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GENERAL AND APPLIED PHYSICS

Effect of Environmental Fluctuation in the Dynamics of a Three-Species Food Chain Model with Sexually Reproductive Generalized Type Top Predator and Crowley-Martin Type Functional Response Between Predators

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Abstract
The main aim of this paper is to explore the dynamical behavior of a three-species prey-predator interaction model with sexually reproductive generalized type top predator under the consideration of environmental fluctuations. Our discussion has involved a continuous tritrophic food chain model with Crowley-Martin senses and Holling type II functional responses. For the deterministic model, the existence of equilibria as well as boundedness of the solution has been established here. The feasibility and local stability of the interior and non-interior equilibrium points has been investigated. The global dynamics of the co-existence of all the three species are shown at the interior equilibrium point. To determine the direction of Hopf bifurcations under the non-hyperbolic case, the first Lyapunov number is computed using the center manifold theorem. Several bifurcation analyses are performed at the interior equilibrium point. The effect of environmental fluctuation on some of model parameters are studied here through the verification of existence of unique positive global solution, existence and persistence of stationary solution. Numerical simulation has been carried out to illustrate the theoretical findings by using the MATLAB and Maple software packages and finally some concluding remarks are given.

Keywords Holling type II functional response · Crowley-Martin functional response · Global stability · Hopf bifurcation · Center manifold theory · Stochastic model · Persistence in mean

1 Introduction

The ecological world is a complex interconnected system of species interacting with one another. Competition can take many forms, but food competition (intra-species) and prey-predator relations (inter-species) are the most common [1, 2]. Several studies have been accomplished on prey-predator interaction using Lotka-Volterra type functional response [3]. Typically, the prey-predator models combine functional responses, which describe how each predator responds to changes in prey density during a given period of time [4–6]. According to Holling, four types of functional responses were developed as a result of simplification of prey searching, prey consumption, and environmental complexity, (referred to as Holling types I, II, III, and IV) on the basis of empirical field data [7–11]. The nature of prey consumption rate when a predator consumes a population of prey determines the form of the functional response (linear, hyperbolic, and sigmoidal). A number of studies have been conducted that consider Holling type II functional responses in prey-predator systems [12].

Traditionally, prey-predator models assume that functional response is entirely dependent on prey density, which has come under increased scrutiny of late. As suggested by Arditi and Ginzburg [13], another prey-predator model assumes that functional responses are affected by the densities of both prey and predator populations. According to them, the traditional functional response is based on the

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DYNAMIC INTERACTIONS BETWEEN PREY AND PREDATOR WITH COOPERATION AND ALLEE EFFECT: DETERMINISTIC AND STOCHASTIC APPROACH

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In this paper, we investigate the behavior of a predator–prey model with cooperation and Allee effect considering both deterministic and stochastic approaches. The main aim of this paper is to investigate the effect of environmental fluctuation in a deterministic predator–prey model. During the analysis of the deterministic model, it is shown that the system has saddle-node point of co-dimension 1, Hopf bifurcation and Bogdanov–Takens bifurcation of co-dimension 2. To study the effect of environmental fluctuation, we use perturbation to the birth rate of prey and death rate of predator density by Gaussian white noise. The persistence of the model and the stationary distribution is shown by forming a suitable Lyapunov function. Finally, numerical simulations are performed to validate the theoretical findings.

Keywords: Predator–Prey Model; Cooperation; Allee Effect; Stochastic; Hopf Bifurcation; Bogdanov–Takens Bifurcation.

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Regular Article - Experimental Physics

Measurement of electric quadrupole moment in neutron rich ^{131,132}I

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Abstract The quadrupole moments of the excited levels in neutron rich iodine isotopes, viz., ^{131}I ($5/2^+_1$) and ^{132}I (3^+_1), have been measured with $LaBr_3$(Ce) detectors using Time Differential Perturbed Angular Correlation (TDPAC) spectroscopy. The excited levels were populated from β^- decay of the radiochemically separated tellurium (Te) fission products produced in ^{nat}U(^{4}He,f) reaction at E_α(lab) = 40 MeV from K-130 cyclotron at VECC, Kolkata. The active tellurium fission products were radiochemically doped in metallic tellurium matrix to provide the necessary Electric Field Gradient (EFG) required for TDPAC measurement. The values of quadrupole moments for the $5/2^+_1$ level of ^{131}I and 3^+_1 level of ^{132}I were determined to be (−)0.30(1) eb and (−)0.25(2) eb, respectively. The present measurement provides the first experimental determination on the electric quadrupole moment of $5/2^+_1$ level of ^{131}I.

1 Introduction

The measurement of electric quadrupole moment is important to estimate the deviation of the nuclear charge distribution from sphericity [1,2]. It is also a sensitive probe to indicate the evolution of shell structure. Thus, such measurements in neutron rich nuclei below doubly closed ^{132}Sn are of substantial importance to probe the prevalence of expected spherical character as one approaches the N = 82 shell closure in this exotic domain [3–5]. However, the availability of experimental data on electric quadrupole moments (EQM) in this mass region are inadequate. Apart from a few, most of the existing results are from measurements done during early 60s to late 80s [6]. So, it is important to perform more measurements on electric quadrupole moment to enrich the understanding of the evolution of shell structure around ^{132}Sn.

In case of iodine nuclei, the systematic change of measured EQM for the $5/2^+_1$ and $7/2^+_1$ levels were studied in 1964 [7]. It was found by the authors of Ref. [7] that a linear extrapolation of the measured values to the closed neutron shell at N = 82 predicted a value of Q = 0.11 b for the $7/2^+_1$ state. However, the extrapolated value of EQM for $5/2^+_1$ state, obtained in a similar manner, is much larger. In contrast to the data, both the theoretical calculations performed at that time, (i) by Kisslinger and Sorensen [8] and (ii) the single-particle estimates and the configuration mixing calculations by Horie and Arima [9], predicted a larger absolute value of EQM for $7/2^+_1$ level compared to that for $5/2^+_1$ level in N = 82 iodine nucleus.

It is worth mentioning that in Ref. [7], specifically for the $5/2^+_1$ level, the linear extrapolation was based on only three data points which are again significantly away from shell closure of N = 82. So, systematic experimental determination of quadrupole moments up to N = 82 iodine is of importance to understand the evolution of nuclear deformation of the $5/2^+_1$ and $7/2^+_1$ levels. Subsequent to the work of Ref. [7], very few measurements of EQMs of iodine nuclei have been performed [10–13]. Till date, no experimental measurement exists on the EQM of $5/2^+_1$ levels in odd-A iodine with $N > 76$.

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Decay spectroscopy of ^{117,118}Sn

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Abstract

The low-lying states of ^{117,118}Sn have been studied from the decay of ^{117g,118m}Sb, and ^{117m}Sn. These long-lived species were populated through the reaction ^{4}He + ^{nat}In at E_{lab} = 32 MeV. Singles, as well as γ-γ coincidence data, were acquired. The uncertainties in the placement of some of the γ-rays in the excitation spectra of ^{118}Sn observed by previous workers have been removed. A γ-ray (984 keV) previously assigned to ^{118}Sn has been eliminated from the level scheme, based on the present analysis. The decay half-lives of ^{117g,118m}Sb have been remeasured. The slope method and deconvolution technique have been used to determine the half-lives of a few isomeric states in ^{117,118}Sn. The results are interpreted in the framework of large scale shell model calculations performed in the 50 - 82 valence shell using truncations. Although the excitation energies were not reproduced well, the theoretical calculations could reasonably reproduce the isomers' transition probabilities due to their nearly pure configuration.

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Shape coexistence scenario in ^{150}Sm from a γ-γ fast-timing measurement

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Lifetimes are measured for low lying states of ^{150}Sm, populated from β^- decay of ^{150}Pm produced through (p, n) reactions with a ^{150}Nd target. The VENTURE array comprising of eight fast $CeBr_3$ detectors is used for lifetime measurement with γ-γ fast timing technique. The lifetime of 0_3^+ level of ^{150}Sm is measured for the first time to be 36(10) ps. The 0_3^+ level is found to have enhanced decay strengths to the $K^\pi = 0_2^+$ structure compared with $K^\pi = 0_1^+$. A high $\rho^2(E0)$ strength for the $0_3^+ \rightarrow 0_2^+$ decay confirms shape coexistence and shape mixing in $N = 88$ ^{150}Sm.

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I. INTRODUCTION

The presence of multiple close lying eigenstates with different intrinsic deformation in a finite nuclear many-body quantum system is known as shape coexistence [1]. It is closely related to the shell gaps and the nature of particle-hole excitations leading to an induced deformation around the spherical (deformed) structures of the ground state. The nuclei around $Z = 64$ and $N = 90$, especially the Sm and Gd isotopes, provide the classical examples of shape coexistence and shape phase transitions with interesting observations already made through decades [2–6]. However, understanding shape coexistence is still challenging and there exist unsolved problems that require more attention on the low-lying excited levels as a function of N and Z. One of these to mention is the underlying structure of the excited 0^+ levels in even-even nuclei that are not understood completely and are of contemporary interest [7–11].

The two-nucleon transfer data from (p, t) reactions [12] suggests the shape coexisting features of the 0^+ levels in ^{150}Sm and ^{152}Sm. In this work, the 0_3^+ levels of ^{150}Sm and ^{152}Sm are observed to have different deformation in coexistence with their near spherical and deformed ground states, respectively. In case of ^{152}Sm, which is described as the critical point of the first-order phase transition from spherical vibrator to axial rotor [13], the 0_3^+ level was described as a pairing isomer [14]. On the contrary, such description for ^{152}Sm was contradicted by Mach *et al.* [15] and by Gupta and Hamilton [16]. In the work by Mach *et al.* [15], all the 0^+ bands in ^{152}Sm are interpreted to follow quadrupole phonon multiplet structures [17] from energy, $B(E2)$ and the $\rho^2(E0)$ systematics. In the work of Gupta and Hamilton [16], all low-lying 0^+ levels have been interpreted to have similar rotational character, so rejecting the shape coexistence and/or pairing isomer pictures for these levels.

Similarly, in case of ^{150}Sm also, the 0_3^+ state was found to correspond to a deformed structure [18] in coexistence with its near spherical ground state. Whereas the recent work by Gupta, Kumar, and Hamilton [19] proposes the 0_3^+ (1255 keV), 2_4^+(1417 keV), and 4_4^+(1819 keV) levels to be the candidates of a $K = 0$ band having a quasirotational $\beta\beta$ two phonon structure. Their interpretation is based on the $E(0_3^+)/E(0_2^+)$ ratio of 1.7, presence of γ transition from $0_3^+ \rightarrow 2_2^+$ (level of $K = 0$, β vibrational band) and from the $B(E2)$ values obtained from dynamic pairing plus quadrupole (DPPQ) model calculations. Such structure was further supported by the observation of another γ transition from the 2_4^+ level to the 2_2^+ level of $K = 0$, β vibrational band [20].

The transition strengths, $B(E2)$ and the $\rho^2(E0)$, from the low-lying excited levels in the even-even nuclei are shown to be the best direct indicators in identifying the shapes, deformation, and their coexistence [1,2,4,21,22]. So, measuring the $E0$ and $E2$ transition strengths in ^{150}Sm ($N = 88$) is important in the context of shape coexistence around $N = 90$. However, the population of the 0_3^+ level in this nucleus has been observed only in decay, neutron-induced reactions and transfer reactions, but not in any fusion evaporation reaction giving rise to high yield. In the present work, lifetime measurements have been carried out for the low-lying levels in ^{150}Sm, viz., 2_1^+ (334 keV), 0_2^+ (740 keV), and 0_3^+ (1255 keV), using γ-γ fast timing spectroscopy with VECC array for nuclear fast timing and angular Correlation studies (VENTURE array) [23] and populating the excited levels from beta decay of ^{150}Pm.

II. EXPERIMENT

The low-lying excited states of ^{150}Sm were populated from the β^- decay of ^{150}Pm. The ^{150}Nd$(p, n)^{150}$Pm reaction was used with 8.0 MeV proton beam, provided by

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Lifetimes and transition probabilities for low-lying yrast levels in ^{130,132}Te

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Lifetimes have been measured for the low-lying yrast levels of ^{130,132}Te using $\gamma-\gamma$ fast timing methods. The excited states were populated in β^- and IT decay of fission fragments, mass-separated by the Lohengrin separator at Institut Laue-Langevin. Four $LaBr_3$(Ce) detectors, placed at the focal plane of the spectrometer, were used for the $\gamma-\gamma$ fast timing measurement. Lifetimes of μs isomers were measured using coincidence of an ionization chamber with two Clover HPGe detectors. The measured lifetimes and absolute transition probabilities are discussed in the light of systematics with the neighboring nuclei. Large basis shell model calculations have been performed to interpret the level structure and transition probabilities in these even mass Te isotopes.

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I. INTRODUCTION

Nuclear structure studies around doubly magic ^{132}Sn are of contemporary interest and are being explored with different experimental techniques [1–3]. One of the key focuses is on the measurement of transition probabilities for the low-lying levels [4–6], as this provides direct insight into the nucleon-nucleon interactions. Systematic measurements in even-even Te nuclei, having two protons above the $Z = 50$ shell closure, are useful to understand the evolution of nuclear structure between two extreme double shell closures of ^{100}Sn and ^{132}Sn, respectively. In this context, the measurement of nuclear level lifetimes becomes important and can be performed with the use of an appropriate γ-γ fast timing method [7,8]. The neutron-rich isotopes of Te, with few neutrons away from $N = 82$, can be populated with fission reactions and decay spectroscopy measurements can be carried out after separation of fission fragments in either or both of nuclear charge (Z) and mass (A).

The even-even Te isotopes show consistent vibrational structure having E_4^+/E_2^+ ratios close to 2.0 between $N =$ 50–82 [9–11]. The $B(E2)$ values, for both $10^+ \rightarrow 8^+$ and $2^+ \rightarrow 0^+$ decays, increase with increasing number of neutron holes around the $N = 82$ shell closure [10]. This increase in $B(E2)$, in case of even mass Te isotopes, was conjectured as the effect of configuration mixing with pure two-proton structure in neighboring even Sn isotopes. An unusual behavior was observed in the trend of transition rates around $N = 82$ as $B(E2)(2^+ \rightarrow 0^+)$ for $N = 80$ Te appeared to be higher compared to that at $N = 84$ [12]. This was explained with reduced neutron pairing beyond $N = 82$ in Ref. [13] but was resolved with new measurements and shell model calculations in the recent work of Ref. [5]. Systematic measurements of transition probabilities and their evolution are not available for all the low-lying levels in even mass Te isotopes below $N = 82$. This information would be of substantial importance to have a complete picture on the structural evolution as a function of angular momentum and changing neutron number up to the $N = 82$ shell closure.

Prior to the present work, in ^{130,132}Te, the lifetimes of the 10^+ levels were measured through the decay spectroscopy of μs isomers [10] and the $B(E2)$ of the $0^+ \rightarrow 2^+$ transition was measured through Coulomb excitation [12,14]. The level lifetimes of 6^+ and 7^- levels are known from the decay of Sb isotopes [15,16]. The lifetimes of 7^- and 10^+ levels in ^{132}Te were also measured in decay spectroscopy of mass-separated isomers [17,18] resulting in differing values for the 7^- level, compared to Ref. [16]. For the 4^+ and 8^+ levels no lifetime data exist in literature. In the present work, lifetimes have been measured for the low-lying yrast levels (2_1^+, 4_1^+, 6_1^+, 7_1^-, and 10^+) in the ^{130,132}Te nuclei, among which results for 4^+ levels are new.

II. EXPERIMENTAL DETAILS

The low-lying excited states of ^{130,132}Te have been populated from the combined routes of β^- decay of ^{130,132}Sb

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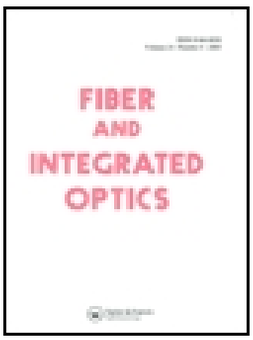

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Dynamics of Compressed Optical Pulse in Cubic-quintic Media

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Original research article

Optical solitons in saturable cubic-quintic nonlinear media with nonlinear dispersion

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ABSTRACT

We study an intense-short pulse propagation in a saturable cubic–quintic nonlinear media in the presence of nonlinear dispersion within the framework of an extended variational approach. We derive an effective equation for the pulse width and demonstrate how the saturation due to nonlinearity is achieved in presence of nonlinear dispersion. We find that the nonlinear dispersion can change the pulse width and induce motion in the system. The direction of induced motion depends on the sign of nonlinear dispersion. The pulse is energetically stable at an equilibrium width. A disturbance can, however, induce oscillation in pulse width, the frequency of which is always smaller due to nonlinear dispersion. We check dynamical stability by a direct numerical simulation.

1. Introduction

Studies on the propagation of optical pulse in nonlinear media have been receiving great of attention in the context of solitary-wave-based communication, especially, in femtosecond domain and, consequently, in ultrafast optics (pulse compression) and all-optical switching for last few decades. While propagating several nonlinear phenomena including filamentation, harmonic generation, third-order dispersion, self-steepening and self-frequency shift are associated with the pulse. The observations of such nonlinear phenomena depend crucially on the properties of the medium and the pulse [1–4].

An intense short pulse induces higher-order nonlinearities (HON) in an optical medium. Effects of such pulse are described by various forms of generalized nonlinear Schrödinger equation(GNLSE). The GNLSE is a version of the NLS equation which includes different types of nonlinear terms, some of which have already been realized experimentally. For example, quintic nonlinearity has been obtained in semiconductor doped glasses while septic nonlinearity has been measured in different glasses. It can also be possible to obtain saturation in the nonlinearity in some materials if the intensity of the pulse is relatively high. In semiconductor-doped glasses and organic polymers, however, the nonlinearity becomes saturated even at moderate pulse intensities [5–7].

Self-steepening is one of the effects that commonly arises due to propagation of ultrashort intense pulse in a nonlinear medium. It is related to nonlinear dispersion [8]. In the presence of this effect several attempts have been made to analyse the response of higher-order nonlinearities on the propagation of ultrashort pulse [9–13]. In the recent past, the existence and stability of various types of wave patterns (periodic pattern, bright and dark solitary pulses) have been investigated by Chow et al. It is seen that these modes are stabilized due to competition among different higher-order nonlinearities [14]. The existence of chirped solitary wave solution has been investigated by Triki et al. [15]. Recently, Konar et al. studied the characteristics of chirped solitary pulse in

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Effects of dispersion and saturable nonlinearity on dissipative solitons

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We study the properties of an intense pulse propagating in dissipative nonlinear systems considering nonlinear dispersion within the framework of the variational approach. We model the system by the so-called saturable cubic-quintic nonlinear Schrödinger equation including perturbing terms like two-photon absorption, intra-pulse Raman scattering, and dissipative losses. Introducing Rayleigh's dissipative function we derive a set of coupled differential equations for the various parameters of the pulse. It is clearly demonstrated how the interplay among dispersion, saturable nonlinearity, and dissipative losses affects intense-short pulse propagation in optical media. © 2023 The Japan Society of Applied Physics

1. Introduction

Studies on optical pulse propagation in a nonlinear medium have remained an interesting area for theoretical as well as experimental research in various contexts ranging from optical communication to ultrafast optics. Theoretically, the propagation of an optical pulse with a width of about 1 picosecond is described by the famous nonlinear Schrödinger equation (NLSE) where the dominant nonlinearity arises from Kerr effects.[1,2)] In the case of intense ultrashort (∼1 fs) pulse propagation, various non-Kerr nonlinearities come into play. Such pulses are described by the so-called generalized nonlinear Schrödinger equation (GNLSE). There exist several models similar to that of GNLSE to understand the effects of various forms of pulse degradation processes arising from non-conservative and conservative perturbations.[3–8)] The prime perturbing effects faced by a propagating optical pulse in a real physical system are the dissipative loss, two-photon absorption (TPA), intra-pulse Raman scattering(IPRS), and self-steepening.[2,9–11)]

The effects of higher-order perturbations result in some changes in the characteristics of the fundamental soliton. For example, the IPRS causes a self-frequency shift in the pulse and thus transfers its spectral component from the low to high-frequency region. The frequency increment depends on the propagation distance and frequency of the original pulse. More specifically, it is larger at a large distance and faster for short a pulse. However, the frequency of the spectral component may decrease depending on the sign of the IPRS strength. Intensity dependence of group velocity, called self-steepening, generates irregular spectral broadening by inducing asymmetry in the propagating pulse with its peak shifting towards the trailing edge. These perturbation effects become significant near two-photon absorption (TPA) resonance. In the vicinity of TPA resonance, the effects of higher-order nonlinearity are enhanced due to the propagation of high-power pulses. The nonlinearity may, however, get saturated for some materials like semiconductor (CdS_xSe_1)-doped glass and organic polymers.[12–15)] It is seen that chalcogenide glasses exhibit saturable nonlinearity and generate higher-order nonlinearity at a larger reduced-photon energy.[16,17)] The existence of nonlinearity saturation has motivated several interesting works in the framework of both generalized and fractional NLS models.[18–21)]

The objective of the present paper is to investigate the effects of perturbations, namely, dissipative loss, IPRS and TPA on a fundamental soliton propagating in saturable cubic-quintic nonlinear media in presence of nonlinear dispersion. In the absence of saturable nonlinearity, a number of studies based on variational techniques, soliton perturbation theory, the inverse scattering method, Lie symmetry analysis, and Laplace–Adomian decomposition method have been carried out to understand the effects of different types of perturbations.[9,22–36)] Cerda et al. studied pulse propagation in a nonlinear dissipative medium with TPA perturbation. In the recent past Roy et al.[37)] evaluated the effects of perturbing terms on pulse parameters by introducing Rayleigh's dissipation function (RDF). It is seen that the concept of RDF is very effective in describing the dissipation of a pulse arising from dispersive loss, filtering, two-soliton interaction, IPRS, and self-steepening in nonlinear systems. Recently, we have investigated the properties of bright soliton in the presence of saturable cubic-quintic nonlinearity (SCQNL) and nonlinear dispersion without any perturbation.[38)] The incorporation of perturbations makes the system non-conservative. Thus, we make use of the Rayleigh dissipative function and find that the SCQNL can enhance the effect of intra-pulse Raman scattering and stop the trend of exponential amplitude attenuation arising due to linear and nonlinear losses in a short window of propagation.

In Sect. 2, we formulate the problem using the Rayleigh dissipation function and find equations of different parameters of the pulse. Here we discuss the role of linear loss and TPA (nonlinear loss) in the dissipation of energy of the pulse. In Sect. 3, we discuss the case where saturable nonlinearity is absent and a fundamental soliton evolves under the combined action of nonlinear dispersion and perturbations. Similar studies have been carried out by several authors considering some or none of the nonconservation terms.[36,39,40)] Here we include all possible gain–loss terms. In Sect. 4 we find the effects of cubic-quintic saturable nonlinearity on the dissipative solitons. We see that the decay of soliton amplitude can be arrested in presence of SCQNL in a small window of propagation. We make some concluding remarks in Sect. 5.

2. Theoretical model

Pulse propagation in a saturable cubic-quintic nonlinear media in presence of dissipation can be modeled by a

Stability of Binary Solitons in Optical Fibers with Cubic-Quintic Cross-Phase Modulation

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We consider the propagation of nonlinear coupled pulses in an optical fiber with cubic-quintic self-and cross-phase modulation. We model the system by extended Manakov equations incorporating higher-order cross-coupling terms. We find that the pulse gets a certain minimum width for stable propagation in the medium. However, the pulse width reduces in the presence of higher-order cross-coupling terms. We make use of the Vakhitov–Kolokolov criterion and examine whether the pulse is linearly stable for different values of the pulse power. We also simulate the dynamics of a coupled soliton by a purely numerical routine.

topics: optical solitons, manakov model, variational approach, Vakhitov–Kolokolov criterion

1. Introduction

Soliton is a nonlinear wave that emerges from the interplay between non-linear and dispersion effects. During propagation, the shape and velocity of the solitons remain unaltered. Interestingly, all properties of solitons, except phase, remain invariant after collisions. However, the propagation of solitons in a particular medium is largely affected by the variation of the frequency and intensity of the pulse [1, 2]. More specifically, a high-frequency solitary wave (short pulse) enhances the dispersive effects, while its intensity affects the non-linearity of the optical medium. In the optical medium, the primary dispersive and nonlinear effects are respectively the group velocity dispersion (GVD) and the Kerr effects, which are responsible for the formation of the fundamental soliton. The properties of the shorter and highly intense pulse, however, are affected by the presence of non-Kerr effects like quintic non-linearity, stimulated Raman scattering, self-steepening, two-photon absorption, third-order dispersion etc. Most of the non-Kerr effects start to play if the optical pulse is very short (< 100 fs). Mathematically, such pulses can be described by the generalized Kundu–Eckhaus equation [3, 4]. There exists several studies based on the model [5, 6]. Recently, on the basis of the model, the existence of dipole soliton was predicted under some parametric conditions [7]. New types of solitary waves with the combined properties of a dark and bright soliton have been reported in [8].

For a pulse having a width greater than 100 fs and of moderate intensity, the dominant non-Kerr effect is quintic nonlinearity [3]. In this case, the displacement vector of the dielectric medium becomes the square function of the electric-field amplitudes, and the refractive index of the medium, if expressed in terms of the intensity of the medium, can be written as $n = n_0 + n_2 I + n_4 I^2$, where n_0 is the linear refractive index, and n_2 and n_4 are the refractive indexes of cubic and quintic nonlinearities, respectively. Studies on cubic-quintic nonlinear media have renewed considerable interest due to the technological development for inducing artificial higher order-nonlinearities in optical materials like semiconductor doped glasses, chalcogenide glasses, organic polymers [9–12] and possible applications. The system supports interesting phenomenon which include pulse compression [13], Town's solitons [14] and cicular soliton [15].

In addition to the scalar soliton, a single-mode birefringent fiber or multi-mode fiber can support a pair of solitons such as bright–bright, dark–dark, which are coupled through cross-phase modulation (XPM) [16, 17]. Recently, incoherently coupled dark–bright (DB) vector solitons have been observed experimentally. It was found that, unlike the scalar soliton, the dark–bright vector solitons are formed in single-mode fibers for both normal and anomalous group velocity dispersion (GVD) [18]. All studies are based either on the Manakov model or the Helmholtz–Manakov model, where XPM is cubic. Since at a moderate intensity the quintic

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Photoluminescence and photo-induced conductivity in 2D siloxene nanosheet for optoelectronic applications

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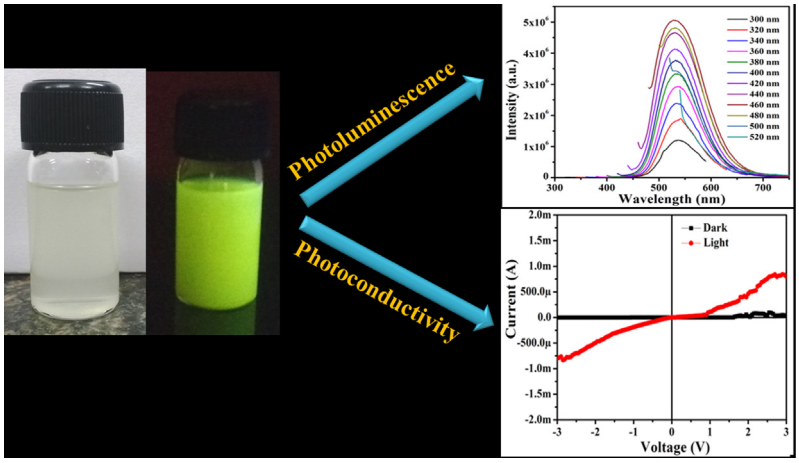
GRAPHICAL ABSTRACT



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ABSTRACT

Semiconducting 2D siloxene nanosheets of thickness 1.7 nm and band gap of 2.54 eV are synthesized using simple chemical route. Strong photoluminescence is observed in the as-synthesized nanosheets due to presence of oxygen atoms. The photoluminescence behaviour of siloxene nanosheets is investigated by controlling temperature, excitation and pH of the solution to understand the optical response and stability of the material. The as-synthesized sample heated with temperature 200 °C shows a blue shift of 90 nm compared to the sample synthesized at room temperature. The low temperature luminescence measurements of as-synthesized samples dried at different temperatures viz. 27, 100 and 200 °C. It is seen that the luminescence intensity is increasing with decreasing temperature for the sample dried at room temperature. However, after heating the sample at 100 °C, the luminescence intensity is not only increased but also red-shifted up to 52 nm. The photocurrent has been measured for the device structure of ITO/PEDOT: PSS/Siloxene/Al with different film thicknesses to optimize the photocurrent and the maximum percentage change in photo power gain. The maximum photopower gain of 2693% is observed for the film thickness of 600 nm.

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Regular Article

White light emitting lanthanide based carbon quantum dots as toxic Cr (VI) and pH sensor

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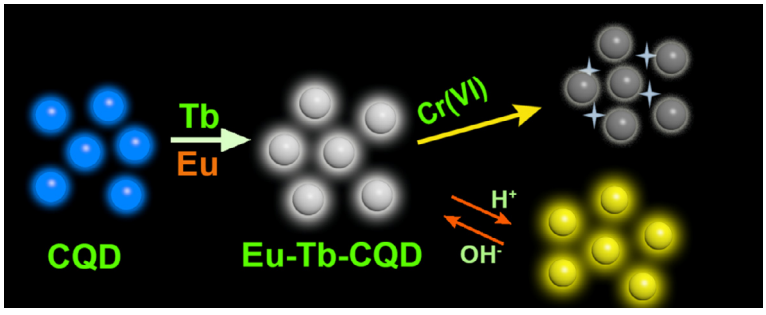
GRAPHICAL ABSTRACT



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Carbon quantum dots
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ABSTRACT

Although, great attention is paid to synthesize fluorescent carbon quantum dots (CQDs) for versatile applications, the field remains still attractive to achieve white light using these nano materials. In the present work, CQDs are synthesized from citric acid and lanthanide ions viz. Europium (Eu) and Terbium (Tb) are doped in CQD moiety to explore superior optical response for multifunctional applications. By proper tuning of excitation wavelength, perfect white light with Commission Internationale de l'Elcairage (CIE) index (0.345, 0.344) is obtained using these Europium Terbium co-doped CQDs (Eu-Tb-CQD). The observed photoluminescence of white light emitting lanthanide based CQD is pH dependent and will be used as a visual pH sensor. These luminescent Eu and Tb co-doped CQDs are also very useful to detect toxic Cr (VI) with excellent selectivity and sensitivity as compared to pure CQDs. It shows high quenching efficiency (~95%) in presence of only 160 μM Cr(VI). The selectivity and lower detection limit are also obtained as ~80% and 0.175 μM respectively.

1. Introduction

Carbon quantum dot's (CQD) are a new class of Carbon based fluorescent nano materials with superior properties of stability, eco-friendly, low toxicity, good water solubility. During last 10 years intensive research has been carried out on various carbon based nano materials for numerous applications viz. sensing [1], bio-imaging [2], security ink [3], drug delivery [4], photo catalysis [5] and optoelectronics [6].

In the past few years, significant studies on tuneable optical properties of CQD have been noticed. These optically tuneable properties arise due to several factors like size effect [7–9], surface defect states [10,11] and hetero atom (B, N, S, P) doping [12–15]. CQDs of various emission colours like blue [16,17], green [18], yellow [19], red [20] etc are also well reported. Pang et al. have also synthesized multi color PL emissive carbon dots from blue to red

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SHORT NOTE

Polynomial central set theorem near zero

Aninda Chakraborty[2] · **Sayan Goswami**[1]

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Abstract
Hindman and Leader introduced the set 0^+ of ultrafilters on $(0, 1)$, characterized the smallest ideal of $\left(0^+, +\right)$ and proved the Central Set Theorem near 0. Recently Polynomial Central Set Theorem has been proved by Bergelson, Johnson Jr. and Moreira. In this note, we will Polynomial Central Set Theorem near 0.

Keywords Van der Waerden's theorem · Ramsey theory near zero · Polynomial Hales–Jewett theorem

1 Introduction

Given a discrete semigroup $(S, \cdot)$, it is well known that one can extend the operation $\cdot$ to βS, the Stone-Čech compactification of S so that $(\beta S, \cdot)$ is a right topological semigroup (i.e., for each $p \in \beta S$, the function $\rho_p : \beta S \to \beta S$, defined by $\rho_p(q) = q \cdot p$, is continuous) with S contained in the topological center (i.e., for each $x \in S$, the function $\lambda_x : \beta S \to \beta S$, defined by $\lambda_x(p) = x \cdot p$, is continuous). Further, this operation has frequently proved to be useful in Ramsey Theory. See [7] for an elementary introduction to the semigroup $(\beta S, \cdot)$ and its combinatorial applications.

It is also well known that if S is not discrete, such an extension may not be possible (see [6, Section 2] where it is shown how bad the situation is for any dense subsemigroup of $([0, \infty], +)$).

Surprisingly, however, it has turned out to be possible to use the algebraic structure of $\beta\mathbb{R}_d$ to obtain Ramsey Theoretic results that are stated in terms of the usual topology

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RICHNESS OF ARITHMETIC PROGRESSIONS IN COMMUTATIVE SEMIGROUPS

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Abstract

Furstenberg and Glasner proved that for an arbitrary $k \in \mathbb{N}$, any piecewise syndetic set contains k-term arithmetic progressions and, in a sense to be made precise later, the set of such arithmetic progressions is piecewise syndetic in $\mathbb{Z}^2$. They used the algebraic structure of $\beta\mathbb{N}$. The above result was extended for arbitrary semigroups by Bergelson and Hindman, again using the structure of the Stone-Čech compactification of a general semigroup. Beiglböck provided an elementary proof of the above result and asked whether the combinatorial argument in his proof can be enhanced in a way which makes it applicable to a more abstract setting. In a recent work S. Jana and the second author of this paper provided an affirmative answer to Beiglböck's question for countable commutative semigroups. In this work we will extend the result of Beiglböck in different types of settings.

1. Introduction

A subset S of $\mathbb{Z}$ is called syndetic if there exists $r \in \mathbb{N}$ such that $\bigcup_{i=1}^{r}(S-i) = \mathbb{Z}$ and it is called thick if it contains arbitrary long intervals. Sets which can be expressed as the intersection of thick and syndetic sets are called piecewise syndetic sets.

For a general commutative semigroup $(S,+)$, a set $A \subseteq S$ is said to be syndetic in $(S,+)$, if there exists a finite nonempty set $F \subseteq S$ such that $\bigcup_{t\in F} -t + A = S$ where $-t + A = \{s \in S : t + s \in A\}$. A set $A \subseteq S$ is said to be thick if for every finite nonempty set $E \subseteq S$, there exists an element $x \in S$ such that $E + x \subseteq A$. A set $A \subseteq S$ is said to be piecewise syndetic if there exists a finite nonempty set $F \subseteq S$ such that $\bigcup_{t\in F}(-t + A)$ is thick in S. It can be proved that a piecewise syndetic set is the intersection of a thick set and a syndetic set [10, Theorem 4.49].

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Hales–Jewett type configurations in small sets

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ABSTRACT

In a recent work, N. Hindman, D. Strauss and L. Zamboni have shown that the Hales–Jewett theorem can be combined with a sufficiently well behaved homomorphisms. Their work was completely algebraic in nature, where they used the algebra of Stone–Čech compactification of discrete semigroups. They proved the existence of those configurations in piecewise syndetic sets, which are Ramsey theoretic rich sets. In our work we will show those forms are still present in very small but Ramsey theoretic sets, (like J-sets, C-sets) and our proof is purely elementary in nature.

1. Introduction

Let $\omega = \mathbb{N} \cup \{0\}$, where $\mathbb{N}$ is the set of positive integers. Then ω is the first infinite ordinal. For any set X, let $\mathcal{P}_f(X)$ be the set of all nonempty finite subsets of X.

Given a nonempty set $\mathbb{A}$ (or alphabet) we let S_0 be the set of all finite words $w = a_1a_2 \dots a_n$ with $n \geq 1$ and $a_i \in \mathbb{A}$. The quantity n is called the length of w and denoted $|w|$. The set S_0 is naturally a semigroup under the operation of concatenation of words. We will denote the empty word by θ. For each $u \in S_0$ and $a \in \mathbb{A}$, we let $|u|_a$ be the number of occurrences of a in u. We will identify the elements of $\mathbb{A}$ with the length-one words over $\mathbb{A}$.

Let v (a variable) be a letter not belonging to $\mathbb{A}$. By a variable word over $\mathbb{A}$ we mean a word w over $\mathbb{A} \cup \{v\}$ with $|w|_v \geq 1$. We let S_1 be the set of variable words over $\mathbb{A}$. If $w \in S_1$ and $a \in \mathbb{A}$, then $w(a) \in S_0$ is the result of replacing each occurrence of v by a.

A finite coloring of a set A is a function from A to a finite set $\{1, 2, \dots, n\}$. A subset B of A is monochromatic if the function is constant on B. If $\mathbb{A}$ is any finite nonempty set and S is the free

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ORIGINAL PAPER

A Memory Dependent Partial Backlogging Inventory Model for Non Instantaneous Deteriorating Item with Stock Dependent Demand

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Abstract
In this paper we introduce a more generalized inventory model for deteriorating item where the memory effect is taken into consideration to analyze for generalization of our concept. Memory effect in inventory system is introduced here through the viable ideas of fractional calculus approach. Fractional Calculus has a proficiency through which we can signify the memory effect. Here a memory dependent inventory model for non instantaneous deterioration with stock dependent demand and partial backlogging is considered. Fractional order derivative and fractional order integration has been used to calculate holding cost, deterioration cost, backlogging cost, lost sale cost. Here the fractional order differentiation is introduced in terms of Caputo sense. The idea of memory kernel is considered to establish the memory dependent inventory model. Here the different type of costs, optimal ordering interval, minimized total average cost are calculated through both theoretical and numerical way. The memory effect is clearly justified by considering a numerical example. The order of the fractional derivative and integration is considered here as the memory index. Sensitivity analysis has also been presented to recognise the essential model parameter for various memory effected problem in different situation.

Keywords Fractional differential equation · Mittag-Leffler Function · Memory Kernel · Shortage · Backlogging

Mathematics Subject Classification 90B50 · 90C31 · 34A08 · 26A33

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An EOQ model for deteriorating item with continuous linear time dependent demand with trade of credit and replenishment time being demand dependent

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Abstract: This study is about an inventory model with continuous linear time dependent demand rate with constant rate of deterioration in the consideration of partial backorder including delay in payment and time period is demand dependent. Demand is the fundamental attribute for consideration of inventory related problem. In reality, there is some inter connection of demand function among various time interval for which the demand cannot change drastically at some critical point during the appearance of another state of system. Thus, it is quite natural that the demand function should be continuous in nature in inventory management problem. So, here the most prominent part of our present study is the consideration of time dependent continuous demand in the proposed model. A supportive numerical example of the proposed model is illustrated for insightful investigation. The solution method and sensitivity analysis has also been presented.

Keywords: inventory; deterioration; delay in payment; trade credit period; backlog dependent.

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Hydroboration of nitriles, esters, and amides catalyzed by simple neosilyllithium

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ABSTRACT

We present here an efficient method for the hydroboration of organic nitriles, carboxylic esters, and carboxamides with pinacolborane (HBpin) using an alkali metal catalyst, neosilyllithium ($LiCH_2SiMe_3$), in neat reaction conditions. The reactions were accomplished with efficient catalytic reactivity and demonstrated by neosilyllithium at room temperature, in solvent-free condition, to afford a high yield of the corresponding *N*-boryl amines, boryl ethers, and amine hydrochlorides. The protocol for the catalytic reaction presented in this paper is simple and efficient, with diverse substrate scope for nitriles, carboxylic esters, and carboxamides showing excellent functional group tolerance. DLPNO-CCSD(T) calculations were also performed, showing that the hydroboration of nitriles catalyzed by neosilyllithium occurs through the pre-coordination of the nitrile at Lewis acid lithium followed by hydride migration from the B–H entity.

1. Introduction

Hydroboration of unsaturated bonds is one of the most versatile tools of synthesis used in organic chemistry [1]. Unsaturated carbon–carbon multiple bonds, such as in alkenes and alkynes, and carbon–heteroatom multiple bonds, such as in nitriles, amides, and carbonyls, can be efficiently transformed and are therefore widely used in organic synthetic chemistry [2]. For example, hydroboration of nitriles and amides produces synthetically useful borylamines that play an important role in many industrial processes, such as production of dyes and polyesters, and as a precursor to pharmaceutical chemicals. In addition, this process offers a milder reduction strategy compared to highly reactive alkali metal hydride reduction [3] and catalytic hydrogenation [4] processes, which generally require harsh reaction conditions. On the other hand, the hydroboration of carbonyls (ketones and esters) is important because the final product, functionalized alcohol, plays an important role as a starting material in the production of bioactive compounds, pharmaceuticals, and agrochemicals [5]. Due to the stability of the C≡N and C═O bond, nitriles [6], esters, and amides [7] are difficult substrates in the hydroboration reaction compared to aldehydes and ketones [8]. It is only in the last few years that hydroboration of nitriles with main group metals [9] and transition metals [10] has been extensively explored (Scheme 1), although hydroboration of amides or esters were less explored compared with carbonyls (ketones and aldehydes) and nitriles by using main group and transition metal catalyst. A smaller number of examples have been reported based on main group metal catalysts [11], early transition metal catalysts, [10j,12] and rare earth metal catalysts [10b,13], and the use other catalytic systems is very limited (Scheme 1).

Although main group metals have been employed as very effective catalysts for hydroboration under ambient conditions, very few catalytic hydroboration reactions were employed using lithium compounds, despite offering clean, cheap, and efficient alternatives in the search for new catalysts and processing systems. Homogeneous lithium catalysts are excellent for use in a wide variety of catalytic reactions, such as hydrogenation [14], oxidative dehydrogenation [15], polymerizations [16], carbon–carbon bond formation [17], hydrosilylation, hydroboration, and so on [18]. Recently, *Sen et al.* reported that commercially available and readily accessible lithium complexes, 2,6-di-*tert*-butyl phenolate lithium and 1,1′-dilithioferrocene, act as selective and

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Recollection of *Craibiodendron henryi* W. W. Smith (Ericaceae: Vaccinioideae), a potential ethnomedicinal plant from Arunachal Pradesh after seven decades

Subhasis Panda (https://www.bnhsjournal.in/index.php/bnhs/search/authors/view?firstName=Subhasis&middleName=&lastName=Panda&affiliation=Angiosperm Taxonomy Laboratory, Botany Department, Maulana Azad College, University of Calcutta, 8, Rafi Ahmed Kidwai Road, Kolkata 700 013, West Bengal&country=IN) [1*], Ashiho Asosii Mao (https://www.bnhsjournal.in/index.php/bnhs/search/authors/view?firstName=Ashiho Asosii&middleName=&lastName=Mao&affiliation=Botanical Survey of India, CGO Complex, 3rd MSO Building, Block F (5th floor), DF Block, Sector-I, Salt Lake City, Kolkata 700 064, West Bengal&country=IN) [2]

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Abstract

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FLORAL VISITATION OF A PASSERINE *YUHINA GULARIS* HODGSON ON *ENKIANTHUS DEFLEXUS* (GRIFF.) C.K. SCHNEID. VAR. *DEFLEXUS* (FAMILY ERICACEAE): FIRST GLOBAL RECORD FROM THE OUTSKIRTS OF SINGALILA NATIONAL PARK IN DARJEELING HIMALAYA, INDIA[1]

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Introduction

Enkianthus deflexus (Griff.) C. K. Schneid., a member of the family Ericaceae, has three extant varieties, namely var. *deflexus*, var. *glabrescens* R.C. Fang, and var. *acuminatus* S. Panda & Sanjappa. *E. deflexus* var. *deflexus* appears to be restricted to India, eastern Nepal, Bhutan, south-western China, and northern Myanmar. In India, var. *deflexus* is reported only from Eastern Himalaya [West Bengal (Darjeeling), Sikkim, and Arunachal Pradesh].

During field studies at different sites in Singalila National Park, Darjeeling Himalaya, in May 2019, the author observed a pale olive-brown crested passerine bird on the bright red campanulate flowers of *Enkianthus deflexus* var. *deflexus*, just outside the Singalila National Park Gate near Tumling, at an altitude of *c*. 2,936 m. After a critical study based on photographs taken in Tumling and consultation with ornithology experts in Erfurt Naturkunde Museum, Germany, Zoological Survey of India, Dehradun, WWF-Sikkim, and East India Birding the passerine was identified as Stripe-throated Yuhina *Yuhina gularis* Hodgson (1836), locally known as *Sano Jureli* (in the Gurung Nepalese dialect of Tumling). Dr Mathias Hartmann and Professor Martens of Erfurt Naturkunde Museum confirmed the identity as 'young Stripe-throated Yuhina *Yuhina gularis*'. A survey of literature (Baker 1975; Cronk and Ojeda 2008; Georgian *et al*. 2015; Huang *et al*. 2017; Proctor *et al*. 1996; Quian *et al*. 2017; Stevens *et al*. 2004) reveals that the observed floral visitation by *Yuhina gularis* on *E. deflexus* var. *deflexus* is the first global record of such an event, from the outskirts of Singalila National Park in Darjeeling Himalaya.

Stevens *et al*. (2004) in their monograph on Ericaceae Juss. mentioned "flowers are usually animal-pollinated and bees are common and effective pollinators". They did not mention bird pollinators. But in other taxa, Georgian *et al*. (2015) experimentally determined *Yuhina diademata* Verreaux (1869) as a potential pollinator of a Chinese ericoid *Rhododendron floccigerum* Franch. Huang *et al*. (2017) reported ornithophily in *Rhododendron sinogrande* Bulf. f. & W.W. Sm. by *Yuhina occipitalis* Hodgson (1836). Quian *et al*. (2017) also reported ornithophily by *Yuhina nigrimenta* Blyth with a non-ericoid species, *Brandisia hancei* Hook. f. (Scrophulariaceae).

Enkianthus deflexus (Griff.) C.K. Schneid. var. *deflexus* (*Phulo*: Nepalese of Tumling): Stout, erect shrub up to 3 m tall with reddish branches. 4–7 leaves in pseudowhorl, papery to chartaceo-coriaceous; petioles spatulate, pink to pale green. Inflorescence axillary to terminal corymbs, drooping, 8–14-flowered. Flowers drooping, 4–5 cm long; pedicels 3–4 cm long, deflexed. Corolla broadly campanulate to rarely urceolate-campanulate, blood red (Tumling population), 10–15 mm long. Stamens 10, usually in 2 whorls (5+5), each anther lobe with single slightly recurved warty awn of 1–1.5 mm long. Pistil *c*. 1 cm long; ovary ovoid, densely puberulous. Fruit loculicidally 5-valved capsule, globose to oblong.

Distribution: India: Eastern Himalaya [West Bengal (Darjeeling), Sikkim, and Arunachal Pradesh]; Extralimital: Eastern Nepal, Bhutan, south-western China; northern Myanmar, at 2,100–3,450 m above msl, growing gregariously on loose rocky slopes and in crevices in temperate forest of the Himalaya.

Flowering*:* May to early June. **Fruiting**: June–July.

Specimens examined: India: Eastern Himalaya, West Bengal (Darjeeling), right bank of Tumling (Indian side), toward Gairibas, 2,936 m, 27° 01.053′ N & 88° 03.057′ E, 17.v.2019, S. Panda 94 (Maulana Azad College Herbarium, MAC).

Observations

The bird was identified as *Yuhina gularis* as it had olive and dull brown plumage with a tall, upswept crest, with a black and dull orange panel on the wings, black streaking on pale vinaceous throat and pale brownish-orange belly and vent. The olive tail had a black tip and grey-brown undertail feathers. Call: loud, nasal notes while moving in flocks. The bird was seen on May 17, 2019, twice at 13:00 to 13:05 hrs and 14:30 to 14:32 hrs in flocks of 10 to 12 birds.

Ethnomedicinal study on plant resources from sacred groves of Dakshin Dinajpur district, West Bengal, India

Kushankur Sarkar, Priyankar Roy, Subhasis Panda, Chandrani Choudhuri and Monoranjan Chowdhury

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Research

Abstract

Background: Sacred groves found in Dakshin Dinajpur district are natural *in-situ* conservatories that provide a home to numerous biological entities with rich ethnomedicinal plant diversity. Native communities have been conserving these groves through their own beliefs and folklore practices and they possess vast knowledge of herbal ethnic medicines. The current study aims to explore the ethnic traditional practices of medicinally important plants among different indigenous communities residing in sacred grove-centric villages throughout the district.

Methods: For the current study, 15 ethnomedicinally enriched sacred groves were selected. Ethnomedicinal data were collected from 179 informants and were quantitatively analyzed using various statistical indices viz., Use value, Informant consensus factor, Fidelity level, and Relative Frequency of citation. With the help of an *in-silico* network pharmacological study, the findings were revalidated.

Results: In the present study, a total of 105 ethnic plants belonging to 93 genera and 47 families were documented and the most dominant plant family was Fabaceae. The diseases reported by the informants were classified into 16 different disease clusters. *Cuscuta reflexa* Roxb., *Heliotropium indicum* L. and *Cynodon dactylon* (L.) Pers. were the most popular medicinal plants.

Conclusion: Gathering such first-hand information about ancient traditional practices will be helpful in further pharmacological studies and may show new paths to modern therapeutic approaches.

Keywords: Sacred Groves; Traditional Knowledge; Dakshin Dinajpur; Quantitative analysis; *in-silico*

Background

Since time immemorial, India has been a valuable source of traditional medicine systems and has been documented and explored by various people across the globe (Verma *et al.* 2007). Medicinal plants are hidden treasures of

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Uncommon flowering in *Rhododendron cinnabarinum* Hook. f. subsp. *cinnabarinum* (Ericaceae: Ericoideae) observed in Darjeeling Himalaya, India

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Abstract

During field studies at different places of Singalila National Park in Darjeeling Himalaya from September 2013 to November 2019, uncommon flowering of *Rhododendron cinabarinum* Hook. f. subsp. *cinnabarinum* was observed at three different populations viz., Tonglu, Tumling-Gairibas and Kaiakata-Kalipokhri. *Rhododendron cinnabarinum* Hook. f. subsp. *cinnabarinum* flowers once in a year throughout its natural habitat from April to early June. Flowering populations of this subspecies were not observed in other natural habitats in Darjeeling during September to November since the period from 2013 to 2019 as a result of regular monitoring, also not reported from other phytogeographical regions viz., Sikkim, Nepal, Bhutan and China so far literature and herbarium specimens consulted. Therefore, this phenomenon of uncommon flowering of this subspecies is a significant scientific novelty reported for the first time from Darjeeling Himalaya.

R*hododendron cinnabarinum* Hook. f. was first described by Sir J. D. Hooker[10] based on his collections from Sikkim Himalaya. Populations of this species are variable in respect to shape of lamina and corolla, colour of corolla and presence or absence of lepidotes on corolla lobes. Therefore, Cullen & Chamberlain[5] recognized three distinct subspecies under *R. cinnabarinum* Hook. f., *viz*., subsp. *cinnabarinum*, subsp. *xanthocodon* (Hutch.) Cullen and subsp. *tamaense* (Davidian) Cullen mainly based on presence or absence of lamina lepidotes on upper half, corolla lepidotes outside and corolla shape. Hanbi & Chamberlain[8] treated subsp. *xanthocodon* (Hutch.) Cullen as a distinct species, *R. xanthocodon* Hutch., while treating *R. tamaense* Davidian as subsp.

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A plea for 'Outside protected-Area conservation' of the Himalayan Mayapple (*Sinopodophyllum hexandrum* (Royle) T.S. Ying) in the wild — A Threatened Red Listed Anti-cancerous medicinal plant Rarely Revisited in East Sikkim (India)

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Abstract

Sinopodophyllum hexandrum (Royle) T. S. Ying, a threatened medicinal plant of the family Berberidaceae, is survived by a few individuals in the wild, mostly outside the Protected Areas observed in East Sikkim. Since its rediscovery in September, 2007 at Serabathang in East Sikkim, regular monitoring had been conducted till October, 2018. As a result of this monitoring, this work embodies field observations about its present status.

The Himalayan mayapple, *Sinopodophyllum hexandrum* (Royle) T. S. Ying, an anti-cancerous medicinal as well as Red Listed (Vulnerable) plant of the family Berberidaceae, is struggling for its existence in the wild, especially outside the Protected Areas (Plate 1). It is distributed in the alpine Himalayas of India, Pakistan, Afghanistan, Nepal, Bhutan and China. Nayar and Sastry[11] reported that *S. hexandrum* is distributed in restricted pockets throughout the alpine Himalayan region. The rhizomes of *S. hexandrum* yield cytotoxic lignan podophyllotoxin and resin due to which it possesses anti-cancerous activity[5,6]. Podophyllotoxin is also a major component of the drug used to cure lung cancer[8]. Another anti-cancerous lignan, Podophyllin (resin from rhizomes and roots of *S. hexandrum*) has been used especially in the treatment of ovarian cancer as well as roots also contain several other important anti-cancerous lignans including berberine (ref. http://www.paypal.com; http://www.pfaf.org). The root extract is cholagogue, cytostatic and purgative. Currently, extracts of the Himalayan mayapple are used in topical medications for genital warts, HIV-related oral

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An ethnomedicinal field survey report on traditionally used plants by the Nepalese of Alubari Jungle Busty in Darjeeling Himalaya as potential immunity booster and fever-related herbal drugs

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As a result of several ethnobotanical field visits in and around Alubari Jungle Busty of Darjeeling Himalaya from August 2012 till May 2019, mostly new ethnic uses of different plant parts including dosimetry of 24 wild plant species were documented. Documentation was based on oral interviews with experienced and elderly Nepalese people mainly in respect to immunity boosters and instant remedies against fevers including COVID-19. Some plant parts which were also used by the Nepalese of Alubari Jungle Busty as blood purifiers, lowering high blood pressure, energy provider during a long walk, diarrhoea, chronic piles, bronchitis, asthma, throat pain, cold and cough, were also documented. Present work also embodies botanically authenticated binomial names of documented wild plant species, vernacular names, knowledge informants, voucher information, live photographic documentation and study area map.

Keywords: Ethnomedicinal plants, Nepalese, Darjeeling, Antiviral and nonviral fevers, Immunity booster, COVID-19

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From August 2012 till May 2019 under three state-sponsored projects funded by the Government of West Bengal, several ethnobotanical field visits in and around the Alubari Jungle Busty area, outskirts of Senchal Wildlife Sanctuary and about 9 km from Darjeeling town were conducted. Main purpose of these field visits were to document ethnomedicinal new ITKs from the Nepalese communities. For this purpose, first hand informations were gathered based on oral interviews with elder knowledgeable Nepalese and their ethnomedicinal practices were documented. A perusal of literature revealed that these ITKs are new to science[1-16]. Recently, a local Nepalese herbal medicine man (JKT: second author) is also practising these herbal drugs with their dosimetry against COVID-19 patients in and around the Alubari Jungle Busty area including Darjeeling Municipal Ward No. 1 (part of Alubari TN Road) since the last week of May 2020 and revealed that 15 patients (mostly labours of age group between 30 and 55 coming from other states) out of 22 with COVID-19 symptoms (not tested as positive but remained under quarantine) are cured within 10 to 15 days, and fortunately they are now healthy and safe. Most of these herbal drugs with their prescribed dosimetry are acting as immunity boosters against any type of viral fevers including COVID-19 and other non-viral fevers already mentioned. Therefore, present work embodies new and noteworthy ethnomedicinal uses of 24 wild plant species with their prescribed dosimetry by the Nepalese of Alubari Jungle Busty against viral fever including pandemic COVID-19, other non-viral fevers and other diseases as well as voucher information, vernacular names, knowledge informants, live photographic documentation and study area map.

Methodology

Study area

Alubari Jungle Busty lies 9 km from Darjeeling town and 1 km from Ghoom along the eastern side of T. N. Road starting from Alubari Ward No. 1 and continues till Alubari Monastery up to 1.5 km. The area has T.N. Road and a part of Jalapahar Cantonment on the west, part of Senchal WLS & a part of Rangeyroong valley on the east, Alubari Tea Garden on the north and Jorebunglow & Senchal WLS on the south. Geographically, the study area

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SHORT COMMUNICATION

Re-collection, extended distribution, and amplified description of *Vaccinium paucicrenatum* Sleumer (Ericaceae) from the Arunachal Himalaya in India

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Abstract: *Vaccinium paucicrenatum* Sleumer has been re-collected from three different districts of Arunachal Pradesh approximately after 91 years subsequent to I.H. Burkill's collection (no. 36976, K) from Ripsing of outer Abor Hills (presently a part of East and West Siang districts nearby Pashighat area) of Arunachal Pradesh on 8 March, 1912. Due to poor description by the earlier workers, the present paper provides amplified description based on field and herbarium data including leaf anatomy (leaf stomata and vein-islets), detailed extended distribution, live and herbarium images and distribution map for easy identification in the field.

Keywords: Arunachal Pradesh, leaf anatomy, northeastern India.

The genus *Vaccinium* L., consisting of about 140 species (Mabberley 2008), is distributed in tropical Asia, Europe, southeastern Africa, Madagascar, and north and south America. Of these, 28 species are reported to occur in India (Panda & Sanjappa 2014) and are distributed in the eastern Himalaya, northeastern India (except Tripura) and the hill tops of the southern Western Ghats.

vander Kloet et al. (2003), merged Airy Shaw's new species, *Vaccinium setipes*, under *V. paucicrenatum* Sleumer in *Vaccinium* sect. *Aethopus* Airy Shaw based on average-linkage dendrogram calculated from raw data for 76 *Vaccinium* OTU's (Operational Taxonomic Unit) using the dissimilarity form of Gower's co-efficient for mixed data, principal coordinates analysis, and partitioning analysis (vander Kloet et al. 2003). They re-circumscribed *Vaccinium* sect. *Aethopus* Airy Shaw not only merging *V. setipes* under *V. paucicrenatum* but also included other four species as valid and another four species as synonyms under these valid species transferring from *Vaccinium* sect. *Vitis-idaea* (Moench) W.D.J. Koch. These species are *V. nummularia* Hook.f. & Thomson ex C.B. Clarke (*V. chaetothrix* Sleumer as a synonym), *V. retusum* (Griff.) Hook.f. ex C.B. Clarke (*V. haitangense* Sleumer as a synonym), *V. moupinense* Franch. (*V. dendrocharis* Hand.-Mazz. and *V. merrillianum* Hayata as synonyms), and *V. delavayi* Franch.

Shaw (1948) erected a new species, *V. setipes*, from "Assam population of outer Abor Hills, Ripshing" (Arunachal Pradesh in India) of *V. paucicrenatum* Sleumer based on I.H. Burkill collection (no. 36976, K photo!) which was cited by Sleumer (1941) as *V. paucicrenatum* in the protologue. Shaw (1948) distinguished "Assam"

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