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Entomopathogenic Nematodes: Systematics, Phylogeny and Bacterial Symbionts The Mechanistic Benefits of Microbial Symbionts Symbiosis Bacterial Symbionts in Volvox Defensive Mutualism in Microbial Symbiosis Manipulative Tenants Molecular and functional ecology of aquatic microbial symbionts Symbionticism and the origin of species Isolation and Characterization of Bacterial Symbionts from Crotalaria Spectabilis Grown on Trichloroethene Contaminated Soil Endosymbionts in Paramecium Endosymbiosis of Animals with Plant Microorganisms Molecular Basis of Symbiosis Gastrointestinal Bacterial Symbionts Transmission and Nutritional Contribution of Dual Bacterial Symbionts in Deep-sea Mussels Bacterial Symbionts of Termite Gut Flagellates: Cospeciation and Nitrogen Fixation in the Gut of Dry-wood Termites New Antifungal and Cytotoxic Cyclic Peptides and Studies of the Bacterial Symbionts of Lithistid Sponges The Algal and Bacterial Symbionts of Hydra Viridis (Endo)symbiotic Methanogenic Archaea Bacterial Symbionts of Heterorhabditis The Role of Bacterial Symbionts and Bioluminescence in the Pyrosome, Pyrosoma Atlanticum Cancer cells are crowded with

bacterial symbionts streptococcus hispaniae The Algal and Bacterial Symbionts of Hydra Viridis Mechanisms Underlying Microbial Symbiosis Microbial Symbionts Cellular Dialogues in the Holobiont Xenorhabdus Bovienii Bacteria – Evidence of Luminous Bacterial Symbionts in the Light Organs of Myctophid and Stomiiform Fishes Multi-locus Analysis of Bacterial Symbionts Associated with Two Costa Rican Legumes DNA:DNA Homology Studies of the Bacterial Symbionts of the Tube Worm Riftia Pachyptila from Widely Separated Hydrothermal Vent Sites Diversity of Bacterial Symbionts on Salmonid Eggs Acquisition and Activity of Bacterial Symbionts in Marine Invertebrates Insect Symbiosis Assessment of the Diversity and Roles of Bacterial Symbionts in Fruit Fly Development and Response to Biological Control Entomopathogenic Nematodes and Their Symbiotic Bacteria Biocontrol of Lepidopteran Pests The Biology of Mosquitoes The Ecology of Secondary Microbial Symbionts Endosymbiosis of Animals with Plant Microorganisms Symbiosis in a Changing Environment Burkholderia as Bacterial Symbionts of Lagriinae Beetles

The subject of this thesis is the symbiosis between flagellates and bacteria in the gut of dry-wood termites (Kalotermitidae). In a series of studies, the evolution of devescovinid flagellates and their bacterial symbionts was elucidated, and the physiological basis of the symbiosis was investigated, with a focus on nitrogen fixation. Devescovinid flagellates are the dominant flagellates in

the gut of Kalotermitidae. Species-pure suspensions of devescovinid flagellates (Devescovina and Metadevescovina species) from a wide range of termite species in the family Kalotermitidae were isolated with micropipettes. Ribosomal RNA gene sequences of the host flagellates and their bacterial symbionts were obtained using a full-cycle-rRNA approach. Phylogenetic analysis showed that Devescovina spp. present in many species of Kalotermitidae form a monophyletic group. They were consistently associated with a distinct lineage of ectosymbionts, which form a monophyletic group among the Bacteroidales. The well-supported congruence of their phylogenies documented strict cospeciation of flagellates and their ectosymbionts, which were temporarily classified as "Candidatus Armantifilum devescovinae". Nevertheless, the complete incongruence between the phylogenies of devescovinid flagellates and Kalotermitidae (COII genes) demonstrated horizontal transfer of flagellates among several species of Kalotermitidae. The presence of filamentous "A. devescovinae" on the surface of Devescovina spp. was corroborated with scanning electron microscopy and fluorescent in situ hybridization. However, several Metadevescovina species, which form a sister group of Devescovina spp., did not possess Bacteroidales ectosymbionts. Moreover, a combination of molecular analysis and electron microscopy led to a correction of the previously overestimated diversity of Metadevescovina species in the gut of termite Incisitermes marginipennis. In contrast to the Bacteroidales ectosymbionts, the endosymbionts

of Deves. Mutually beneficial symbioses (mutualism) between bacterial symbionts and plant or animal hosts are ubiquitous, and quite frequently these associations are broad host-range in nature, in that the bacterial symbiont can associate with several different hosts. Although broad host-range mutualisms are widespread and fundamentally important to our understanding of biological systems, our basic knowledge of how these systems are maintained and evolve is limited. The work detailed in this thesis describes the development of the Xenorhabdus bovienii bacterial strain – Steinernema spp. nematode association as a model for exploring such questions. In the work described here I characterize a suite of nine X. bovienii bacterial strains that associate with six different nematode host species. Through genomic and phenotypic analysis, I demonstrate that these bacterial strains are functionally diverse, providing the potential for variability in symbiotic interactions. Experimental testing demonstrates that indeed variability in symbiotic interactions occurs and that these differences are likely due to coevolution between nematode host species and bacterial strain symbionts. Further comparative genomic analyses provide insight into which bacterial functions are diverse and may contribute to variability in symbiotic interactions. Finally, I provide an in-depth analysis of the incompatible relationship between S. feltiae nematodes and the symbionts of S. intermdium and S. affine nematodes, which demonstrates that bacterial symbionts can influence the outcome of host competition. In total, these experiments define features of the X. bovienii bacterial strain – Steinernema spp. association to

begin to answer basic biological questions about broad host-range symbiosis, such as the impact of interactions on the ecology of organisms and the maintenance of associations through evolutionary time. Additionally, the described characterizations will enable the use of the system as a model for future experimentation to understand broad host-range symbioses. The aim of this thesis is to describe symbiotic gastrointestinal bacterial populations in relation to their environment, both at the community and cellular level, in order to advance the field of microbial ecology. Two different levels of relations are examined: in bacterial populations as they undergo differentiation, and in bacterial symbiotic communities in relations with a host. Bacterial populations routinely collaborate in order to fully differentiate in response to environmental stress. The literature review herein describes the current state of knowledge about bacterial programmed cell death during differentiation. This study found that programmed lysis of the Low G+C Gram positive bacterial symbiont Epulopisciumoccurs after marked DNA replication in the terminally differentiated mother cell, as well as the expected replication in developing offspring cells. This energetically expensive process sustains the large metabolically active cell and may allow nutrient storage in the form of DNA for later use by the offspring or host. The close relative of Epulopiscium, Metabacterium polyspora, has different DNA dynamicsand reproduces through the formation of multiple dormant endospores. In model systems DNA replication is blocked after induction of sporulation, In contrast,

M. polysporareplicates DNA inside developing forespores. This may allow M. polysporato modulate the number of forespores produced based on local nutrient availability within the gastrointestinal tract of its host. Both Epulopiscium and M. polysporaappear to have evolved reproductive strategies and related DNA replication dynamics that are suited to their particular relationship with the host. Studies of the gastrointestinal microbiota of the coral reef fish Pomacanthus sexstriatus also illustrate the ability of organisms to shape and be shaped by their environment. The unusual prevalence of sulfate reducing bacteria in this community could aid host digestion of a wider range of algae, including those that use sulfonated carbohydrates as a defense against predation. This ability may have an impact on larger coral reef ecology, promoting coral reef resilience by controlling fast-growing algal populations. In summary, investigations into these bacterial populations and communities provide data that can only be explained when bacteria are placed within the context of their environment and evolutionary history. Insects engage in intimate associations with microbial symbionts that colonize their digestive systems or internal cells and tissues. The stability and near ubiquity of many of these "symbioses" implies their importance, a prediction supported through experimentation. With the advancing power of experimental methodologies and the growing accessibility of genomic techniques, insect science has reached a powerful new stage enabling the study of previously recalcitrant symbioses, including several with medical and agricultural significance. In

this volume we publish a collection of chapters focused on the physiology of insect-microbe symbioses, emphasizing their mechanistic underpinnings, and the ecological and evolutionary causes and consequences of these interactions. Resident microbes modulate insect digestion, nutrition, detoxification, reproduction, interspecies signaling, and host-parasite interactions, and these chapters synthesize impactful, state-of-the art research on insect-microbe symbioses. Through discussions of the mechanisms that both stabilize and regulate these symbioses, these chapters yield further insight into the physiological integration between many insects and their influential microbial partners. A broad look at the wide range of symbiont roles and impacts throughout Insecta Molecular and genomic-assisted insights into the diversity and function of symbioses Insights into the influence and integration of symbionts from medically and agriculturally important insects This updated monograph deals with methanogenic endosymbionts of anaerobic protists, in particular ciliates and termite flagellates, and with methanogens in the gastrointestinal tracts of vertebrates and arthropods. Further chapters discuss the genomic consequences of living together in symbiotic associations, the role of methanogens in syntrophic degradation, and the function and evolution of hydrogenosomes, hydrogen-producing organelles of certain anaerobic protists. Methanogens are prokaryotic microorganisms that produce methane as an end-product of a complex biochemical pathway. They are strictly anaerobic archaea and occupy a wide variety of anoxic

environments. Methanogens also thrive in the cytoplasm of anaerobic unicellular eukaryotes and in the gastrointestinal tracts of animals and humans. The symbiotic methanogens in the gastrointestinal tracts of ruminants and other “ methanogenic ” mammals contribute significantly to the global methane budget; especially the rumen hosts an impressive diversity of methanogens. This makes this updated volume an interesting read for scientists and students in Microbiology and Physiology. The pelagic tunicate, Pyrosoma atlanticum, is known for its brilliant bioluminescence, but the mechanism causing this bioluminescence has not been fully characterized. This study identifies the bacterial bioluminescent symbionts of P. atlanticum collected in the northern Gulf of Mexico using various methods such as electron microscopy, light microscopy, and molecular genetics. The bacteria are localized within a specific pyrosome light organ. Bioluminescent symbiotic bacteria of Vibrionaceae composed >50% of taxa in tunicate samples (n=13), which was shown by utilizing current molecular genetics methodologies. While searching for bacterial lux genes in 2 tunicate samples, we also serendipitously generated a draft tunicate mitochondrial genome which was used for P. atlanticum pyrosome identification. Furthermore, a total of 396K MiSeq16S rRNA reads provided pyrosome microbiome profiles to determine bacterial symbiont taxonomy. After comparing with the Silva rRNA database, a 99% sequence identity matched a Photobacterium sp. R33-like bacterium (referred to as Photobacterium-Pa1) as the most abundant bacteria within P.

atlanticum samples. Specifically-designed 16S rRNA V4 probes for fluorescence in situ hybridization (FISH) verified the Photobacterium-Pa1 location around the periphery of each pyrosome luminous organ. Scanning and transmission electron microscopy (SEM, TEM respectively) confirmed a rod-like bacterial presence which also appears intracellular in the light organs. This intracellular bacterial localization may represent a bacteriocyte formation reminiscent of other invertebrates. Anemones and fish, ants and acacia trees, fungus and trees, buffaloes and oxpeckers--each of these unlikely duos is an inimitable partnership in which the species ' coexistence is mutually beneficial. More specifically, they represent examples of defensive mutualism, when one species receives protection against predators or parasites in exchange for offering shelter or food to its partner species. Explores the Diverse Range of Defensive Mutualisms Involving Microbial Symbionts The past 20 years, since this phenomenon first began receiving attention, have been marked by a deluge of research in a variety of organism kingdoms and much has been discovered about this intriguing behavior. Defensive Mutualism in Microbial Symbiosis includes basic ecological and biological information on defensive mutualisms, explores how they function, and evaluates how they have evolved. It also looks at the implications of symbiosis defensive compounds as a new frontier in bioexploration for drug and natural product discovery--the first book to explore this possibility. Chapters Written by Field Authorities The book expands the concept of defensive mutualisms to evaluate defense

against environmental abiotic and biotic stresses. Addressing the topic of defensive mutualisms in microbial symbiosis across this wide spectrum, it includes chapters on defensive mutualistic associations involving multiple kingdoms of organisms in terrestrial and aquatic ecosystems--plant, animal, fungi, bacteria, and protozoans. Defensive Mutualism in Microbial Symbiosis unifies scattered findings into a single compendium, providing a valuable reference for field researchers and those in academia to assimilate and acquire a knowledgeable perspective on defensive mutualism, particularly those involving microbial partners. In the English edition of his landmark book Endosymbiosis of Animals with Plant Microorganisms (1965), Professor Paul Buchner, probably the most prominent founder of systematic symbiosis research, wrote: “ I too soon fell victim to the spell of this subject, and from 1911 on devoted myself to it. ” Almost half a century later, a growing number of entomologists are recognizing the impact that arthropod-bacteria symbiosis has on virtually all aspects of the biology of both host and symbiont. The discussion of this subject tends to be system based, with primary emphasis on the insect host. However, recent screening studies have revealed that the diversity of bacteria associated with arthropods may not be as wide as initially expected, and some genera are constantly being found in hosts that belong to distantly related taxa. Manipulative Tenants: Bacteria Associated with Arthropods introduces the fascinating world of bacteria-arthropod associations with an emphasis on the bacterial partner. Written by an interdisciplinary team of international contributors, this

book provides an overview of the diversity of bacterial symbionts identified to date as frequent partners of terrestrial arthropods. It discusses primary (obligatory) symbionts as well as the most abundant secondary (facultative) symbionts currently known. Summarizing the most up-to-date information available on each symbiont, the book presents a synopsis of the field from the bacterial angle. Chapters examine Proteobacteria, including Sodalis and Wigglesworthia in tsetse flies and Stammerula and other symbiotic bacteria in fruit flies, as well as Bacteroidetes such as Blattabacterium and Cardinium. The book also identifies questions that emerge from the study of these systems. This comprehensive reference introduces the topic of bacteria-arthropod associations to researchers who are not familiar with it, enlarges the scope of knowledge of those who are, and provides a textbook for students in microbiology and other branches of biology. "The discovery of several members of the Leguminosae family growing on a TCE contaminated site demonstrated that they have the capabilities to tolerate the TCE contamination. This led to an investigation of the plants' ability to metabolize TCE. Research by Dr. Lee Newman showed that nodules from Crotalaria spectabilis grown on the site had TCE metabolites present while nodules from other legumes at the site did not. The presence of TCE metabolites within the C. spectabilis nodules suggests that the bacterial symbiont may be responsible for TCE metabolism. This led us to investigate the symbiont of C. spectabilis and its ability to metabolize TCE. Nodules from C. spectabilis grown on TCE contaminated and non-contaminated

soils were used to isolate the bacterial symbiont. Some species of Crotalaria are known to host Methylobacterium nodulans and this unique symbiont may explain why only the C. spectabilis nodules metabolize TCE. However, methane and methanol enrichments from the nodules were not successful and led to other approaches of isolating and identifying the symbiont. Sequencing of the 16S rRNA gene amplified from crushed nodules identified the symbionts as members of the Mesorhizobium genus. Symbiotic bacteria were isolated from control and dosed nodules and isolates of potential symbionts were verified by comparing PCR products from nodules and isolates using DGGE analysis. Sequencing of the 16S rRNA gene from the isolate confirmed that the isolates are members of the genus Mesorhizobium. This bacterium is different from symbionts isolated from other Crotalaria species and represent a new bacterium capable of nodulating Crotalaria sp. Attempts to demonstrate TCE metabolism by the isolated symbionts were unsuccessful suggesting that TCE metabolism may depend on a partnership with the host plant"--Abstract, leaf iii. This book provides basic information and different protocols associated with the Entomopathogenic nematodes (EPNs) and their symbiotic bacteria. Entomopathogenic nematodes (EPNs) of the genera Steinernema and Heterorhabditis and their associated bacterial symbionts Xenorhabdus and Photorhabdus aid nematode infective juveniles (IJs) in infecting and killing their insect hosts, creating a unique tripartite complex of host-vector-symbiont interactions. Due to this insect killing capability, EPNs

are used as biological control agents of economically important insect pests. They are also a model system to study host-parasite interactions. It provides a systematic approach to various nematode procedures including pathogenicity, reproduction, foraging behaviour. It gives a brief outline on historical aspects, nematode-bacterium complex, biology and chemical ecology of EPNs. It concisely describes host insect rearing, nematode sampling and storage, isolation techniques, counting, handling and staining of nematodes, characterization including morphological, molecular and ecological studies, mass production, virulence bioassay, field application and efficacy. The book also includes methods and techniques for their associated symbiotic bacteria. This book serves as a laboratory manual and assists the readers to undertake advanced research in different aspects related to nematodes. It is useful for researchers in the fields of nematology, microbiology, bacteriology and entomology. ras 20 a ñ os de investigaci ó n los autores encuentran que los n ú cleos de las c é lulas tumorales est á n repletos de bacterias del Genus streptococcus. Estas actu á n como simbiontes nucleares e inducen en las c é lulas portadoras divisiones nucleares que sirven para autoperpetuarse en los nuevos n ú cleos (formas reproductivas). Algunos streptococcus son capaces de salir de als c é lulas e infectar nuevos n ú cleos (formas infectivas). Ambos mecanismos, junto con la liberaci ó n de metabolitos, originan una r á pida progresi ó n tumoral que explica el crecicimento y diseminaci ó n de las c é lulas cancerosas. La destrucci ó n espont á nea o inducida de las

c é lulas tumorales sirve de liberaci ó n y diseminaci ó n, siendo un factor agravante para el organismo. Estos hallazgos abren nuevas perspectivas patog é nicas, diagn ó sticas y terape ú ticas en esta severa y a menudo mortal enfermedad. Th è se. Biologie. M é decine. 2014 Endosymbiosis is a primary force in eukaryotic cell evolution. In order to understand the molecular mechanisms involved in this mutualistic relationship, experiments to reproduce endosymbiosis are indispensable. The ciliate "Paramecium" is an ideal host for performing such studies. Topics presented in this volume are: the origins of algal and bacterial symbionts in "Paramecium", the diversity of endosymbiotic bacteria, such as "Holospora" bacteria and especially "Chlorella" species, as well as the infection and maintenance processes. The metabolic control, the regulation of circadian rhythms and photobiological aspects of the mutualistic association, as well as the killer effect of "Paramecium" and its causative agents are further points discussed. Tephritid fruit fly -- Bactrocera dorsalis -- Bacterial symbionts -- Gut bacteria -- Biological control -- Endosymbionts -- Fruit fly development. Algal symbiosis. Symbiosis with fungi and bacteria. Wrong paths in symbiosis research. Symbiosis in insects feeding on cellulose, herbaceous plant parts, seeds, and similar substances. Symbiosis in animals which live in tree sap. Symbiosis in animals which suck plant juices. Symbiosis in animals sucking vertebrate blood and feeding on corneous substances. Symbiosis in luminous animals. Cases of symbiosis localized in excretory organs. Localization of the symbionts. Methods of transmission. Embryonic and

postembryonic phenomena. Correlation between host organism and symbionts. Historical problems. The signioficance of endosymbiosis. Microbes influence the evolutionary trajectories of animals through symbiosis, which ranges from parasitic to mutualistic associations. Fungus-growing ants engage in multiple microbial symbioses, including an obligate mutualism with a fungus, Leucoagaricus spp., which is the ants' main food source and is cultivated into structures known as 'fungus gardens.' In addition, Escovopsis is a system-specific fungal parasite that destroys Leucoagaricus hyphae. The interactions between the ants, Leucoagaricus, and Escovopsis represent ancient co-evolving symbioses with well-described roles. However, other microbial symbioses within the system are less explored. Metagenomic studies revealed a consistent bacterial community in fungus gardens dominated by Proteobacteria, but the specific functional roles of most of these bacteria are unknown. Likewise, one metagenomic study found bacteriophage in fungus gardens, yet virus presence and dynamics are poorly described. Overall, the goal of my research is to investigate the function and diversity of the understudied secondary bacterial and viral communities present within the multipartite symbiosis of fungus-growing ants. In this dissertation, I use interdisciplinary approaches to assess the functional capacity of bacteria that associate with fungus gardens and to explore viral diversity in the fungus-growing ant system for the first time. In Chapter 2, I explore the ability of fungus garden bacteria to detoxify plant secondary compounds that are harmful to the fungal mutualist, Leucoagaricus spp.

Using methods including isolation of bacterial and fungal strains, phenotypic and genomic analyses, and gas-chromatography to quantify toxin degradation, I concluded that plant secondary compound detoxification is a polymicrobial process that includes multiple fungus garden bacterial community members and the fungal mutualist. These microbial associations enable leaf-cutter ants to be the successful generalist herbivores that they are. In Chapter 3, I describe the role of fungus garden-associated bacteria in the genus Burkholderia as potential defensive symbionts that protect the ants against the parasitic fungus Escovopsis. Using selective isolations of bacteria in the family Burkholderiaceae, genomic analysis, competitive bioassays, and analytical chemistry techniques, I found that Burkholderia sp. can inhibit Escovopsis via the production of two synergistic or additive antifungals, pyrrolnitrin and burkholdine1213. In Chapter 4, I performed virus-enriched metagenomic and metatranscriptomic sequencing of fungus-growing ants and Leucoagaricus spp. to identify viruses that associate with the system. Here, I identified 34 eukaryotic viruses that associate with either ant or fungal tissue, with certain viruses demonstrating evolutionary congruence with ant host phylogeny. Overall, my work sheds light on the secondary microbial interactions and functions within the fungus-growing ant system. Together, these studies enhance our knowledge of how fungus-growing ants associate with a diversity of microbes to succeed in the presence of biotic stressors, underscoring the importance of symbiotic microbes on the evolution and ecology of their host. Taking

account of developments over the last decade, this 2nd edition addresses advances in the field and the emergence of fields such as cellular microbiology, immunoparasitology and cytobiology which have revealed new aspects of symbiosis. The volume deals with history, morphology, taxonomy, and systematics of entomopathogenic nematodes (EPN) in the families Steinernematidae and Heterorhabditidae, molecular methods and bacteria associated with these nematodes. Microbial Symbionts: Functions and Molecular Interactions on Host focuses on microbial symbionts of plants, animals, insects and molecular methods in the identification of microbial symbionts. The book describes the molecular mechanism and interactions of symbiosis of microbiome in plants, animals and humans. It brings the latest techniques for identification, localization and functional characterization of host-associated microbes and explains the role/importance of microbial symbionts. This comprehensive reference covers a wide range of symbiotic microorganisms used for basic and advanced techniques associated with the isolation, characterization and identification of microbial symbiotic microorganisms and their functions and molecular interactions on the host. The book will also helps users plan and execute experiments with appropriate knowledge rather than experimental trial and error in a wide range of disciplines, including Microbiology, Biotechnology, Botany and Zoology. Provides basic knowledge and working protocols for a wide range of disciplines like Microbiology, Biotechnology, Botany and Zoology Presents the most current information in symbiotic

microbiome and holobiome Includes color photos pertaining to techniques This book examines how the growing knowledge of the huge range of protist-, animal-, and plant-bacterial interactions, whether in shared ecosystems or intimate symbioses, is fundamentally altering our understanding of biology. The establishment and maintenance of these interactions and their contributions to the health and survival of all partners relies on continuous cell-to-cell communication between them. This dialogue may be concerned with all aspects of the biology of both partners. The book includes chapters devoted to exploring, explaining, and exposing these dialogues across a broad spectrum of plant and animal eukaryotes to a broad field of biologists. Key Features Explores the nature of the interactions between eukaryotic hosts and their microbial symbionts Examines the links between prostist, animal, and plant evolution and microbial communities Reviews specific taxa and the microbial diversity associated with these taxa Illustrates the role microbes play in the physiology and etiology of several model species Includes chapters by an international team of leading scholars This volume summarizes recent advances in our understanding of the mechanisms that produce successful symbiotic partnerships involving microorganisms. It begins with a basic introduction to the nature of and mechanistic benefits derived from symbiotic associations. Taking that background knowledge as the starting point, the next sections include chapters that examine representative examples of coevolutionary associations that have developed between species of microbes, as well as associations

between microbes and plants. The authors conclude with a section covering a broad range of associations between microbes and invertebrate animals, in which they discuss the spectrum of hosts, with examples ranging from bryozoans and corals to nematodes, arthropods, and cephalopods. Join the authors on this journey of understanding! This volume describes the various applications of entomopathogenic soil microorganisms in the management and control of the devastating lepidopteran pest. An introduction describes the insecticidal properties of viruses, bacteria, fungi, nematodes and their metabolites, as well as their applications in the context of crop improvement. Subsequent chapters focus on topics such as insecticidal proteins; the role of nucleopolyhedroviruses; Bt toxins and their receptors; control of lepidopterans using entomopathogenic fungi; management of cotton defoliators; and sustainable use of entomopathogenic nematodes and their bacterial symbionts. An overview of culture collections of entomopathogenic microorganisms rounds out the volume. The associations between insects and microorganisms, while pervasive and of paramount ecological importance, have been relatively poorly understood. The third book in this set, Insect Symbiosis, Volume 3, complements the previous volumes in exploring this somewhat uncharted territory. Like its predecessors, Volume 3 illustrates how symbiosis research has important ramifications for evolutionary biology, microbiology, parasitology, physiology, genetics, and animal behavior, and is especially relevant to the control of agricultural and disease-carrying pests worldwide. Insect Symbiosis, Volume 3, includes

pioneering chapters on Paratransgenesis in termites, Bacterial symbionts in anopheles spp. and other mosquito vectors, Endosymbionts of lice, and the Structure and function of the bacterial community associated with the Mediterranean fruit fly. These individual studies suggest practical applications in pest control involving novel, pesticide-free, biological control approaches. This new volume adds to the growing body of knowledge on the ubiquitous endosymbiont Wolbachia. This bacterial genus and its potential as a weapon against insect pests and vectors have been covered in the first two volumes of Insect Symbiosis. Volume 3 contains chapters on Wolbachia and anopheles mosquitoes, Feminizing Wolbachia and the evolution of sex determination in isopods, and Wolbachia – induced sex reversal in Lepidoptera. The book examines symbiotic relationships in the context of how host organisms recognize their own cells as self and other cells or potentially parasitic or pathogenic organisms as nonself, allowing researchers to make predictions of compatible and incompatible interactions. Following in the tradition of the first two volumes, this book serves as a great reference on host-parasitic relationships for professionals from a broad range of disciplines. Algal symbiosis. Symbiosis with fungi and bacteria. Wrong paths in symbiosis research. Symbiosis in insects feeding on cellulose, herbaceous plant parts, seeds, and similar substances. Symbiosis in animals which live in tree sap. Symbiosis in animals which suck plant juices. Symbiosis in animals sucking vertebrate blood and feeding on corneous substances. Symbiosis in luminous animals. Cases of

symbiosis localized in excretory organs. Localization of the symbionts. Methods of transmission. Embryonic and postembryonic phenomena. Correlation between host organism and symbionts. Historical problems. The signioficance of endosymbiosis. Nothing provided Symbiosis is ubiquitous in nature and can play a crucial role in shaping the biology of both eukaryotes and prokaryotes. Importantly, the interaction of microorganisms with eukaryotes can range from pathogenicity to mutualism, also shifting along this continuum. The ecological settings facilitating such lifestyle transitions are, however, poorly understood. This dissertation focuses on the symbiosis between Lagriinae beetles and Burkholderia gladioli, a bacterium mostly known for its plant pathogenic traits. In Lagria hirta and Lagria villosa beetles, I localized these bacteria on adults, larvae and eggs of both species confirming a vertical transmission route. The presence of B. gladioli in these and four other Lagriinae species suggested that the association is relatively ancient and evolved within this phytopathogenic bacterial group. Additionally, B. gladioli from L. villosa can successfully infect soybean plants, a food source for this beetle species, and negatively affect the plant's reproductive output, implying that the insect symbiont conserves the ability to intimately interact with a plant. Presumably, the potential of plant pathogenic B. gladioli bacteria to produce potent bioactive substances was also essential for establishing a mutualism with the insect. In L. villosa beetles, I could show that B. gladioli on the surface of eggs inhibit the growth of antagonistic fungi. I thereby demonstrate a symbiont-

mediated defense, which could be highly advantageous at the nutrient-rich and immobile egg stage. Furthermore, we elucidated four compounds (toxoflavin, caryoynencin, lagriene and lagriamide) that could be responsible for the protective effect by the symbionts. Finally, multiple symbiotic B. gladioli strains were found coexisting in individual beetles, bringing about interesting questions regarding the potential advantages of strain diversity in defensive symbiosis and the evolutionary dynamics supporting their long-term maintenance. Symbiotic associations involving prokaryotes occur ubiquitously and are ecologically highly significant. In symbiotic associations, co-evolution of the partner organisms has led to specific mechanisms of signal exchange and reciprocal regulation, and resulted in novel physiological capabilities of the association as compared to those of the individual partners. Symbiosis research has recently entered an exciting era because molecular biology techniques are available for studying partner organisms in association and in a culture-independent manner. It is the goal of this book to contribute towards a broader perspective and an understanding of the function of symbiotic systems. 14 different model systems have been chosen, comprising well known symbioses as well as novel experimental systems which have only recently become amenable to experimental manipulation.

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