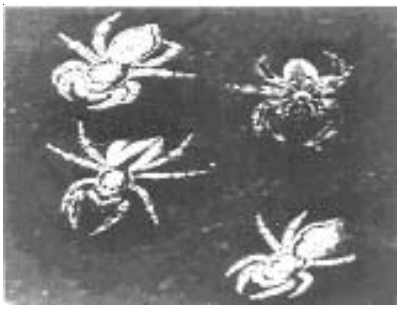
Nest of potter wasp *Eumenes spp.*

Brood chambers of a potter wasp.

- **Providing food to the young ones**. We know that honey bees feed honey or royal jelly to their young ones. Some wasps such as paper wasps also feed the young. Other wasps like potter wasps sting the prey insect such as Butterfly or moth caterpillar or spider etc. to make it unconscious and then store it in the brood chamber so that it is available to their young ones. Some wasps sting and then chew the prey insect to make food balls which they store in the brood chamber.



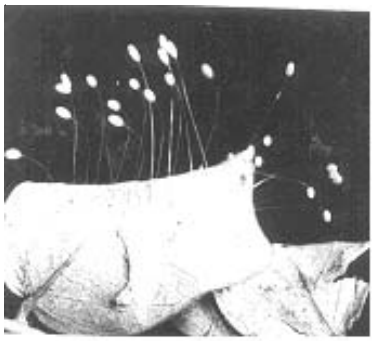
Larvae stored in the nest by potter wasp.



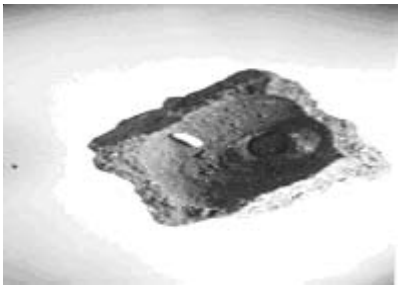
Spiders stored in the nest chamber.

- **Laying of eggs on appropriate medium and place.** For example butterflies, moths and also other insects lay their eggs on the food plant or the food so that the larva on hatching doesn't need to search. Some insects lay eggs on the tip of silken thread so that they are protected from the predators. Wasps lay egg on the food or on the wall of the earthen brood chamber**.**

Egg mass on leaf.

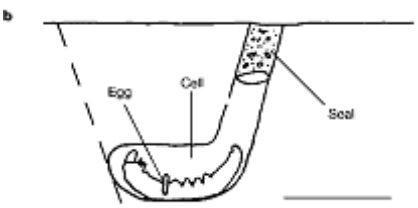


Eggs of Chrysopa on silk threads.

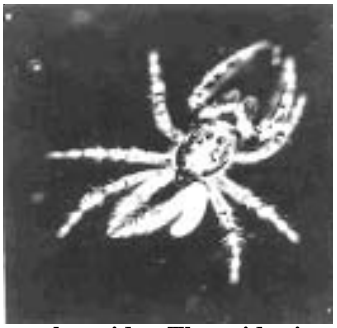


Egg of wasp on the wall of earthen brood chamber.

Wasp carrying caterpillar.



Caterpillar in the underground nest. Wasp egg on the caterpillar.



Wasp egg on the spider. The spider is stung by the wasp.

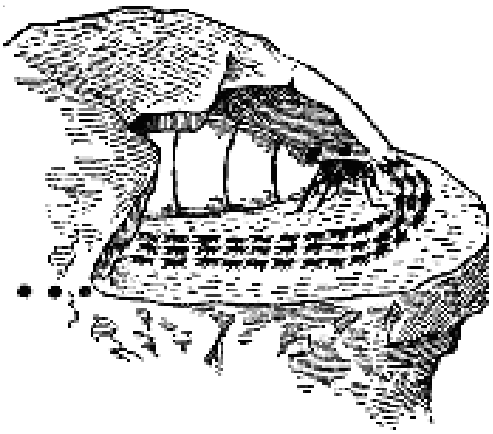
Following are some more example of Parental care

Bug guarding young ones.

Paper wasps colony

Honey bee collecting nectar and pollens for their youngs.

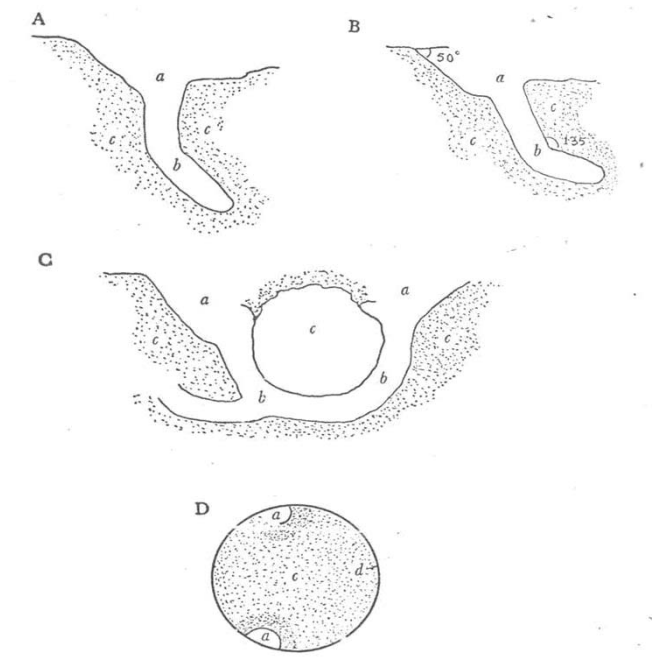
Termite colony (Diagrammatic)



Ant colony (Diagrammatic).

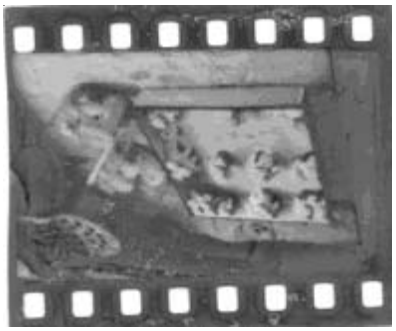
Parental care in Earwigs.

The earwigs construct underground nest which has galleries and chambers**.** They take care of the eggs as well as young. The adults often lick the eggs and keep them free from infection. They also care their young ones.



A, B, C Longitudinal Sections. D. Surface View

Under ground nest of Earwig.



Earwig colony maintained in a tray.

Earwig with egg mass.

Earwig licking an egg.

Earwig with young ones.

Acknowledgement : The author acknowledges with thanks, for the photos of Earwig provided by Prof. P. S. Ghaisas, Pune.

Simple Projects on Insects

Dr. B. G. Kulkarni
Institute of Science, Mumbai

- There are over 200,000 individual insects for every one human on earth. They are everywhere! Insects can be found anywhere from water to land, and swamps to mountain tops.
- Do you like insects?
- Do you think we need insects?
- Do you think they should be killed?
- 1 million different known species of insects in the world,
  All these species are divided up into about 32 orders
- The largest is the Beetles, or Coleoptera, with 125 different families and around 500,000 species

In fact, one in every four animal species on this planet is a beetle.

What type of projects on Insects one can take up?

- **Biodiversity –** One can study diversity of insects in any location such as college campus, garden, a particular forest area, aquatic insects in pond or lake or river etc.
- **Taxonomy and Systematic –** One can practice taxonomic identification of different insects around.
- **Responses to Pollutants –** One can study effect of pollutants on the the insects.

Some other projects :

Project 1

Honey bee

- Identification of three castes types of honeybees and their responsibilities inside the hive. *Queen*, *drones, worker*
- Importance of the honeybee to humans.
- To discover how honeybees communicate. Waggle Dance".

Project 2

- Identification of the life stages of different insects. Three different types of insect life cycles
- Egg, larva, pupa, adult egg, (Butterflies, Moth) Holometabolous insects.
- Egg, immature, and adult. (Crickets, cockroaches)
- The ametabolous stages are egg, larva (many), and adult. (Springtails and silverfish)
- Care for and observation of the life cycle of one species.

Project 3

Who Lives Here?

Take a pillow case, sheet or large piece of white paper. Place it under a plant or a tree. Shake it to see what insects fall out. Examine the insects and identify them. Some might fly away, but others will stay. How many different kinds of insects were found? Now try another plant and see if the insects are the same or different

Project 4

Take a Bug Census

- Ask the students to find out what kind of bugs are in a certain spot.
- Place a container (like a plastic margarine tub) in the ground with bait. The top of the container should be level with the ground.
- For bait you can use popcorn, fruit, grains, raw meat, kitchen waste or candy. Place a stone across the top, but do not cover it completely.
- The next day, lift out the container and see what insects you have caught in the container.
- The experiment can be repeated for several days to see if different insects appear. Put the container in different spots in the garden, like under a bench or in the lawn, to see if you get different insects in different places.

Project 5

Night Time Insects

- There are many insects that like to come out at night when it's dark. These insects are called nocturnal. Insects rarely seen during the day can be observed at night by setting up a simple light trap.
- Hang a white sheet under an outdoor light or hang the sheet from the branches of a tree.
- Turn on the porch light or shine a bright light on the sheet hanging from the tree.
- Soon, because of insects being attracted to the light, you will see many insects clinging to the sheet.
- Look at them up close and record what you find and how many different insects come to visit your light trap.

Project 6

Fast Food for Butterflies

- Even if you don't have room for a butterfly garden, you can attract butterflies to your house or school garden by offering them some "fast food."
- Cut purple, red, and yellow sponges into the shapes of flowers and place them into a shallow dish or pie tin.
- Mix 1/3 cup of sugar into one cup of water, stirring well until the sugar dissolves.
- Pour the sugar water into the dish with the sponges almost to the top of the sponges. The sponges should be wet to the touch.
- Place the dish outside and before long you should see butterflies landing on the sponges to sip the sugar water. Don't be surprised if other insects find their way to the sponges to take advantage of the sweet treats.

Life History of Butterfly *Papilio polytes polytes* L

(Lepidoptera: Papilionidae)

Dr. Sunil M. Gaikwad
Bhogawati College, Kurukali, Karveer, Dist. Kolhapur.

The *Papilio polytes polytes* is true black bodied swallowtail butterfly called the common Mormon. Among the various insect pests that attack lemon, curry leaf, orange and other plants of Rutaceae, the *P. p. polytes* is a serious and regular pest. The caterpillars feed voraciously and cause extensive damage to nurseries and young seedlings. Severe pest attack resulted in entire defoliation of the tree and leads to retardation of plant growth. Being a holometabolous insect, metamorphosis is complete with egg, larva, pupa and adult stages in life cycle of this insect.

Egg: The eggs are smooth, spherical, pale yellowish when laid but become grey and ultimately black when close to hatching. All the fertile eggs have a prominent dark spot on the top (Fig.1). Eggs measured 0.98 mm to 1.12 mm with an average of 1.05 mm in diameter.

Larva: There are five larval instars which are totally lasted for 20.02 days during rainy, 22.64 days during winter and 20.94 in summer season. Molting occurs usually during morning hours. Early four instars look like bird droppings while fifth instar is different well camouflaged with host plant

First instar larva: After 4 days of incubation the first instar larva cuts the eggs shell put. The hatching requires 100 ± 10 Sec. and it occurs during any time in day light. Newly hatched larvae are cream coloured and later on become brown and have spiny appearance due to presence of fleshy protuberances on body (Fig.2). The first instar larva on an average measures 2.39 mm and 0.47 mm in length and width respectively. The average duration of first instar larva is 3.38 days, 3.52 days and 3.48 days during rainy, winter and summer seasons respectively.

Second instar larva: The second instar larva is pale brown and became darker as it grew older. It posses milky white prolegs and anal legs and thorax is larger than head (Fig.3). The average length and width of second instar larvae are 6.84 mm and 2.04 mm respectively. The average period of second instar larvae is 3.37 days, 3.20 days and 3.33 days during rainy, winter and summer seasons respectively.

Third instar larva: Third instar larvae are dark brown in colour and resemble the second instar larvae except in size (Fig.4). The third instar larvae are with an average length and width of 12.57 mm and 2.56 mm respectively. The average second instar larval period is 3.81 days, 4.14 days and 4.35 days during rainy, winter and summer seasons respectively.

Fourth instar larva: Initially fourth instar larvae are brownish black which gradually turn to light green as they grow old (Fig.5). The average fourth instar larval length and width are 27.55 mm and 4.06 mm respectively. The average fourth instar larval period is 4.60 days in winter, 5.70 days in winter and 4.70 during summer season.

Fifth instar larva: Fifth instar larvae are pale green initially which gradually turns to dark green as they grow older. Brown cross band on the dorso lateral region of the 4^{th} and 5^{th} abdominal segment and two smaller spots on dorsal region of 6^{th} abdominal segment are present (Fig.6). The average length and width of fifth instar larva is 51.32 mm and 8.75 mm respectively. This stage lasted for average of 4.86 days, 6.08 days and 5.08 days during rainy, winter and summer season respectively.

Prepupa: The late fifth instar larva selects suitable place for pupation, shrinks in size and hangs in upright direction with the help of silken girdle and makes the shape C as prepupal form (Fig.7). The average length and width of pre -pupa is 27.81 mm and 7.83 mm respectively. The average pre pupal period is 0.98 days during rainy, 1.23 days during winter and 1.13 days during summer season.

Pupa: The complete process of pupation takes approximately 30 minutes and usually pupation occurs in the early night hours. The pupae are naked, angular and varied in colour from green, brown or grey. Head is slightly bifid, thorax conical in front and abdominal segments with dorsal tubercles (Fig.8). The average pupal length and width is 32.24 mm and 10.33 mm respectively. The pupal period is 9.87 days, 15.05 days and 10.30 days during rainy, winter and summer seasons respectively.

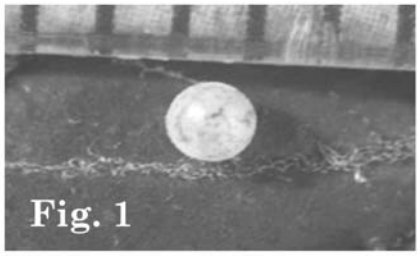
Adult: The exclusion (emergence of adult) occurs at dawn and it is completed within approximately 1 minute. The adult is dark black bodied butterfly with prominent tailed hind wing (Fig. 9). Fore wings with gold yellow scales, slender longitudinal cell streak with broad apex position. The outer marginal area has series of small creamy white yellow spots decreasing in size upwards to the apex. Hind wing has transverse discal recurred series of seven variable short, creamy white or yellowish spots divided by the veins. The lowest spot has a few outer side blue scales and also has strongly marked red marginal crescent. Body, leg and antennae were black. Dorsally on the head and thorax seven pairs of smaller white spots are present.

The female of this butterfly exhibit in three different forms, form *cyrus* resembles typical male, form

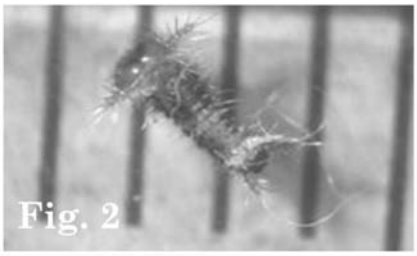
stichius mimic the common rose *Pachliopta aristolochiae* and form *romulus* mimics the crimson rose *Pachliopta hector*. The average length, width and wing expanse of adult is 27.05 mm, 6.08 mm and 100.33 mm respectively. The longevity of adult is 3.95 days during rainy, 3.80 during winter and it was 3.93 during summer season only because adult does not accept the provided 10% honey or sucrose solution as artificial food.

The average total life cycle of *P. p. polytes* is 38.65 days, 48.67 days and 40.38 days during rainy, winter and summer seasons respectively. It indicates rainy season is more suitable for the growth and development of this insect than summer and winter.

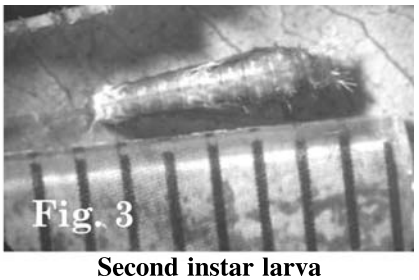
Life cycle of *Papilio polytes polytes*



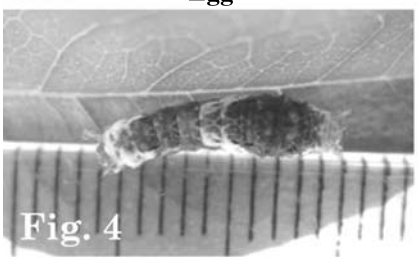
Egg



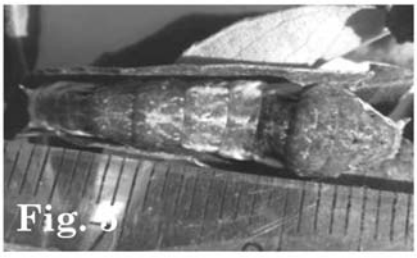
First instar larva



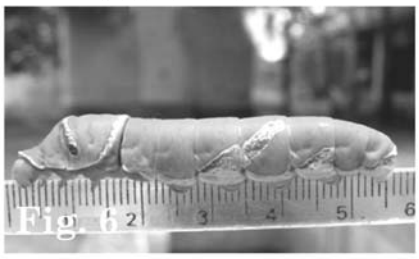
Second instar larva



Third instar larva

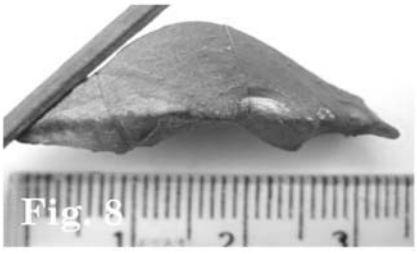


Fourth instar larva



Fifth instar larva

Prepupa



Pupa

Adult Female Form *cyrus*

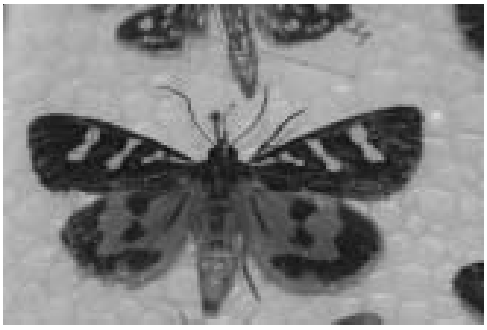
A short note on Moths

Mrs. Alka vaidya
BNHS, Mumbai.

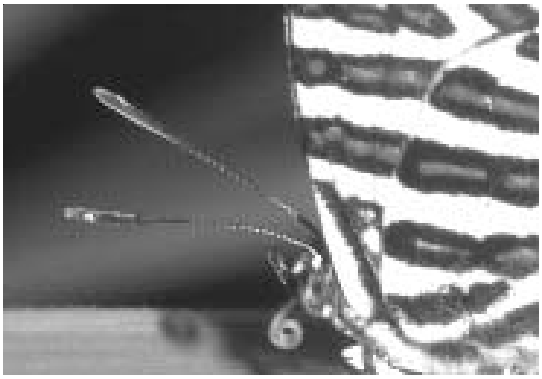
The Order Lepidoptera is the second largest order in the class insecta of Phylum Arthropoda which comprise moths and butterflies. Lepidoptera in Greek means scaly wings.

The difference between butterflies and moths is not great. Moths usually have antennae that are like thread or feathery. Butterflies always have clubbed antennae. Generally butterflies fly during the day and moths fly during night. But there are some moths which are day flying.

Difference between Moth and Butterfly



Moth-Threadlike antennae &Feathery antennae



Clubbed antennae of butterfly.

The moths are divided into macro Lepidoptera and micro Lepidoptera.

Most of the species feed on plants. Many moths are beautiful, many are aesthetic and most through their diversity and association with vegetation reflect ecological stability of natural environments .They are integral part of an ecosystem.

Moths are insects with four wings and most of them have a long coiled proboscis with which they feed. Some moths have chewing mouthparts and some have no mouthparts at all. Their life cycle passes through a complete metamorphosis of egg, larva, pupa and adult.

Nothing is known of the detailed life-histories of many moths. Very little has been recorded on the distribution of species by habitat. There is enormous field of research of rearing moths is open to enthusiast.

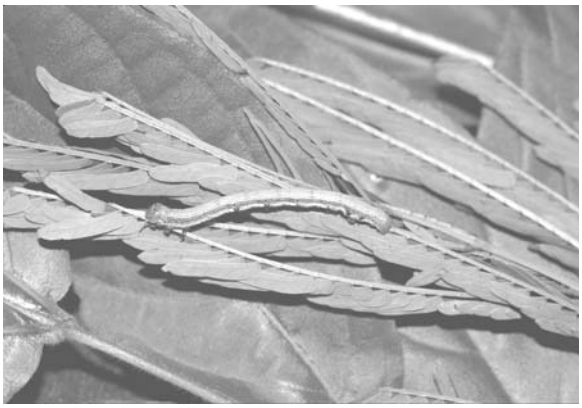
Female moths are born loaded with eggs, but the eggs are infertile until the male locates the female. The eggs are laid soon after mating is completed. In some cases parthenogenesis has also been recorded. On hatching, these eggs have sometimes been known to produce only females for several generations.

The eggs are generally spherical but in some cases they are flat, elongated, smooth and irregular.

They are laid singly or in groups. After hatching the caterpillar eat its empty egg shell which provides nutrients for the new born. If it does not eat the shell the caterpillar often can not survive .

Larvae feed on a variety of plants. In most species, specific plants are acceptable. Some are polyphagous. They feed on leaves, stems, flowers and the seed pods. Some feed on lichens and some are carnivorous feeding on scale insects, flies etc.

Larvae of different moths



The growth of the larvae goes through series of moults or shedding of old skin.

Pupation takes place in woven leaves, or in the stem, or in the ground litter or in the ground. In some cases, pupa is protected in silken cocoon spun by the larva, from which we get raw silk.

Pupae of Moths -

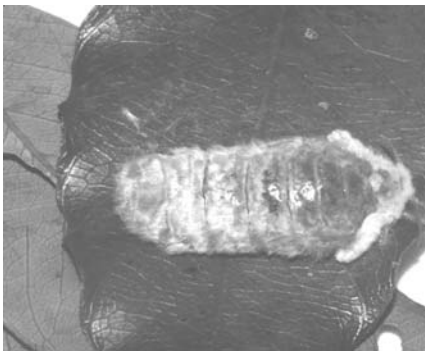
The entire life cycle may take variable time depending on climatic conditions such as temperature, rainfall, humidity and food plant availability.

The adult emerges from the pupa around late evening and dawn taking advantage of darkness and low light and thus protecting it from predators.

Moths are predominantly night fliers and their attraction to light is a well known phenomenon. Moth vision is completely different than human vision. Moths have large compound eyes containing hundreds of facets. Each facet is a light focusing and detecting organ. The compound eye permits all around vision and also very sensitive to movement because a moving object must move across the face of the eye, from one group of facet to another which makes it detectable. Moths often prefer to fly at a particular time of night depending particularly on the temperature. Moonlight affects the numbers of moths attracted to lights. There seems to be low activity with bright moonlight. The position of the light is important. The light looking down a slope may be more attractive because the moths prefer to fly up. Still the physiological reasons for this phenomenon are not fully understood. During past several years extensive work has been undertaken trapping moths using various forms of light trap.

Light trap for collection of moths

Some prominent families of moths –

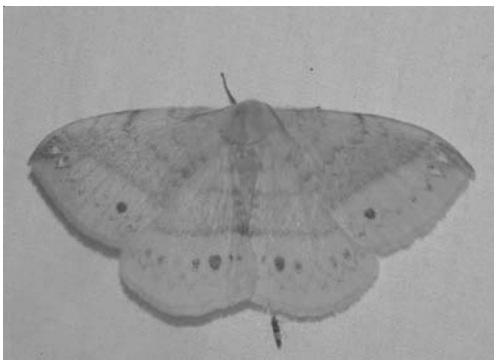


Limacodidae- Slug caterpillars

- 1000 Species Worldwide
- Means "slug-like"
- Small to Medium size
- Mouth Parts Vestigial
- Caterpillars look and move like slugs
- Caterpillars have Stinging Hairs or Spines Pupae like Cartridges

Cossidae- Goat moths

- 500 Species Worldwide
- Dull Coloured
- Caterpillars are stem-borers
- Pests in Coffee and Cocoa
- Frass smells like Goat, so common name 'Goat Moth'

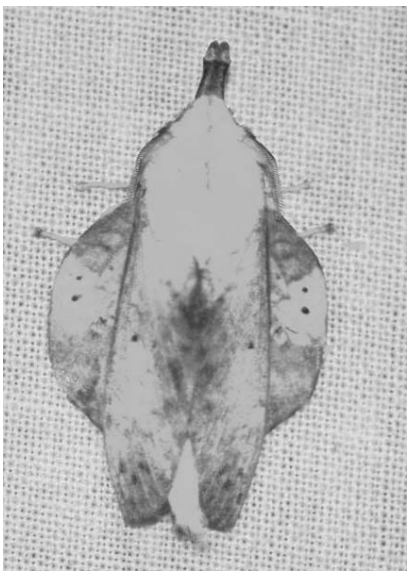


Eupterotidae- Monkey moths

- 300 Species Worldwide
- Hairy Appearance, so common name 'Monkey Moths'
- Mostly Dull Coloured

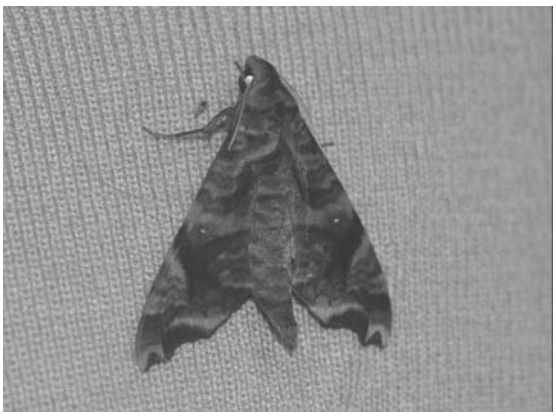
Saturniidae- Emperor moths.

- 1,000 Species Worldwide
- Largest and Most Spectacular Moths, so common name 'Emperor Moths'
- Many have Transparent Patches on Forewings and Hindwings
- Cocoons used for Silk making



Lasiocampidae-Lapper moths

- 1000 Species Worldwide
- Caterpillars have Lobes or Lappets on their sides, so common name 'Lapper Moths'
- Broad Hindwings protrude forward from under the Forewings

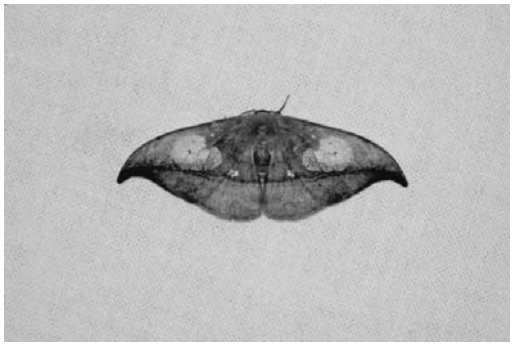


Sphingidae- Hawk moths

- 1,000 Species Worldwide
- Streamlined Wingshapes
- Robust Bodies
- Powerful Fliers, so common name 'Hawk Moths' Well Developed Long Tongues

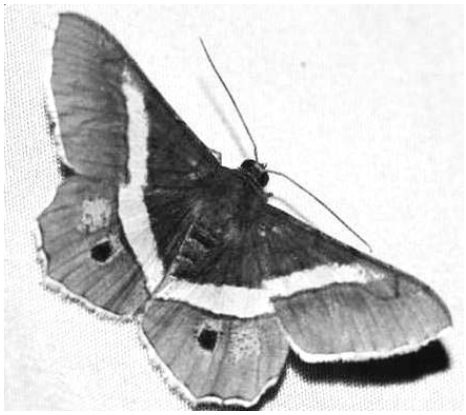
Lymantriidae- Tussock moths

- **2**5,000 Species Worldwide
- Caterpillars have Body Hairs grouped in Toothbrush like Tufts, so common name 'Tussock Moth'
- Wingless Females



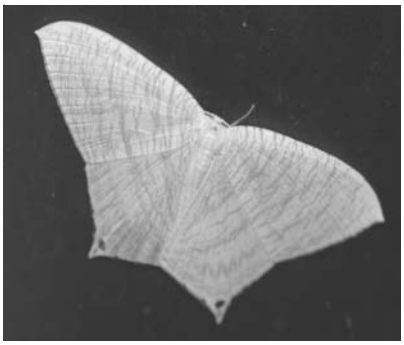
Drepaniidae- Hooktip moths

- 800 Species Worldwide
- Strongly Curved Forewing Tip, so common name 'Hook Tip'
- Tongue Vestigial



Geometridae- Looper caterpillars.

- 15,000 Species Worldwide
- Rounded Wings
- Slender Body
- Looper Caterpillars
- Ungainly walk, so common name 'Loopers' or 'inch worms'



Uraniidae- Upside down moths

- Some Day-Flying
- Well developed Tails on Hindwings, so common name 'Upside down'

Bombycidae	-	Silk moths.
Brahmaeidae	-	
Notodontidae	-	Prominent moths.
Arctiidae	-	Tiger, Ermine moths.
Nolidae	-	Snout moths.
Agarstidae	-	Forester moths,
Noctuidae	-	Active at night.

What use are moths? / Importance of Moths

- They exist in large numbers; in evolutionary terms, they have been successful.
- There are several species of family Saturniidae that have been used for silk extraction. Moths have been used to control weeds.
- Moths help pollination, recycling of organic matter.
- They are a source of food for birds and other vertebrates.
- Few moth larvae attack scale insects and are thus beneficial to plants.
- Many species are pest to crops and require biological research to control them.

Silk producing insects

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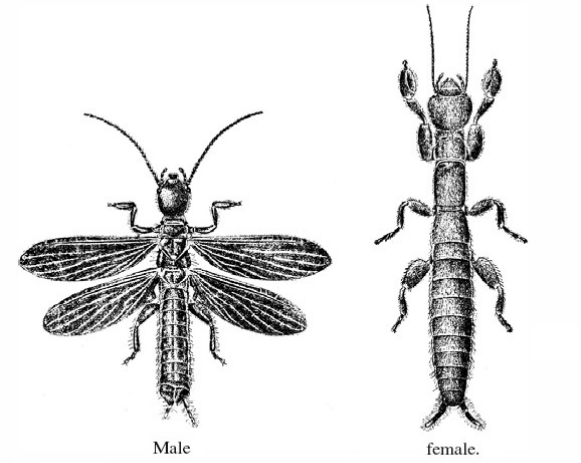
Grihakalpa Apartment, Karve Road, Pune

During the prolonged period of evolution of animals the insects did numerous experiments. In some experiments they got significant success. One such successful experiment is secretion of silk. It is not that only silk moth larvae produce silk, there are others too which has the ability to secrete silk. The silk is secreted by different body structures such as salivary glands, integument glands, Malpighian glands, reproductive accessory glands etc. Following are some examples.

Embia major

This is a small insect living under rocks or in the cracks on the tree stems. The female is wingless and produces a tubular silken bag and lives in it with her young ones. The silk is produced by integument gland on the 1st pair of legs.



Embia major (Embioptera).
From A. D. Imms, 1913, On *Embia major* n. sp. From the Himalayas, *Trans. Linn. Soc. Zool.* **11**:167–195.

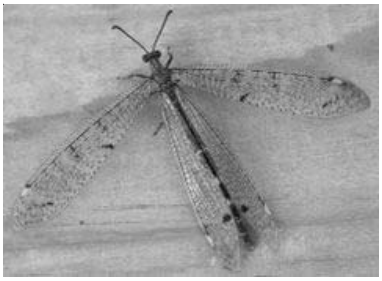
Hilara **,** a dipteran fly also secretes silk through the gland in the integument, but it uses it as a pupal covering (case).

Antlions

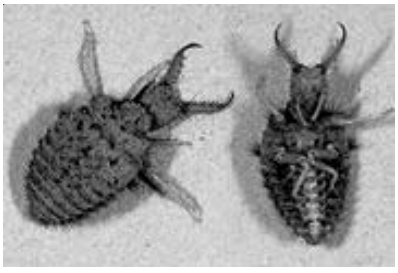
The adults resemble dragonflies or damselflies. Antlions are easily distinguished from damselflies by their prominent, apically clubbed antennae which are about as long as head and thorax combined. The adults of some species eat small pollen and nectar, while others are predators of small arthropods.

The antlion larva is a ferocious-appearing creature with a robust, fusiform body, a very plump abdomen, the thorax bearing three pairs of walking legs. Their head is square, flattened which bears an enormous pair of sickle like jaws. Depending on species and where it lives, the larvae will either hide under leaves or pieces of wood, in cracks of rocks, or dig pits in sandy areas. The antlion larvae eat small arthropods - mainly ants.

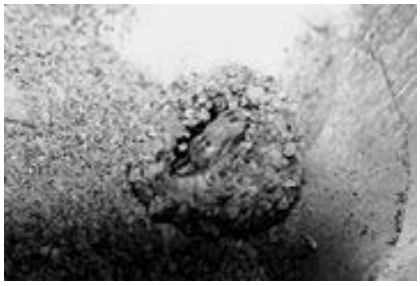
The larva makes a globular cocoon of sand stuck together with fine silk spun from a slender spinneret at the posterior end of the body.



Antlion adult



Larvae

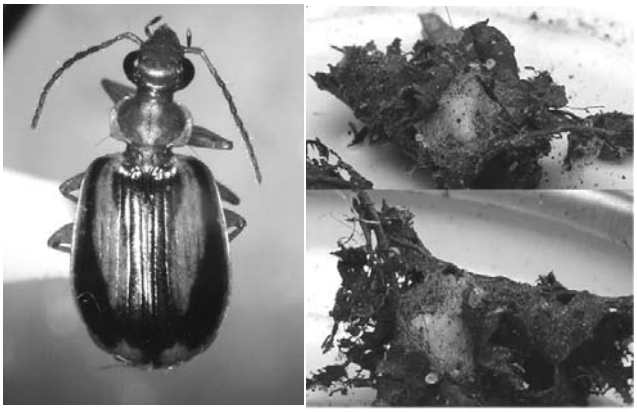


Pupa in silk cocoon

Lebia scapularis.

Larva of this beetle secretes a silken cover around while pupating. The silk is secreted in the intestine by the Malpighian tubules, in form of a chemical which on coming out from anus becomes silken thread.

The cells of Malpighian tubules have excretory function but they probably have taken up this other function.

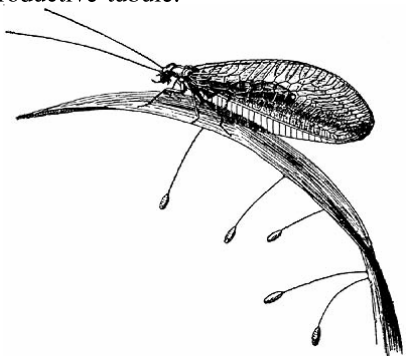


Lebia **beetel and pupae in silken cover**

Hydrophilus **beetle**

Hydrophilus beetle is aquatic insect living in fresh water. Its female encloses the eggs in silk covering so that they get protection. The silk thread is secreted by glands in the reproductive system.

Chrysopa or lacewing female while laying egg, touches the reproductive opening to the leaf or stem. At this time she secretes a sticky droplet. Then she lifts the abdomen so that the secretion gets stretched and a tough silk thread is formed. She then lays the elongated egg at the tip of the thread. This gives protection to the egg from predators. The silk thread is secreted by reproductive gland, which in fact has reproductive function, to ensure safe passage of egg through the reproductive tubule.



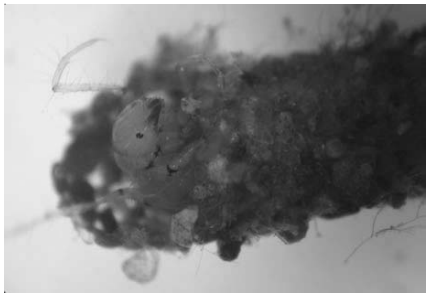
Lacewing and the eges on silken threads

Caddis fly

The larva of this insect is aquatic. It secretes a tubular covering around it self. The silk is secreted by the salivary gland or silk gland. Sand particles, small sticks etc. stick to the covering which the predators can not eat, giving protection to the larva

Caddis fly adult

Egg mass



Larva in silk tube

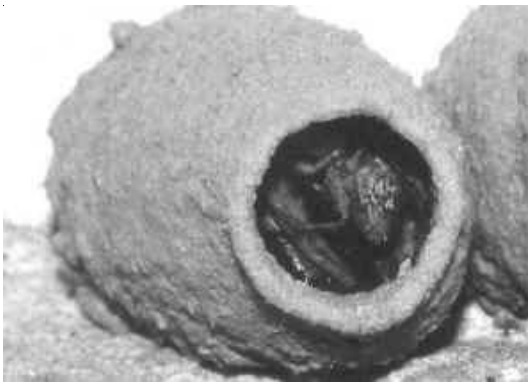
Pupae

Larvae of Honey bees and ***Eumenes*** secrete silken layer on the innerside of the cell in which they live. In case of *Eumenes* the inner side of the earthen potlike cell is rough; the silk layer gives them protection. In honey bees the cells are made up of wax and are smooth. Even then they secrete silk. It is probably their natural instinct! Both secrete silk through their silk gland.

***Eumenes* wasp**

Pot like mud nest.

The *Sceliphron* wasps have different species. Some construct earthen pot nests as shown in the photos whereas some use ready tubular structures; such as those in electric plugs, gas burners that are not in use etc. as their nest (brood chamber). The fully grown larvae secrete silken covering

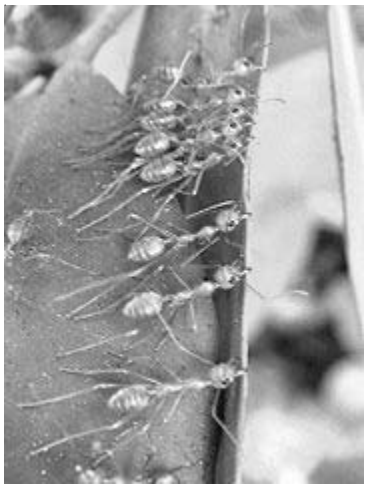


***Sceliphron* wasp and its pot nests arranged in a row.**

for the pupa .The covering is thin but tough and is reddish brown in colour. The colour is stable and does not change even slightly in many years. The pupal covering is supported by white silk fibers that are connected to the wall of the earthen cell. In these larvae the silk is secreted by silk glands or salivary glands.

Oecophylla smaragdina (common names include *weaver ant*, *green ant*, *green tree ant*, and *orange gaster*) is a species of arboreal ant found in Asia and Australia. They make nests in trees made of leaves stitched together using the silk produced by their fully grown larvae. Weaver ants may be red or green. In Malaysia they are sometimes mis-called "fire ants"

Weaver ants



Weaver ants collaborating to pull nest leaves together.

Weaver ants nest on a Mango tree

Larvae of Butterfly *Gangara thyrsis* use silk thread for connecting leaves of coconut tree, to provide them shelter.

Giant Red Eye Butterfly

Larva

Pupa in rolled leaf

All the insects described so far, secrete good quality, elastic and long lasting silk. However its quantity is too less, not enough to make spun silk also. Hence they are not used for culturing and commercial production of silk. The major silk producer is silk moth.

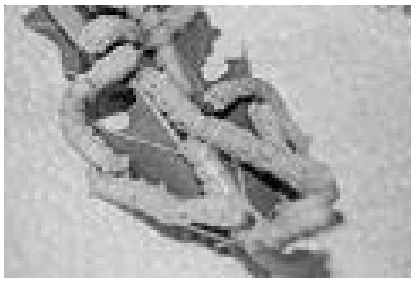
Silk moths of approx. 80 species are scattered all over the world. However 4 of them are important for silk industry. They are *Antheraea assama, A.mylitta, Philosamia ricini* and *Bombyx mori*. *A. assama* is common in the forests of Assam, its larvae feed on leaves of a variety of plants (polyphagous). *A. myllita* moth occurs in the forests of Bihar, W. Bengal, Madhya Pradesh. It produces Tussar silk. Both these moths cannot be cultivated in laboratory. Hence their cocoons are collected from forest.

Tussar silk moth

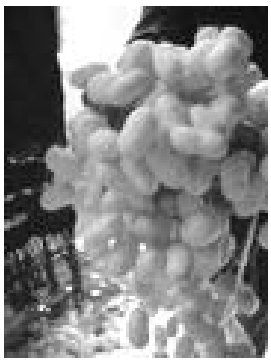
Antheraea assama

Adult *Bombyx mori*

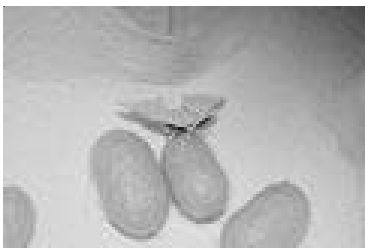
Bombyx mori moth is from China, where moth cultivation started about 5000 years back.



larvae



Cocoons



Cocoons

The silk thread is elastic and tough; however it is soft and lustrous. Its' strength is given by the central core of fibroin protein thread which is insoluble in water. There are two coats of sericin around fibroin which give softness and luster to the thread.

The silk is useful to man in many ways, however for the insects it protects the life stages such as eggs, larvae, pupae and sometimes even adults.

Stingless Bees

Prof. Dr. R. V. Ranade.
Krishna Kunja, 33, Anandbaug, Navi Peth, Pune

The bees that sting are quite well- known but most of us are practically unaware of the "stingless honey bees." However, the sting is not altogether absent in these bee, the bees do posses a sting that is much reduced, functionless and hence of no use as a weapon of defense. But in no way does this make the stingless honey bees harmless creatures. When disturbed they chase away the victim clinging on to it and biting with their powerful jaws while their irritant secretions produce a burning sensation.

Fig 1: Stingless bees.

Stingless honey bees, commonly called as dammar bees, bhunga or dambhar bees in hindi, are highly social insects and live in permanent colonies. The number of bees inhabiting as many as 2 lakhs which includes the queen mother, some virgin queens, a few hundred drones or males and the rest workers.

These honey bees inhabit the equatorial regions of the world, including India and southeast asia. However they are numerous in South America. Five genera are mainly recognized —

a) Melipona (tropical America)
b) Meliponula (Africa)
c) Dactlylurina (Africa)
d) Lestrimelitta (Africa and tropical American robber bees that rob honey from other honey bees)
e) Trigona (all along the equator. Tertagona a subgenus of trigona occurs in south America and in indo-australian tropics. Thus dammar bees in India represent the species of the sub genus Tetragona.

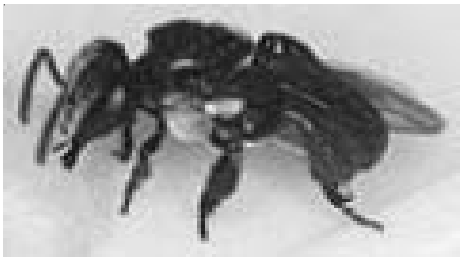
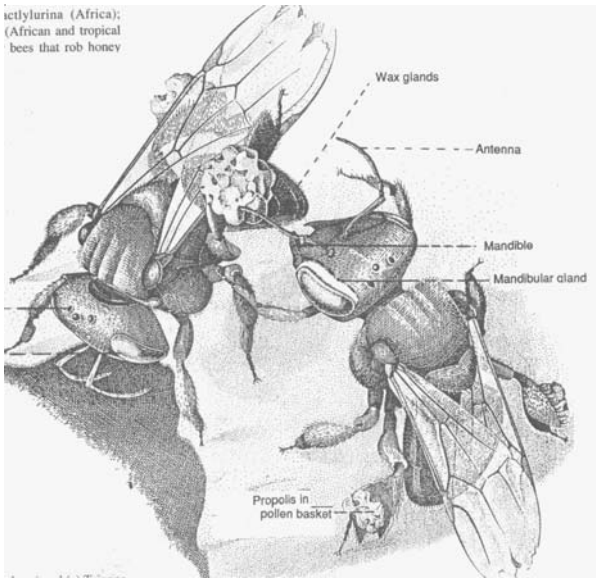


Fig 2: *Trigona carbonaria*

The stingless honey bees are usually small insects. A worker bee (more commonly observed outside the colony) measures about 2mm to 3mm in length, is black-brown in colour with rather short but stout built, is slightly larger than a fruit fly (Drosophila) common in every house whirling around and over ripe fruits or buttermilk.

Fig 3: This stingless bee (arrowed) is much smaller than the commercial Honey bee.

In most stingless bees secretions of mandibular glands have a peculiar smell and cause a burning sensation to the victim bitten by the bee. They also contain pheromones. The secretions are also utilized for trail marking by bees in the field.



Some segments of the last pair of legs are modified as 'pollen basket' or 'corbicula' for storing and transporting pollen and propolis collected in the field to the nest. Pollen and nectar constitute food while propolis is the nest building material, all obtained from plants. Four pairs of wax glands are present dorsally in the abdominal region. They secrete wax which too is utilized as a building material along with propolis. A worker is a female bee with rudimentary sex organs. In stingless bees a large number of workers lay eggs (unfertilized since not mated with male) from which males or drone bees develop.

Queen mother, the only fertile female in the colony, is 3 to 4 times larger in size than a worker. Mating of the queen occurs only once in her life- just outside the nest. After mating the queen starts laying eggs. The queen roams over the nest looking for a suitable cell in which she deposits a single egg. The cell is already provided with enough food for the future larva by the worker bees.

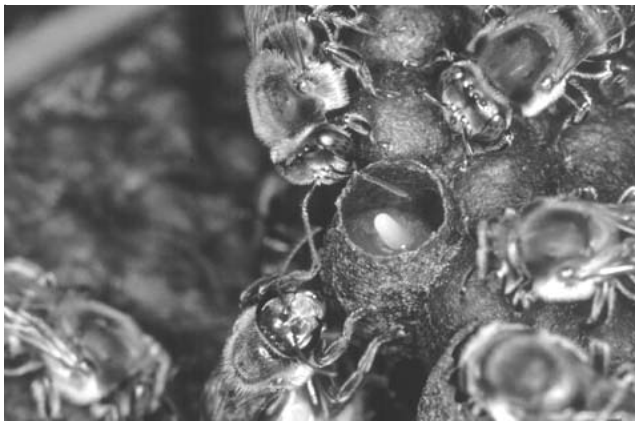


Fig 4:*Melipona beecheii*, cell provisioning and oviposition process; worker egg is placed vertically on liquid larval food in cell

The queen can regulate fertisation of the egg before it is laid. Drones develop from unfertilized eggs, while the fertilized egg gives rise either to a worker or queen bee possibly depending upon qualitative difference in food material nursed to the larvae and some other factors.

A drone (male) bee being almost equal in size to a worker bee is difficult to distinguish. It has well developed male sex organs. Mating with the queen seems to be the only function of these bees.

Stingless honey bees construct their nest in any hollow away from light where temperature fluctuations are not abnormal. A cavity in a tree trunk, an empty log, underground space given up by termites or rodents, cavities of masonary wall, even a cardboard or wooden box is easily utilized by them for the purpose.

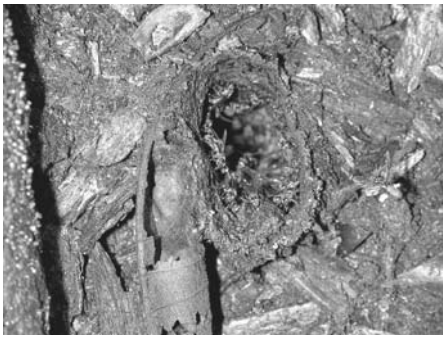


Fig 5: Entrance of colony

In India their nests are frequently observed in cavities of masonary walls. Ample, cool but irregular space amongst stones of the wall seems to be preferable to these bees.

Fig.6: A colony of stingless bee

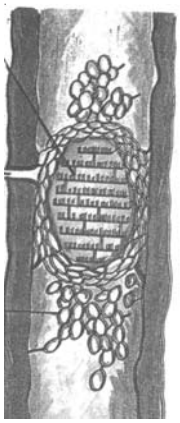


Fig. 7: Section of the colony

The raw material for construction includes wax (secreted by workers) and propolis, a resinous gummy substance obtained by chewing buds of certain plants. Propolis is anti-viral, anti-bacterial and anti-fungal due to the terpenoids present in it. Besides these two, mud and vegetable matter are also utilized in nest building. Wax and propolis(with possible addition of some substance by the bees) together constitute 'cerumen', a highly plastic and sticky substance. Its plasticity allows the bees easy alternation of the shape and capacity of the cells. These honey bees are extremely economical in utilizing raw material. Cerumen obtained from repairs or breakdown of the old cells is effectively reused. Stores of raw material in the nest are a common sight.

In almost all nests there is an entrance tube that leads inside. The outside opening of the tube and the entrance tube too are plastered with cerumen. The presence of black-brown shining cerumen in the form of a tubular projection forming main entrance and guarded by a few guards(worker bees) at once helps one to locate the nest from outside.

A large numbers of potlike 'cells', made up of cerumen, constitute the actual nests or comb. These cells may be constructed to form one layer (tier) or several layers. All cells are interconnected by means of pillars and connectives that extend in all directions. There is a gap between every two cells through which colony members can freely move and have access to each and every cell. Air too can circulate through out the nest by this means. There are three types of cells in the nest:

a) Large storage cells for food (pollen/honey), each cell equal to a peanut in size.

b) Medium sized 'gyne' or queen cells for rearing queen larvae, and

c) Smaller cells about the size of Jowar grain for the development of males and workers. The last two constitute the 'brood cells'.

All brood cells together constitute the 'brood chamber' which is the heart of the nest.

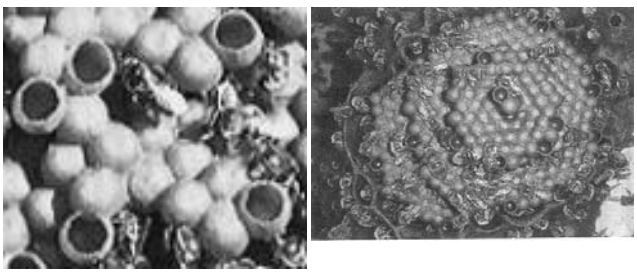


Fig 8: Colonies showing pot like cells

When the colony population exceeds a particular limit, it divides into two or several colonies by a process called swarming. When about to swarm a few workers fly out and choose a suitable location that is usually near the parents' colony. For some time construction material is carried from the parent colony to this new location. Accompanied by some workers, few virgin or unmated queens leave parent nest to reach this place. This group constitutes the swarm. Thus the queen mother remains with the old colony.

After establishing at the new site, one of the virgin queens goes out for the mating flight, and returns to start egg laying. Workers then kill all the other virgin queens that accompanied the swarm. A new colony thus begins its life.

Five to ten guard bees who attend to the main entrance confirm the identity of every incoming member (possibly by smell) before it is allowed to get in. When confronted with an enemy such as a human being or any other large animal, a large number of workers fly out and bite the victim. They crawl into the soft parts like the nasal cavities, eyes and ears. After biting they remain attached to the victim. Certain substances present in the secretions attract more workers who continue to attack.

Rock bees or wasps often linger at the entrance for robbing honey. Workers attack and cling to the body of the intruder. By the sheer weight of the attacking workers the victim falls down only to be killed.

Large black and red ants are intercepted at the entrance by the guards and killed. The body of the victim is mummified by coating it with propolis or cerumen. Such mummies are frequent at the nest entrance. Most colonies keep the nest entrance closed by cerumen from dusk to dawn. Extremely sticky plaster of the entrance tube does not allow an intruder to proceed much further even if it succeeds in getting in.

Stingless honey bees do not yield wax. The honey produced is also very little in quantity (about 100 ml per colony), dark in colour and sour in taste, but is supposed to have a high medicinal value. Furthermore, this little honey is extremely difficult to obtain due to the sticky storage cells. For this reason their rearing is much neglected in our country. Consequently very little information is available on their behaviour, floral specificity. These bees may be very efficient pollinators since being small they can enter into very small flowers too.

Colonies of these bees can be very easily reared even in wooden or cardboard boxes kept in cool and shady places. No further care is required by the bee keeper.

Considering the dry conditions of farming that prevail in most parts of India, these small and sturdy bees may prove extremely useful for crops under dry farming like oil-seeds and pulses.

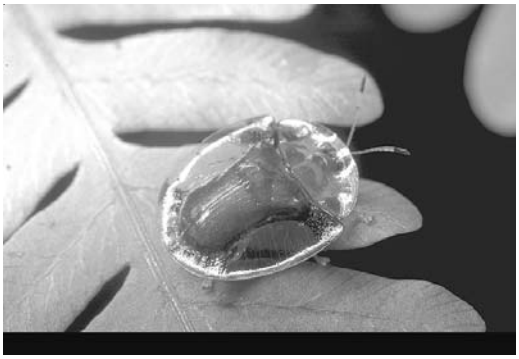
Entomological Research in Department of Zoology at Modern College, Pune 5

H.V. Ghate and students
Modern College, Pune

Having spent nearly 15 years in experimental biology I finally decided to carry out entomological work with my students in Modern College. The main emphasis was on identification 3 groups of insects: Cassidinae or Tortoise beetles, Mantodea or Preying mantids and Cerambycidae or stem borers. Some aspects of biology were also studied simultaneously.

Cassidinae work involved collection of all the available species in Maharashtra and also procuring specimens from different parts of India through students. An attempt was also made to locate correct host plants of these leaf eating beetles and to find out their egg-cases and larvae-pupae. We succeeded in identifying nearly 100 species of Cassidinae (including Hispinae, which were once treated as a separate subfamily). We described 5 new species to science and added information about the life history if some very poorly known species. Especially, the life histories of *Notosacantha vicaria*, *Oncocephala* and *Chaeridiona* have been significant contribution to Cassidinae biology. A detailed description of the chaetotaxy of larvae and pupae of 10 species of *Chiridopsis* has been another significant contribution and we have studies several other genera from this point of view. Some 10 excellent papers have been published so far and a few more are in the pipeline. We also added species that were previously unknown in India and established food plants for several species of Cassidinae! We were the first to record an Indian Cassidinae feeding on plant of the family Bignoniaceae. Much remains to be done about these beautiful beetles still! The work on this group gave us a chance to know and collaborate with internationally renowned experts like Prof. Lech Borowiec and Dr. Jolanta Swietojanska as well as many others. We thank UGC for funding part of the research.

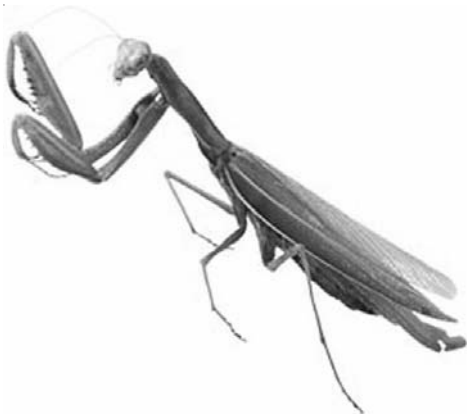
Tortoise beetle



Tortoise beetle

In Mantodea we described 2 new species and also plan to describe a few more. Have also published preliminary list of mantids of Maharashtra. We collected about 60 different species and could study some very interesting forms. We are in the process of preparing a digital pictorial monograph of Mantodea of Maharashtra. The work is also in progress with respect to detailed description of the species along with preparation of male genitalia that are diagnostic. A plan also involves study of predatory potential of these excellent predators. There are still many lacunae in the taxonomy of Mantodea and much work remains to be done, especially to know their distribution, feeding preferences, ootheca and general dispersal of the nymphs. The research on Mantodea is without any financial support so far.

Colourful Praying Mantis



Praying Mantis

Cerambycidae work is relatively recent and we have perhaps spent about 10 years in collecting literature, specimens and identification. This is perhaps the most difficult group we have undertaken, primarily because of lack of relevant literature, lack of a museum where identified material is deposited. Doing taxonomy without these two is like trying to breath in a vacuum! Fortunately internet and bioinformatics have been of a great help. We were able to seek help from renowned experts like Dr. Carolus Holzschuh, Dan Heffern, Steven Lingafelter, Francesco Vitali and others. We have over 100 species, many still not determined!

Cerambycidae beetle

The most recent work aims to prepare a list of DNA Barcodes for identification of butterflies of Western Ghats. This DBT funded project aims to sequence Cytochrome Oxidase I gene from all available species and it is hoped that these sequences, when deposited in public domain (free access internet), will help identification of the butterflies even on the basis of a single leg, severely damaged specimen beyond recognition, larval and pupal stages. What is required is only a small amount of tissue from which DNA can be extracted. We have successfully done this for more than 50 species of butterflies so far and we aim to do so for

Cerambycidae beetle

100 species. The work is very interesting and we have also started sequencing 3 more genes and we will attempt what is being currently called as molecular phylogeny. We will try to understand evolutionary relationship between various genera under one family as well relationship between families currently recognized. The work may also reveal genetic difference in various populations, for which we will be taking one or two species from all over India.

As far as entomological taxonomy and phylogeny is concerned what we need is a major collaborative effort among different entomologists and institutions. Increasing use of bioinformatics tools, sharing of literature, specimens and images is the need of the time. Digitization of all insect collections present in an institution must be undertaken without delay and this data must be freely made available to interested taxonomists. Taxonomy as an important branch of biology without which most applied branches would contribute very little meaningful information. Though molecular techniques are increasingly being used, the need for morphological analysis and morphology based identification is very necessary. Sequences do not and cannot define species, we need detailed morphological description. Modern taxonomy must use all the new techniques as additional data. We hope that there will be more people who are interested in insects and their identification in future and ready to pursue that relentlessly.

Entomological Research in Department of Zoology, Shivaji University, Kolhapur

G. P. Bhawane
Department of Zoology, Shivaji University, Kolhapur.

Entomology (Greek Entomon = insects & logus = discourse) is the branch of Zoology which includes study of each and every aspects of insect life.

Insects are Hexapods (having three pairs of legs) are the trachaeate arthropods constituting the dominant class of animal kingdom having more than 10 lakh described species from all over the world and more than this number (approximately 60 lakhs) is yet to be investigated and described. From India recent estimate from red data book (ZSI sources), about 60,000 species of insects are reported.

Insects are an ancient group of animals and inhabited our planet somewhere in carboniferous period of Paleozoic era i. e. 250 million years ago since, they are dominating the earth and not eliminated by evolutionary processes of natural sections.

Their dominance is because of their structural and functional adaptations and they undergo diapause during adverse environmental conditions.

They have mastered the various techniques like paper making, earthen pot making, drilling, tunneling, food preservation, nidification etc. and it is supposed that man has learnt these technique from them.

They are powerful creatures: Stag horn beetle can drag 90 times of its own weight for a distance of 30 times of its own length. Flea having leg of 1 mm length and can take long jump of 32 cms and high jump of 20 cms, if man has to perform similar feat he has to take 212 m high jump 137 m long jump.

Reproductive potential of insects is very high and astonishing. A pair of houseflies in a span of six months gives rise to a population of 1901000 crores when the conditions are favourable.

Their shapes, size, colouration, architecture is highly variable and astonishing and they are truly cosmopolitan in distribution occurring from frozen antartica to scorching sun of tropics.

They are having great economic importance both harmful (pestiferous nature) and beneficial (giving useful products) and hence their study has assumed the status of special or independent subject: ***ENTOMOLOGY***.

In Shivaji University, Kolhapur: Entomology as special subject has been introduced since June 1980 by the initiatives of Prof. N. K. More. Since then considerable amount of research work has been done on both basic and applied aspects of Entomology.

Before the introduction of entomology as special subject, histochemical analysis of mucoploysaccharides were made in the salivary glands of various dipterous maggots.

Studies on lipid composition (both neutral and phospholipids) during metamorphosis of blow flies *Chrysomia rufifacis* were also done.

After introduction of Entomology specialization research work on morphology, taxonomy, physiology, biochemistry, ethology, sericulture and other aspects were done by selecting locally available species of insects as experimental models.

Major research activities are as follows:

i. Taxonomic studies of insects: Collection, preservation and identification of insects belonging the major insect orders 34 orders = Apterygote (04), Exopterygotes (19) and endopterygote (11).

ii. Studies on insect pests of various agricultural, horticultural and silvicultural crops.

iii. Studies on medical and veterinary pests of animals and human especially mosquitoes, lice and flies.

iv. Studies on biocontrol, agents, biology and taxonomy especially hymenopterous insects, beetles (lady bird beetle), neuropterous, dipterous and odonates.

v. White grubs are the members of the largest superfamily Scaraboidea: assumed status of National pest, distributed in 12 different endemic pockets all over India. Kolhapur is one of the pockets and during last 3 decades *Leucopholis lepidophora, Holotrichia serrata* and *Holotrichia fissa* are serious pests of sugarcane and other crops. Therefore, considered for investigating the following aspects:

   a. Life cycle

   b. Histophysiology of digestive system:

   c. Reproductive behaviour and physiology.

d. Circulatory system.

e. Endocrine system and endocrine control of reproduction.

f. Effect of induced environmental factor and ecology: soil moisture i. e. desiccation stress on survival and physiology of grubs and reproduction.

g. Thoracic muscle trehalase.

h. Effect of indigenous plant extracts (herbal pesticides) on various physiological processes.

vi. Biology of dung beetles: Coprophagus and necrophagus beetle actively involved in biological control of dung and dung borne dipterous flies – vectors of animals and human diseases therefore, considered for the following studies:

a. Ecology: Seasonal abundance

b. Biology

c. Physiological aspects, digestive, reproductive, circulatory and endocrine system studies.

vii. Biology of butterflies and moths: Common mormon (*Papilio polytes polytes),* Jowar stem borer *(Chilo partellus)*, Mulberry silkworm (*Bombyx mori)* and Temperate tasar silkworm (*Antharea proylei).*

a. Life cycle

b. Physiological aspects: digestive, circulatory, reproductive and endocrine systems.

viii. Digestive physiology of cetoniid beetle *Chiloloba orientalis.*

ix. Digestive and reproductive physiology of Tenebrionid beetles *Platynotus belli.*

x. Haemocyte study: Comparative account of coleopterous and lepidopterous insects.

xi. Use of magnetic energy in increase of silk yield.

xii. Utilization of plant juvenoids in the increase of silk yield

xiii. Utilization of plant products in the disease management of silkworm.

xiv. Dissemination of tasar culture technology for SC, ST and EWS population in Kolhapur district.

xv. Non traditional rearing of temperate tasar silkworm, *Antherea proylei* in tropical condition of Kolhapur district.

xvi. Utilization of scarabaeoid grubs in recycling of organic wastes: grubs of *O. rhinoceros*, *C. orientalis* and other ctoniids and copronids.

xvii. Utilization of Hister (Coleoptera) in biological control of dung borne dipterous flies: vectors of animal and human diseases.

xviii. Orthopteroid insect diversity of Chandoli National Park.

xix. Insect pests of economically importance forest trees of Kolhapur district.

xx. Diversity of forest insects of Kolhapur, Pune and Sindhudurg district.

xxi. Insect pests of legumes, vegetable, sugarcane and stored grains.

xxii. Aquatic insects of Kolhapur district.

xxiii. Indoor rearing (chowki worms) of tropical and temperate tasar.

Future plans:

a. Diversity studies of insects and their documentation.

b. Insect cell culture of economically important species like silkworms, mosquitoes.

c. Studies on aging in insects especially in silkworm by inducing with D galactose for shortening the larval duration and its impact on economics of sericulture. Simultaneously use of natural antioxidant like *Bacopa* (Brahmi) and *Lactuca* (Lettuce) to prolong the larval duration so as to promote the larval growth and size to increase the cocoon size.

d. Formulation of ecofriendly herbal antibiotic preparation to control the silkworm diseases and herbal pesticides to control the insects.

Genera of Click Beetles (Coleoptera: Elateridae) From Maharashtra

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Abstract: Click beetles are members of the family Elateridae. It is the 9th largest family with approximately 10,000 species identified all over the world. Family Elateridae along with four other major families are placed under super family Elateroidea. About 350 species have been identified from India, mostly by foreign workers. Very little is known about these beetles because of their elusive nature and prolonged life cycle. They remain hidden under the bark, stones, crevices etc. and therefore they are difficult to locate. Most of the adults are attracted to the nectar and hence can be collected from the flowers. At night they are attracted to yellow, white and black light. Larvae of click beetles are long wire like hence called as wireworms. Wireworms are characterized by long body, heavily sclerotized head and notched terminal abdominal segment. This segment has importance in taxonomy. Preliminary work on elaterids of Maharashtra state is reported. Total 23 genera and 53 species have been listed.

Keywords: Elateridae, wireworms, Maharashtra.

Introduction:

Family Elateridae which includes click beetles is the ninth largest family with approximately 10,000 identified species all over the world. The hierarchy of this family is as follows;

Order Coleoptera Linneaus 1758

Sub order Polyphaga Emery 1886

Series Elateriformia Crowson 1960

Super family Elateroidea Leach 1815

Family Elateridae Leach 1815

Super family Elateroidea includes 15 families including family Elateridae, which share some morphological characters of adults and larvae. Family Elateridae includes 15 sub families as Cebrioninae Latreille 1802, Tetralobinae Laporte 1840, Thylacosterninae Fleutiaux 1920, Lissominae Laporte 1835, Semiotinae Jacobson 1913, Pityobinae Hyslop 1917, Oxynopterinae Candeze 1857, Agrypninae Candeze 1857/Lacordaire 1857, Denticollinaae Stein & Weise 1817, Negastriinae Nakane & Kishii 1956, Diminae Candeze 1863, Elaterinae Leach 1815, Cardiophorinae Candeze 1859, Hemiopinae Fleutiaux 1941 and Physodactylinae Lacordaire 1857. Three subfamilies are uncertain to be placed in Elateridae viz. Eudichronchychinae Girard 1971, Anischiinae Fleutiaux (1941) and Subprotelaterinae Fleutiaux (1941) (www.fond4beetles.com).

The adult beetles have an ability of jump when they fall on their back. Prosternal projection is forcefully slided into the mesosternal cavity which causes upward movement to the pronotum lifting the beetle in the air. This process produced clicking sound.

Click beetles are found in all types of forests and grassland ecosystems. Some species which feed on grasses have become pests of crops. Some species are diurnal while some are nocturnal. Nocturnal species are readily attracted to the light. The larva of click beetle is called as 'wireworms'. They spend one to six years under the soil. Wireworms of some species are serious pests of sugarcane, beet, potato, ground nut etc. Many authors think that the clicking mechanism is evolved by these beetles to right themselves whenever they fall on their back. Crowson (1961) thinks that it could be equally be considered as an defensive mechanism.

Linneaus and Fabricius pioneered the work Elateridae. Linneaus (1758) brought all elaterids known then, under one genus *Elater.* Eschscholtz (1829) raised the tribe Elaterites. Later the name Elateridae was proposed and raised to the family level (Leach, 1815). Candeze, Belgian entomologist, done a major taxonomic work on elateridae of the world. He published (1857, 1859, 1860, 1863) four volumes of *Monographie des Elaterides* in which he described 153 genera under 8 tribes. These four volumes are still used as a major reference. Schwarz (1895, 1902a,1902b,1902c,1902d,1902e, 1903a,1903b) tried further higher classification by addition of many new morphological characters and raising many subtribes described by Candeze to tribe level, also described many new species in Deutsch journals. He published *Genera Insectorum* (1906b, 1906c, 1907a) in which he described many new species in addition to Candeze's work. He also described elaterids from Australian region. Schenkling (1925) published *Coleopterum Catalogus* in which he described previous work on elateridae. Crowson (1961) used apical sclerites of the elaterid hind wing along with adult and larval characters and divided elateridae into six subfamilies (Pyrophorinae (= Agrypninae), Cardiophorinae, Elaterinae, Pityobinae, Corymbitinae (=Denticolinae pars)

and Oestodinae). In all the previous works the number of species described from India is not more than 350. Schimmel (1998), Schimmel & Platia (1991) added new species to genus *Penia* and raised new genus *Neoathousius* from north India. Stibick (1980) revised Hypnoidinae of the world with descriptions on Hypnoidinae of India. Dolin and Suzuki (1987) added new species to genus *Penia* from Himalayan region.

Vats (1991) published a report on Elateridae of north India. In his work he described 167 species out of which only 39 were previously described in older work. His description of the species is very less and hence seems doubtful. Chakraborty (2000) listed species of Agrypninae from India. Zoological survey of India (1995) has listed previously described species from mid and western Himalaya.

Materials and Methods:

The specimens were collected from different parts of Maharashtra from February 2003 till now (Fig.1; Table 1). The places visited include agricultural fields, different types of forests. The state boasts variety of habitats from agricultural fields to grasslands to tropical forests.

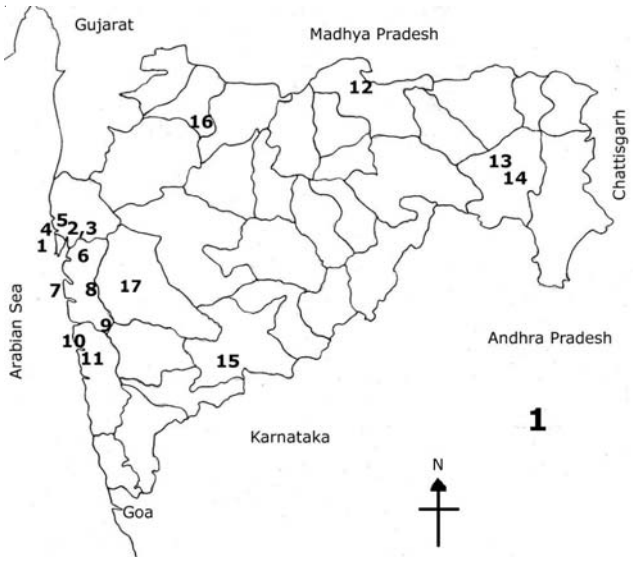

Fig.1. Maharashtra state showing collection sites. Not to the scale.

Table 1. The collection sites from Maharashtra state.

Sr. No.	Location	District	Sub-region
1	Goregaon	Mumbai Suburban	Konkan
2	Thane city	Thane	
3	Yeoor		
4	Nagla		
5	Tungareshwar		
6	Matheran	Raigad	
7	Supegaon		
8	Sudhagad		
9	Poladpur		
10	Anjerla	Ratnagiri	
11	Dapoli		
12	*Anonymous*	Amravati	Vidarbha
13	Tadoba	Chandrapur	
14	Kolsa	Chandrapur	
15	Pandharpur	Solapur	Marathwada
16	Dhule	Dhule	Khandesh
17	Pune city	Pune	Desh

The beetles were collected by hand picking, pit fall traps and light traps. They were kept alive in the terrarium and their general behavior, feeding habit, mating habits were observed. The dead specimens were preserved in alcohol glycerol (1:1). Various publications mentioned in the introduction were referred for the taxonomic placement of the species.

Morphological details of every species were recorded. To study them, a dissecting binocular light microscope of Lawrence & Mayo was used. Left hind wing was taken out to identify specific wing venation. Male and female genitalia were also dissected out of the specimen wherever possible. Both the wings and genitalia were preserved in the same preservative mentioned above.

Line drawings were made using simple compound microscope with camera lucida and normal HB and 2B caliber lead pencil.

The specimens are deposited in the zoology department of B.N. Bandodkar college of science, Thane, Maharashtra.

Results and Discussion:

The beetles were obtained throughout the year, however the occurrence was not frequent and the number was usually low. Relatively higher abundance was observed in the seasons pre-monsoon (Apr-May), monsoon (Jun-Sept) and postmonsson (Oct-Nov). Winter and early summer were of low occurrence; however some species of *Melanotus, Adelocera* and *Ludioschema .spp*. were collected in Jan-Feb.

Total 5 subfamilies, 23 genera and 53 species have been collected from the study area. The placement at the tribe level is still under process. Denticollinae is characterized by incomplete frontal carina; serrate or pectinate antennae; mandibles simple or dented; mesocoxal cavity open to mesepimeron and mesepisterenum; claws simple without basal setae. Only one genera *Plectrosternus* Lacordaire, 1857 was recorded. Cardiophorinae is characterized by complete frontal carina; single or double punctuation; serrate antennae; scutellum cordate; mesocoxal cavity closed; claws simple or bifid or dented with or without basal setae. Two genera *Paracardiophorus* Candeze, 1857 and *Cardiophorus* Eschscholtz, 1829 were recorded. Agrypninae is characterized by body covered by scales or setae or both; incomplete frontal carina; mandibles simple or dented or bifid; antennae serrate or pectinate; pronotosternal sutures deep to accommodate antennae; hypomera with or without grooves; claws with or without basal setae. Three genera *Lanelater* Arnette, 1952, *Adelocera* Latreille, 1829 and *Agrypnus* Eschscoltz, 1829. Elaterinae is characterized by body covered by setae; complete or incomplete frontal carina; mandibles simple or dented or bifid; antennae mostly serrate; pronotsternal sutures simple or deep; mesocoxal cavity open to mesepimeron and mesepisternum; claws simple or pectinate.

Elaterinae comprised of many tribes like Melanotinii, Ampedinii, Dicrepidinii, Conoderinii, Adrastinii, Agriotinii. Placement of of Hemirrhipnii under Elaterinae is under scrutiny.

Tetralobinae is characterized by body covered by setae; thick nasal plate; incompleted frontal carina; antennae serrate or uni or bipectinate; well marked chin piece; pronotosternal suture double; mesocoxal cavity open to mesepimeron and mesepisternum; claws simple with basal setae.

Following is the list of genera collected from the study area (Table 2).

Table 2.List of species collected, identified and described from Maharashtra state.

	Subfamily Tribe	Genus	Number of species
Denticollinae		*Plectrosternus*	1
		Paracadiophorus	1
Cardiophorinae		*Cardiophorus*	4
		Lanelater	3
		Agrypnus	6
Agrypninae	Agrypninii	*Adelocera*	8
		Melanotus	5
	Melanotinii	*Metriaulacus*	1
		Melanoxanthus	2
		Megapenthes	1
		Xanthopenthes	1
	Ampidinii	*Procraerus*	1
		Propsephus	2
		Elius	1
	Dicrepidinii	*Adiaphorus*	2
		Aeoloderma	1
		Heterodores	1
	Conoderinii	*Conoderus*	5
	Adrastinii	*Silesis*	2
Elaterinae	Agriotinii	*Ludioschema*	2
?	*?*	*Cardiorhinus*	1
	Hemirrhipinii	*Punctodensus n.gen.*	1
Tetralobiane		*Tetralobus*	1
		Total 23 genera	**Total 53 species**

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