काष्ठ विज्ञान एवं प्रौद्योगिकी संस्थान
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार की एक स्वायत्त निकाय
पी.ओ. मल्लेश्वरम बेंगलुरु - 560 003.

INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY
Indian Council of Forestry Research and Education
An Autonomous Body of Ministry of Environment, Forest and Climate Change, Govt. of India
P.O. Malleswaram, Bengaluru - 560 003

No.11-3/2016-17/IWST/FWP/MANG/ 4372 Date: 12.03.2018

To
The Executive Director,
Mangrove and Marine Biodiversity Conservation Foundation,
Office of Chief Conservator of Forests, Mangrove Cell,
2nd floor, A Wing, S.R.A. Building,
Ananth Kanekar Marg, Bandra (East)
Mumbai-400051

Sir,

Sub: Requesting to release IInd installment for the project "Development of Integrated Pest Management (IPM) strategies against the major defoliating pests of Mangroves in the Thane district of Maharashtra."

Ref: Sanction Letter No.ADMIN/2016-17/3559 dt. 20.03.17

With reference to the above, please find enclosed herewith the Utilization Certificate for Rs.5.24 Lakh towards the Ist installment released. As desired, please find enclosed herewith as Annexure for break-up of expenses, work plan and deliverables and the annual progress report in the prescribed format for the period till 1st March 2018.

You are requested to kindly release the IInd installment of Rs.6.56 Lakh at the earliest for smooth continuation of the project.

Yours faithfully,

(Surendra Kumar, IFS)
Director

Encl: 1. Utilization Certificate
2. Annexure of break-up of expenses
3. Work plan and deliverables
4. Annual progress report

FUND UTILIZATION CERTIFICATE

(From 01.04.2017 to 01.03.2018)

To

Date: 12.03.2018

The Executive Director,
Mangrove and Marine Biodiversity Conservation Foundation,
Office of Chief Conservator of Forests, Mangrove Cell,
2nd floor, A Wing, S.R.A. Building,
Ananth Kanekar Marg, Bandra (East)
Mumbai -400051

Sir,

Sub: Submission of Fund Utilization Certificate for I[st] installment for the project: "Development of Integrated Pest Management (IPM) strategies against the major defoliating pests of Mangroves in the Thane district of Maharashtra."

Ref: Sanction Letter No.ADMIN/2016-17/3559 dt. 20.03.17

As per the terms of the sanction of the above project and release of I[st] installment, please find herewith the "Fund Utilization Certificate" up to 01.03.2018 as under:

1. Funds received : Rs. 7,70,000/-
2. Total expenditure incurred : Rs. 5,24,301/-
3. Balance : : Rs. 2,45,699/-

1. Certified that the conditions on which the grant-in-aid was sanctioned and received in favour of Director, Institute of Wood Science and Technology, Bengaluru, a sum of Rs. 5,24,301/- (Rs. Five lakh twentyfour thousand three hundred and one only) has been utilized for the purpose for which it was sanctioned and that the balance of Rs. 2,45,699/- (Rs. Two lakh forty five thousand six hundred and ninety nine only) remaining unutilized at the end of 01.03.2018, will be utilized within 31[st] March 2018, except amount in fellowship will be adjusted towards the grants-in-aid payable during the next installment.

2. Certified that I have satisfied myself that the conditions on which grants-in-aid was sanctioned have been duly fulfilled and I have exercised the cheques to see money was actually utilized for the purpose for which it was sanctioned.

Drawing and Disbursing Officer
Institute of Wood Science and Technology
Bengaluru

Drawing & Disbursing Officer
Institute of Wood Science & Technology, Bangalore-03

Director
Institute of Wood Science and Technology
Bengaluru

BREAK UP OF EXPENSES FOR UTILISATION OF THE FIRST INSTALLMENT AMOUNT OF Rs. 7,70,000 FOR THE YEAR 2017-18:

Budget heads	First installment for 2017-18 (Rs. In lakhs)	Expenditure till 1.3.2018 (Rs.)	Balance (Rs.)	Remarks
TE	2.00	95,900	1,04,100	Balance will be spent in March 2018
M&S	0.50	51,183	(+) 1,183	--
Contingencies	0.30	15,581	14,419	Balance will be spent in March 2018
Fellowship	2.90	1,68,377	1,21,623	Two months fellowship of Rs.48200 will be spent in March 2018
Capital Assets (equipment)	1.00	93,260	6,740	--
Others (Institutional charges)	1.00	1,00,000	Nil	--
TOTAL	**7.70**	**5,24,301**	**2,45,699**	--

आर. राजा ऋषि / R. Raja Rishi
वैज्ञानिक - डी / Scientist-D

Annual progress report for the year 2017-18

Title of the Project: Development of Integrated Pest Management (IPM) strategies against the major defoliating pests of Mangroves in the Thane district of Maharashtra

Name & Designation of PI : R. RAJA RISHI, Scientist D

Project Duration : 2017-2020

Approved Budget (Rs.): 20.37 lakhs

Summary:

Five field tours were carried out in different areas of mangroves at Airoli, Vashi creek of Thane district of Maharashtra State during the months of May, August, December in 2017, January and February in 2018. Observations were made on the pest problems of important mangrove species *Avicennia marina, Avicennia officinalis, Sonneratia apetala* and *Sonneratia alba* at Airoli and Vashi creek. Eight different types of defoliating pests were collected from the mangrove ecosystem. Among the defoliating pests collected, six species of caterpillars (Lepidoptera), one species of leaf miner (Lepidoptera) and one beetle (Coleoptera) and two species of snails were recorded. One species of grass hopper (Orthoptera) was also recorded. The intensity of the pest problems were recorded. In the insect pests recorded, the snails and the leaf miners are in moderate level of intensity. Other pests were recorded as minor pests. The collected insects were reared in the laboratory condition and the specimens were send for identification. One lepidopteran pest was identified as *Streblote helpsi* (Lasiocampidae). Two snails were identified as *Melam pusceylonicus* and *M. puspulchellus.* The biology of the *Streblote helpsi* was studied in laboratory condition. One entomopathogenic fungus (natural enemies) isolated from the infected larvae in the field was sub-cultured and pure cultured in the artificial media. The natural enemies of three different predatory spiders and One Pentatomidae bug were collected from the field brought to laboratory and preserved for identification purpose. The temperature, humidity of that area and the GPS readings were recorded during the period.

Introduction:

Mangroves are forests found on coastal lowlands of tropical and subtropical intertidal region and near river mouths. This system occupies about one quarter of world's coastal line covering an

area of 1,90,000 to 2,40,000 km^2 (Upadhyay et al. 2002). Mangrove forests are comprised of taxonomically diverse, salt tolerant trees and other plant species, which thrive in the inter tidal zones along the sheltered shores, lagoons, marshes and mud flats. They are open ecosystem which exchange matter and energy with adjacent marine, fresh water and terrestrial ecosystems. They act as an interface between land and sea and are the most productive e of the world's forest (Lugo and Snedaker, 1974).

Indian mangrove ecosystems are known to have a total of 4,011 species that include 920 plants (23%) and 3.091 animal (77%) species. The zoological component is about 3.5 times greater than the botanical component. No other country in the world has recorded so many species in mangrove ecosystems (Bhatt and Kathiresan 2011). In Greater Mumbai, the density of mangrove trees is highest in Thane Creek (30 trees/25 m^2) followed by other creeks (9.5 to 28.5 trees /25m^2) (Vijay et al. 2005). The common species found in Mumbai region are *Avicennia marina* and *Sonneratia apetala, Sonneratia alba, Rhizophora mucronata, Aegiceras corniculatum, Bruguiera cylindrical, Salvadora persica, Excoecaria agallocha, Acanthus ilicifolius, Sesuvium protulacastrum.* Other species such as *Sonneratia caseolaris, Rhizophora mucronata, Lumnitzera racemosa, Kandelia candel, Ceriops tagal, Ceriops decandra, Bruguiera gymnorhiza, Avicennia officinalis, Avicennia alba, Aegiceras corniculatum* are either endangered or threatened species of mangrove (Sharma et al. 200; Vijay et al. 2005; other source: Vivek Kulkani. www.wli-asia- symposium.com). The 60 sq km of mangroves in Mumbai alone is known to attract nearly 206 species of birds, 3d5-40 reptiles, 16 crabs at least three types of prawns and several fish species, according to mangrove conservationist Vivek Kulkarni.

Though insect life in mangrove has not been adequately researched in India, a number of butterflies and moths are commonly found in the ecosystem. Among those documented are the tiny cream coloured butterfly Salmon Arab and the timber moth *Hyblaea puera*, which in 1998 was held responsible for destruction of several mangrove stretches in the city. " They devour certain plants but that seldom causes permanent harm to the ecosystem" reassures Kulkarni (Nitya Kaushik 2008). Ramadevi et al (2008) studied the insect and plant relationships with reference to herbivory in the mangroves of Karnataka state and a total of 8,638 individual insects

belonging to 13 orders and 305 species have been collected. The order Coleoptera represented the maximum diversity at species level followed by Lepidoptera, Orthoptera and Diptera.

Work on the insect community of mangroves in the Indian mainland, especially in the mangroves along the west coast was very patchy and very few references are available on this subject. From the mangroves along the west coast the number of insect species so far reported is less than 10 (Santhakumaran et al. 1995) .Fourteen species of insect borers of mangroves in the Bay island have been studied by Das et al. (1988) from Andaman and Nicobar islands. Raji (2003) reported 340 species of insects belonging to 11 orders in the west coast of South India. Out of this 340 species 201 could be authentically identified and listed. This was the first comprehensive list of mangrove insects found along the west coast of South India. Arjun and Mahajan (2012) reports that *Hyblaea puera*, apart from teak it attacks an alternative host plant *Avicennia marina*. He also reports the lesser known ecological aspects of Hyblaea infestation from the mangrove ecosystem of Thane Creek are of Mumbai, Maharashtra, but there was no attempt of any management for the control of the pest.

Though a reasonable literatures on the pest status of mangrove species are available, no information on the status of defoliating pests and its impact on mangrove species in the state of Maharashtra is available. In recent years heavy defoliation was recorded on the mangrove species in Thane district. Therefore, it is required to assess the pest status of the defoliating pests and their host range, occurrence of abundance, influence of biotic and abiotic factors predisposing the hosts etc to be studied to formulate effective management strategies.

Materials and Methods:

- Periodical survey at various mangrove areas in Thane will be undertaken to record the defoliators. The insect pests will be collected and authentically identified.
- Intensity of attack will be assessed by the level of incidence of the insect pests and percentage of damage/extent of defoliation caused.
- Biotic factors like phenology of the host, bionomics of the pests, natural enemies, host range and alternate hosts; and abiotic factors like temperature, humidity, rain fall etc. Will be gathered operating against the pests will be recorded.

- Management strategies like use of plant based and non chemicals, bio-control agents etc. will be tested and standardized for the defoliating insect pests.

Defoliation intensity can be rated visually by comparing the occurrence of attacked and unattacked leaves in the plants. The intensity of defoliation/ infestation can be classified in to 3 main classes and compared with severity scale.

Defoliation score and severity scale.

LEVEL	DESCRIPTION	
	% Defoliation	Severity Scale
Severe (H)	**61 - 100**	**Severely attacked** Attacked leaves dominate
Medium(M)	**26 - 60**	**Moderately attacked** Equal occurrence of attacked & unattacked leaves
Negligible(L)	**0 - 25**	**Unattacked** Attack symptoms negligible/Nil

Statistical analysis:

The data generated in the lab and field evaluation of biocontrol agents against the major defoliating pests will be subjected to transformation to reduce the experimental error and then the converted data will be subjected to ANOVA and Student's 't' test. The out come data will be further subjected to Duncan's Multiple Range (DMR) test to compare the significance of treatments between the treatment means.

Results:

Study locations:

Airoli mangrove area - N 19° 14'76.5" E 072° 98'43.9"

Gothivali mangrove plantation area - N 19° 14'07.9" E 072° 99'38.5"

Ghansoli mangrove plantation area - N 19° 11'50.9" E 072° 99'17.3"

Objective : 1 - To survey and identify the defoliating pest of Mangroves in Maharashtra.

Five field tours were carried out in different areas of mangroves at Airoli, Vashi creek of Thane district of Maharashtra State during the months of May, August, December in 2017, January and February in 2018. Observations were made on the pest problems of important mangrove species *Avicennia marina, Avicennia officinalis, Sonneratia apetala* and *Sonneratia alba* at Airoli and Vashi creek. Eight different types of defoliating pests were collected from the mangrove ecosystem. Among the defoliating pests collected, six species of caterpillars (Lepidoptera), one species of leaf miner (Lepidoptera) and one beetle (Coleoptera) and two species of snails were recorded. One species of grass hopper (Orthoptera) was also recorded.

Objective : 2 - To determine the most potential defoliators and assessing their host range and damage potential.

The intensity of the pest problems were recorded. In the insect pests recorded, the snails and the leaf miners are in moderate level of intensity. Other pests were recorded as minor pests. The collected insects were reared in the laboratory condition and the specimens were send for identification. The temperature, humidity of that area and the GPS reading were recorded during the period. One lepidopteran pest was identified as *Streblote helpsi* (Lasiocampidae). Two snails were identified as *Melam pusceylonicus* and *M. puspulchellus.* The biology of the *Streblote helpsi* was studied in laboratory condition.

Objective : 3 -To study the bionomics of the potential defoliators and identify the predisposing factors.

One entomopathogenic fungus (natural enemies) isolated from the infected larvae in the field was sub-cultured and pure cultured in the artificial media. The natural enemies of three different predatory spiders and One Pentatomidae bug were collected from the field brought to laboratory and preserved for identification purpose.

Financial details:

Budget heads	First installment for 2017-18 (Rs. In lakhs)	Expenditure till 1.3.2018 (Rs.)	Balance (Rs.)	Remarks
TE	2.00	95,900	1,04,100	Balance will be spent in March 2018
M&S	0.50	51,183	(+) 1,183	--
Contingencies	0.30	15,581	14,419	Balance will be spent in March 2018
Fellowship	2.90	1,68,377	1,21,623	Two months fellowship of Rs.48200 will be spent in March 2018
Capital Assets (equipment)	1.00	93,260	6,740	--
Others (Institutional charges)	1.00	1,00,000	Nil	--
TOTAL	**7.70**	**5,24,301**	**2,45,699**	--

Inference:

Five field tours were carried out in different areas of mangroves at Airoli, Vashi creek of Thane district of Maharashtra State during the months of May, August, December in 2017, January and February in 2018. Observations were made on the pest problems of important mangrove species *Avicennia marina, Avicennia officinalis, Sonneratia apetala* and *Sonneratia alba* at Airoli and Vashi creek. Due to heavy rains at Thane district during the month of August – September, only periodical surveys were carried out. Eight different types of defoliating pests were collected from the mangrove ecosystem. Among the defoliating pests collected, six species of caterpillars (Lepidoptera), one species of leaf miner (Lepidoptera) and one beetle (Coleoptera) and two species of snails were recorded. One species of grass hopper (Orthoptera) was also recorded. Among the different types of defoliating pests were collected, *Streblote helpsi* (Lasiocampidae) is the **first time report from this region**. The biology of the same was also studied in detail. Two snails of Phylum Mollusca was also got identified as *Melampus ceylonicus* and *Melampus*

pulchellus by ZSI, Chennai. This two snails causing damage to the plants by nibbling the leaves of *A.officinalis* and *A. marina.* One entomo-pathogenic fungus (natural enemies) isolated from the infected larvae in the field was sub-cultured and pure cultured in the artificial media and send for morphological identification at *Agharkar* research institute, Pune.

PEST SURVEYS CONDUCTED AT AIROLI AND VASHI MANGROVES

Airoli mangrove

Ghansoli mangrove plantation

Gothivali mangrove plantation

Leaf minor attack on *Avicennia marina*

A. marina defoliated by snails

Leaf gall attack on *S. apetala*

S. apetala severely attacked by the mealy bug *Dysmicoccus brevipes*

Plan of Work and Deliverables for the Third half year (April to September 2018) for the project titled "Development of Integrated Pest Management (IPM) strategies against the major defoliating pests of Mangroves in the Thane district of Maharashtra".

PI: R.Raja Rishi, Sci-D, IWST.

S. No.	List of project activities	Deliverables (Performance indicators)
1	Survey and Sample collection	Surveys will be undertaken to record the major defoliating pests of different Mangroves species in the Thane District.
2	Recording of biotic and abiotic factors	Biotic factors like phenology of the host, bionomics of the pests, natural enemies, host range and alternate hosts and abiotic factors like temperature, humidity will be recorded.
3	Identification of different pests	Collected insect specimens will be reared in laboratory and will be identified authentically.
4	Bioassay studies for the management of key pests of mangrove plant species in the laboratory condition	Management of key insect pests will be studied in laboratory condition by using the biocontorl agents like entomopathogenic fungi and the biopesticides like Neem Seed Kernel Extract (NSKE), Neem oil, etc.
5	Submission of half yearly report and subsequent work plan	The report for the half year ending September 2018 will be submitted, along with the plan of work and deliverables for the subsequent half year.

आर. राजा रिशि / R. Raja Rishi
वैज्ञानिक - डी / Scientist-D