



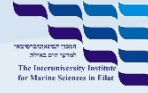
The De Botton Center for Marine Science



אוניברסיטת חיפה
UNIVERSITY OF HAIFA



חקר ימים ואגמים לישראל
Israel Oceanographic & Limnological Research



מרכז המחקר והחינוך
המגויס למדעי הים
The Interdisciplinary Center
for Marine Science & Fisheries

המרכז הישראלי
לחקר הים התיכון



הכנס השנתי ה-13

העמותה הישראלית למדעי הימים

27 אוקטובר 2016

שלום וברכה למשתתפי הכנס ,

הכנס השנתי ה-13 של העמותה הישראלית למדעי הימים מתקיים השנה במלון אכדיה, הרצליה. הכנס על חופי הים התיכון מדגיש את הצורך בנגישות של האדם אל הים ובמחויבותנו להבין את הים ולשמור עליו.

לפניכם התוכנית של הכנס השנתי ה-13 של העמותה הישראלית למדעי הימים לשנת 2016. בהמשכה מקבץ התקצירים של ההרצאות והכרזות המוצגות בכנס (ע"פ סדר הא'ב', עברית קודם).

הכנס יכלול השנה 50 הרצאות ו-38 כרזות.

גם השנה המעורבות של סטודנטים בכנס הינה גדולה וע"פ הנרשמים עד כה כ-70% מהנרשמים הינם סטודנטים לתארים מתקדמים. השנה אף הגברנו את התמריץ להשתתפות הסטודנטים בכך שהקצנו ארבעה פרסים כספיים להרצאות הטובות ביותר וארבעה לכרזות הטובות שיוצגו בכנס ויבחרו על ידי צוות שופטים מחברי העמותה.

מספר רב של מוסדות תמכו בכנס ביניהם, המכון הבין אוניברסיטאי למדעי הים באילת, המכון לחקר ימים ואגמים לישראל, המרכז הישראלי לחקר הים התיכון, אוניברסיטת חיפה ומכון ויצמן למדע (מרכז למחקר ימי על שם דה בוטון) ועל כך תודתנו נתונה. אנו מאחלים לכם כנס מעניין ומקווים לראותכם בשנה הבאה.

וועד חברי העמותה

אורן לוי - נשיא

אייל רהב - גזבר

דניאל שר

יעלה שקד

אסף ורדי

ניר שטרן

מיכל וייס

נגה סטמבלר

נמרוד קרופניק

עדה אלאמרו - נציגת סטודנטים

תוכנית הכנס

התכנסות, רישום, קפה		08:00-08:45
דברי פתיחה: אורן לוי, יו"ר העמותה הישראלית למדעי הימים אספה כללית של חברי העמותה		08:45-09:00 אולם "נוף ים"
אולם "אכדינו צפון"	אולם "נוף ים"	09:00-10:30 מושבים מקבילים
אוקיאנוגרפיה גיאולוגית ופיזיקלית פרופ' יוסי מרט, פרופ' חזי גילדור וד"ר מייקל לזר	מנגנוני אקלימצייה לעקות סביבתיות במיקרואורגניזמים ובע"ח ימיים פרופ' אורן לוי וד"ר אסף ורדי	
הפסקת קפה		10:30-11:00
מיחידות תפוצה לאוכלוסיות: רבייה, מגוון ואבולוציה של חסרי חוליות ימיים פרופ' יוסי לוי וד"ר עמרי ברונשטיין	השפעות אנתרופוגניות על הסביבה ימית ד"ר עידו בר-זאב וד"ר אייל רהב	11:00-12:30 מושבים מקבילים
ארוחת צהרים + הצגת כרזות		12:30-15:00
טכנולוגיות חדשניות במחקר ימי פרופ' חזי גילדור וד"ר טלי טרייביץ	שימור מבוסס מדע של הסביבה הימית ד"ר רותי יהל וד"ר יונתן בלמקר	15:00-16:30 מושבים מקבילים
הפסקת קפה		16:30-17:00
היבטים בביולוגיה התפתחותית ובביוגיאוכימיה ד"ר אור שפירא	אקולוגיה ואינטראקציות ימיות ד"ר ניר שטרן	17:00-18:45 מושבים מקבילים
BEER ON THE PIER הצגת זוכים בתחרות ההרצאות והכרזות המצטיינות		18:45-20:00

♣ הרצאות שמשותפות בתחרות ההרצאה המצטיינת

מושבים מקבילים 09:00-10:30

אוקינוגרפיה גיאולוגית ופיזיקלית פרופ' יוסי מרט, פרופ' חזי גילדור וד"ר מייקל לזר אולם "אכדינו צפון"			מנגנוני אקלימצייה לעקות סביבתיות במיקרואורגניזמים ובע"ח ימיים פרופ' אורן לוי וד"ר אסף ורדי אולם "נוף ים"	
09:00-09:15	יוסי מרט	שינויים במפלס הים מהמאה הראשונה למאה ה-13 לסה"נ ומשמעותם האקלימית	♣ KEREN MAOR-LANDAW	Mediterranean versus Red sea corals facing climate change, a transcriptome analysis
09:15-09:30	EYAL AMITAI	Waves analysis and forecasting at the IMS	♣ ADVA SHEMI	The signaling role of the algal dimethyl sulfide-releasing enzyme during predator-prey interactions
09:30-09:45	YOSEF ASHKENAZY	Current temporal asymmetry and the role of tides: Nan-Wan Bay vs. the Gulf of Elat	♣ OR BEN-ZVI	The effect of fluorescent pigments diversity on UV induced damages in the coral <i>Euphyllia pardivisa</i>
09:45-10:00	♣ YAEL AMITAI	Eastern Mediterranean wind-stress effect on Adriatic deep water formation	OMER MURIK	Unique chloroplast-mitochondria crosstalk in marine diatoms
10:00-10:15	NADAV LENSKY	Seasonal variations of halite saturation in the Dead Sea	♣ GADI PIRIATINSKIY	Proteomic profiling of the infectious Myxozoan polar capsules
10:15-10:30	ORI ADAM	The role of ocean heat fluxes in seasonal and inter-annual variations of the ITCZ	TAL LUZZATO-KNAAN	Marine natural products in 3D: diversity, distribution and discovery

מושבים מקבילים 11:00-12:30

מיחידות תפוצה לאוכלוסיות: רבייה, מגוון ואבולוציה של חסרי חוליות ימיים פרופ' יוסי לוייה וד"ר עמרי ברונשטיין אולם "אכדינו צפון"			השפעות אנתרופוגניות על הסביבה ימית ד"ר עידו בר-זאב וד"ר אייל רהב אולם "נוף ים"	
11:00-11:15	♣ HANNA RAPUANO	Reproductive strategies of the coral <i>Turbinaria reniformis</i> in the northern Gulf of Eilat, Red Sea	מקסים רובין-בלום	טבעו של הנפט – סימביוזה בין חסרי חוליות וחיידקים בגביעות נפט וגז טבעיות במפרץ מקסיקו העמוק
11:15-11:30	♣ EREZ SHOHAM	Mesophotic octocorals in Eilat (Gulf of Aqaba) feature high species richness compared to the shallower reef zones	נגה סטמבלר	השפעות אנתרופוגניות על אוכלוסיות הפיטופלנקטון באזורי החוף של ישראל
11:30-11:45	♣ IGAL BERENSHTEIN	Directional swimming in coral reef fish larvae and its effect on dispersal and connectivity	♣ HILA FRANK	The effects of SWRO desalination brine discharge on benthic heterotrophic microbial communities
11:45-12:00	♣ BAR FELDMAN	Reproductive strategies of the coral <i>Paramontastrea peresi</i> in shallow vs. mesophotic reefs	♣ DANA TITELBOIM	Selective responses of benthic foraminifera to thermal pollution
12:00-12:15	♣ דור שפי	רבייה של האלמוג <i>Stylophora pistillata</i> ממפרץ אילת: לאחר ארבעה עשורים	♣ YAEL LESHNO	Application of ecological quality assessment in the Eastern Mediterranean using live and dead molluscan assemblages
12:15-12:30	♣ ADI ZWEIFLER	Analyzing distribution of coral recruits using fluorescence imaging	♣ RAZ TAMIR	The spectral and spatial distribution of light pollution in the waters of the northern Gulf of Aqaba (Eilat)

מושבים מקבילים 15:00-16:30

טכנולוגיות חדשניות במחקר ימי פרופ' חזי גילדור וד"ר טלי טרייביץ אולם "אכדינו צפון"			שימור מבוסס מדע של הסביבה הימית ד"ר רותי יהל וד"ר יונתן בלמקר אולם "נוף ים"	
15:00-15:15	TAL OZER	Establishing a monitoring Glider program for the investigation of watermass dynamics in the South-Eastern Mediterranean.	יובל כהן	תכנית ימית לישראל ותפקיד הקהילה המדעית ביישומה
15:15-15:30	♣ MARK SHEININ	Underwater multi-platform visual observation paths	רותי יהל	סקר מקיף בשמורות הטבע הימיות בים התיכון והערכת השפעתן על המגוון הביולוגי
15:30-15:45	ROEE DIAMANT	Towards collaboration between underwater acoustic technology and marine science	♣ OHAD PELEG	Bioinvasions shift reef ecosystem processes and functions
15:45-16:00	RONEN ALKALAY	Upcoming deployment of the first, deep-mooring station off the coast of Israel at 1500 m water depth, initiating a study of currents, waves and particle fluxes in the open sea	♣ ORI FRID	Gear selectivity and seasonality in Israeli set net fisheries
16:00-16:15	MOREL GROPER	The importance of maneuver capability on the AUV ability to perform delicate survey missions	SIGAL SHEFER	Illuminating an East-Mediterranean mesophotic sponge ground community and the regional sponge fauna
16:15-16:30	ALI ARNON	High resolution temperature sensing in the Dead Sea using fiber optics	♣ MEY-TAL GEWING	All aboard! Marine vessels as an acute vector of invasive ascidian dispersal

מושבים מקבילים 17:00-18:45

היבטים בביולוגיה התפתחותית ובביוגיאוכימיה ד"ר אור שפירא אולם "אכדינו צפון"			אקולוגיה ואינטראקציות ימיות ד"ר ניר שטרן אולם "נוף ים"	
17:00-17:15	♣ AYAELET DADON-PILOSOFF	Teflon bacteria: non-sticky cell surface allows SAR11, the most abundant marine microorganism, to evade predation	♣ YA'ARIT LEVITT-BARMATS	Investigating the symbiotic relationship between the caridean shrimp <i>Odontonia sibogae</i> and its ascidian host
17:15-17:30	♣ ADI VOLPERT	Diurnal redox patterning and susceptibility to oxidative stress in a bloom-forming diatom	♣ TAL AMIT	Assessment of the coral holobiont through a depth gradient- Do the symbionts make a difference?
17:30-17:45	SOPHIA ZBOROWSKY	Resistance of marine Cyanobacteria to generalist Cyanophages is often intracellular	OMRI BRONSTEIN	Reproduction of the long-spined sea urchin <i>Diadema setosum</i> in the Gulf of Aqaba - implications for the use of gonad-indexes
17:45-18:00	♣ OSHRAT BEN-HEMO	New roles of mortalin, a stress protein, in urochordate astogeny and aging	♣ טל גורדון	רגרציה של הסיפונים ומערכת העצבים באצטלנים ממחלקת ה-Stolidobranchia
18:00-18:15	ELDAD GUTNER-HOCH	The Mediterranean sea urchin <i>Paracentrotus lividus</i> : an effective embryotoxicity model	♣ URI SHEYN	Detection of viral infections by gene expression in a North Atlantic algal bloom
18:15-18:30	EYAL WURGAFT	Microbial sulfate reduction and authigenic precipitation of carbonate minerals in the sediments of the Eastern Mediterranean	♣ ITAI VAN-RIJN	Effect of water temperature on Mediterranean fish size
18:30-18:45	♣ YUVAL JACOBI	Suspension feeding of ascidians at the sub-micron range	ILIA BURGSDORF	Sponge associated Cyanobacteria: life inside a host cell

רשימת פוסטרים

♣ פוסטרים שמשתתפים בתחרות

1	אלמליח טל	מחקר אקולוגי של הטונה כחולת הסנפיר בים התיכון
2	גורדון נורית	מגמות רב-שנתיות בהרכב המיקרופלנקטון לאורך רצועת החוף של ישראל
3	♣ טל אוריה	שונית אילת – מקור או מבלע ל-DMS ו-DMSP?
4	יונה מתן	הבנת תהליכי ביומינרליזציה בקפודי ים בעזרת צבענים פלואורסצנטיים.
5	מזרחי נועם	שינויים מרחביים ועונתיים בתפוצת אוכלוסיות הפיטופלנקטון במפרץ אילת
6	♣ AGRON MAAYAN	Dicer knockdown in the sea anemone <i>Nematostella vectensis</i> reveals bona fide miRNAs and their role in development
7	AHARONOVICH DIKLA	<i>Prochlorococcus-Alteromonas</i> co-cultures: a model for theoretical and experimental investigation of microbial interactions
8	AKKAYNAK DERYA	What is the space of light attenuation coefficients in underwater imaging?
9	♣ BARAK-GAVISH NOA	A pathogenic bacterium switches the fate of algae-derived DMSP in the ocean
10	♣ BERMAN HADAR	Plankton and nutrients dynamics in the Gulf of Eilat: biophysical feedbacks vs. internal dynamics
11	CHERNIHOVSKY NATALIE	High-resolution temporal dynamics of planktonic foraminifera assemblages from sediment traps in the Gulf of Aqaba waters
12	HAVIV SIVAN	The Effect of Depth on the Biomineralization Process in Stony Corals
13	HYAMS-KAPHZAN ORIT	Alien species dominate the benthic foraminifera assemblages on Levant rocky reefs

14	HAZAN OR	Effects of nutrient-rich water mixing on surface microbial biomass and activity in the Eastern Mediterranean Sea
15	HOLODOVSKY VADIM	Underwater optical imaging for quantifying sediment resuspension
16	♣ JACOBSON YITZHAK	Millennial environmental and climate variability across the Mediterranean Basin from vermetid reefs
17	♣ KALMAN AKOS	Reconstructing a flash flood record from the late Holocene in sediment cores from the Gulf of Aqaba (Eilat)
18	♣ LAHYANI MATAN	Isolation and characterization of oligotrophic bacteria from the Eastern Mediterranean Sea
19	♣ LEVY SHANI	The role of GABA-B receptor in nervous system development and metamorphosis of the sea anemone <i>Nematostella vectensis</i>
20	♣ MAIDANIK ILIA	Annual population dynamics of T7-like cyanophages and their hosts in the Gulf of Eilat, Red Sea
21	♣ MAILICK RACHEL	Combatting fouling on fish cages in three seas: towards protocol for long term static immersion tests
22	MARMEN SOPHIE	A long term study of microbial and environmental dynamics in an intensely impacted aquaculture ecosystem.
23	♣ MATHALON ALYSSE	Novel experimental study of bioturbation activity in flood-like sediments in the northern Gulf of Eilat-Aqaba, Red Sea
24	MAYER DANIELLE	High and dry: light effects on epilithic algae in the upper zone of littoral caves
25	MILSTAIN NOA	Effects of roughness on microbial settlement and community composition in artificial reefs
26	♣ NEDER MAAYAN	Tracking the early events of mineral formation during coral development
27	OVADIA GALIT	The impact of airborne microbes on the Southeastern Mediterranean surface seawater following a dust storm event
28	RAHAV EYAL	The role of viable airborne microbes delivered by desert dust into the SE Mediterranean Sea: potential ecological implications
29	♣ RAVEH OFRAT	The effects of well-amelioration brine on coastal microbial populations in the SE Mediterranean Sea

30	ROTH-ROSENBERG DALIT	Changes in the macromolecular composition of <i>Prochlorococcus</i> as it grows and dies
31	♣ ROTHERMAN YAHALA	Has microbiota facilitated the invasion of <i>Spondylus</i> oysters in the Mediterranean Sea?
32	♣ ROUSSEAU MEGHAN	Behavioral responses of reef-associated fish, prawn gobies (<i>Amblyeleotris steinitzi</i> and <i>Amblyeleotris sungami</i>) to anthropogenic diver disturbance
33	♣ SHREIBER DOTAN	Development of a novel sea-surface imaging microscope for quantification of micro plastic
34	♣ SIZIKOV SOFIA	Role of dTDP-L-Rhamnose-deficient lipopolysaccharide in symbiosis between cyanobacteria and sponge
35	SPUNGIN DINA	Mechanisms of <i>Trichodesmium</i> demise within the New Caledonian lagoon
36	TRIVIZKI ROTEM	מוקד SeaWatch – טיפול במפגעים ימיים בסיוע ניטור אזרחי
37	YOSEF OSHRA	Exploring intra-colonial variability in the branching coral <i>Stylophoa pistillata</i>
38	ZEMACH TAMAR	Polydisperse particle-driven gravity currents in non-rectangular cross-section channels

רגרציה של הסיפונים ומערכת העצבים באצטלנים ממחלקת ה- *Stolidobranchia*

טל גורדון^{1,2}, נועה שנקר³

¹המחלקה לזואולוגיה, הפקולטה למדעי החיים, אוניברסיטת תל אביב, תל אביב 6997801 shenkarn@post.tau.ac.il

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³מזיאון הטבע ע"ש שטיינהרדט, אוניברסיטת תל אביב, תל אביב 6997801

אצטלנים הינם אורגניזמים ימיים ישיבים הניזונים מסינון הנחשבים כיום לקבוצה הקרובה ביותר לחולייתנים מבין חסרי החוליות. למין המודל *Ciona intestinalis* יכולות רגנרציה מרשימות של אזור הסיפונים הנחקרות מזה למעלה מ-125 שנים. חרף המידע הרב המצוי כיום בנושא, אין מחקרים העוסקים ביכולות הרגנרציה של מיני איצטלנים יחידאיים ממחלקת ה-*Stolidobranchia*. במחקר קודם התגלה כי האצטלן הטרופי *Polycarpa mytiligera* כבעל יכולת רגנרציה גבוהה של אברים פנימיים כתוצאה מתהליך האוויסרציה של מערכת העיכול. מטרתו של המחקר הנוכחי הייתה לבחון יכולות רגנרציה נוספות של המין *Polycarpa mytiligera* תוך השוואה לשלושה מינים נוספים של אצטלנים ממחלקת ה-*Stolidobranchia*: *Styela plicata*, *Herdmania momus* ו-*Microcosmus exasperatus*. במהלך המחקר נבדקה יכולתם של מינים אלו לשחזר את הסיפונים, המשמשים כאיברי סינון המזון, וכן את יכולתם לשרוד את קטיעתה של מערכת העצבים ולשחזרה. המערכת הניסויית כללה ארבעה טיפולים: (א) קטיעה של סיפון הכניסה, (ב) קטיעה של סיפון היציאה, (ג) קטיעה של שני הסיפונים ומערכת העצבים, (ד) ביקורת שלא עברה כל קטיעה. לכל טיפול השתמשנו בחמישה פרטים. במהלך הניסוי בוצע מעקב אחר שיעור השרידות של האצטלנים בטיפולים השונים. האברים שעברו רגנרציה נמדדו וצולמו על בסיס שבועי לצורך חישוב קצב הגדילה. המין *P. mytiligera* הראה את יכולות הרגנרציה המרשימות ביותר. שני הסיפונים ומערכת העצבים שוחזרו במלואם בטווח זמן של 24 יום ושיעור השרידות היה 100% בכל הטיפולים, בעוד במינים האחרים שיעור השרידות היה נמוך הרבה יותר ונע בין 0% ועד 60% שרידות בטיפולים השונים. עבודה זו מציעה שהמין *Polycarpa mytiligera*, בהיותו בעל יכולות רגנרציה גבוהות, יכול להוות כלי מחקר שימושי נוסף להבנת מנגנונים הקשורים לתהליך הרגנרציה של איברים שונים ושל מערכת העצבים המרכזית.

סקר מקיף בשמורות הטבע הימיות בים התיכון והערכת השפעתן על המגוון הביולוגי

בותינה¹, אורי פריד³, סיגל שפר², רויטל בן דוד –זסלו², נועה שנקר², תמר פלדשטיין², יובל יעקובי³, תום שלזינגר³, עומרי ברונשטיין², ליאון נובק³, עדי ויינברגר³, מי-טל גבינג³, נגה סוקולובר², הנק מינס², עוז ריטנר², רזי הופמן², עדי לביא³, טל גורדון³, רעי קרן³, טל אידן³, יעריט לויט², לילך רייכמן³, אדווה אשכנזי³, הילה דרור³, בר פלדמן³, מילה גרינבלט³, רוני צפירי³, שבי הוטמן³, ניר שטרן², אור בן צבי³, איציק בריקנר², מיכה אילן³, יוסי לוי³, איל מילר¹, יגאל בן ארי¹, עמית דולב¹, גיא אילון¹, בן רחנברג¹, אסף זבולוני¹, אורי פרו¹, מחמוד נאסר¹, גיל בן נון¹, יניב לוי¹, אמיר שפיר¹, עידן חזקיהו הלוי¹, גיל רילוב⁴, אוהד פלג⁴, דר גולומב⁴, דור אדליסט⁴, פטריק שבל⁴, דני צ'רנוב⁵, סטפן מרטיניז⁶, יותם פופוביץ⁵, שי אינבינדר⁶, אביעד שייניץ⁶, עדי ברש⁵ מיכל גרוסוביץ⁵, גל דישון⁵, מיה בריטשטיין⁵, אדם וייסמן⁵, ענת צמל⁶, חגי נתיב⁶, אביעד שייניץ⁶, רמי צדוק⁵, ערן רוזן⁵, בועז מיזל⁷, שחר מלמוד³, איתי גרנות³, איתי ואן-ריין³, רנאל פיקהולץ³, הגר ינקוביץ³, חזי בובה³, עידן דוייב³ ויונתן בלמייקר²

¹ רשות הטבע והגנים

² המחלקה לזואולוגיה ומוזיאון הטבע ע"ש שטיינהרדט, אוניברסיטת תל אביב

³ המחלקה לזואולוגיה, אוניברסיטת תל אביב

⁴ המכון הלאומי לאוקיינוגרפיה, חקר ימים ואגמים לישראל

⁵ בית הספר למדעי הים ע"ש ליאון צ'רני, אוניברסיטת חיפה

⁶ המארג ובית הספר למדעי הים ע"ש ליאון צ'רני, אוניברסיטת חיפה

⁷ אדם טבע ודין

לאורך חופי הים התיכון הישראלי מוכרזות כיום שש שמורות טבע ימיות קטנות. בשנת 2015 בוצע סקר ביולוגי מקיף בשמורות הטבע הימיות ראש הנקרה – אכזיב, שקמונה, דור-הבונים וגדור - שמורות בהן קיימת קרקעית סלעית. מטרת הסקר היו ליצור רשימות מצאי כמותיות למינים המצויים בכל אתר, להשוות בין חברות החי והצומח בתוך שמורות הטבע לאתרים סמוכים ודומים להן מבחינת אופי הקרקעית, לתאר את הדגמים המרחביים של חברות החי והצומח הימיים בעומק של עד כ – 20 מ' לאורך קו החוף בים התיכון הישראלי, וליצור בסיס נתונים שימש כנקודת ייחוס, כדי שניתן יהיה לזהות מגמות של שינויים בעתיד. הסקר התקיים באביב ובסתיו. בכל עונה נערך תיעוד ודיגום אינטנסיבי ובו זמני של יצורים ימיים מקבוצות מגוונות (דגים, חסרי חוליות ואצות) בשטחי השמורות ובאתרי ביקורת דומים סמוכים להן. הסקר בוצע בשיתוף פעולה על ידי מספר גופים ומוסדות מחקר. בסקר נמצא, כי לשמורות טבע בהן מתקיים פיקוח סדיר ישנה השפעה חיובית על מאפיינים הקשורים בבריאות המערכת האקולוגית כמו גודל הפרטים (נבחן בדגים) ועל שכירות טורפים גדולים ומינים נדירים, בעלי ערך מסחרי גבוה או כאלה המצויים בסכנת הכחדה, בהשוואה לשטח דומה מחוץ לשמורה. במדדים אלו היו הערכים בשמורת אכזיב – ראש הנקרה, גבוהים יותר מאתרי הביקורת הסמוכים לה בשתי עונות הדיגום. בכל האתרים תועדה שונות עונתית גדולה בין האביב לסתיו, וכן נמצא שינוי מצפון לדרום במבנה החברות. עם קידום ההכרזה על שמורות טבע נוספות ורחבות מימדים בים התיכון והגברת האכיפה בתחומי השמורות הקיימות, נצפה לעלייה דומה בכל השמורות בהתאם לאופי בית הגידול ולכושר הנשיאה שלו, ולשיפור כולל במצב המערכת האקולוגית בים התיכון הישראלי.

תכנית ימית לישראל ותפקיד הקהילה המדעית ביישומה

יובל כהן

צוות תכנית ימית לישראל, המרכז לחקר העיר והאזור, הפקולטה לארכיטקטורה ובינוי ערים, הטכניון

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"תכנית ימית לישראל" שפורסמה בנובמבר 2015 מציעה לראשונה מדיניות כוללת לניהול המרחב הישראלי בים התיכון (מימי החופין והמים הכלכליים). התכנית מציעה חזון חדש לפיו המרחב הימי יהיה חלק אינטגרלי של המרחב הישראלי ומרכיב מרכזי בשגשוג הכלכלי, מגדירה סדרה של מטרות הנגזרות מהחזון, ומציעה שורה של אמצעי מדיניות ומבנה מרחבי מנחה למימוש המטרות. מטרות התכנית מתייחסות, בין היתר, לנושאי משילות, מידע וידע, הגנה על הסביבה, פיתוח מקורות אנרגיה, הספנות והנמלים, שימוש זהיר ובר-קיימא במרחב הימי כתחליף לשימושים יבשתיים, ועוד. לשיפור המשילות מוצע מנגנון לתכנון כולל של המרחב הימי (שיקבע בחוק) שעיקריו הם: הרחבת סמכויות המועצה הארצית לתכנון ובניה גם לאזור המים הכלכליים והסמכתה להכין ולהביא לאישור הממשלה תכנית אשר תסדיר את מכלול הפעילויות במרחב הימי, תוך תיאום בין הרגולטורים השונים ובשיתוף בעלי עניין והציבור; והרחבת סמכויות הועדה לשמירת הסביבה החופית למרחב הימי כך שתשמש כגוף מייעץ למועצה הארצית בהקשר לתכנון המרחב הימי והממשק שבין הים ליבשה. על מנת לקדם את הידע המדעי ולפתח ולהנגיש את המידע הימי אשר דרושים לקבלת החלטות ניהוליות, מוצע לגבש מדיניות לאומית במדעי הים ומדיניות לאומית לארגון, ניהול והנגשה של נתונים ומידע על המרחב הימי. המבנה המרחבי המנחה המוצע למימוש המטרות והחזון של התכנית מחלק את המרחב הימי לחמישה אזורים תפקודיים שלכל אחד מהם מוצעות הנחיות שונות אשר קובעות סדר עדיפויות ויחסי גומלין בין שימור והגנה על הסביבה לבין פיתוח, ובין שימושים כלכליים לבין שימושים ציבוריים. במסגרת זאת מוצע, בין היתר, לקבוע שיותר מ- 10% מהמרחב הימי יהיו מיועדים לשימור והגנה על ערכי טבע, ולנקוט מדיניות מיוחדת לתכנון השימושים באזור האופק הימי הנצפה מהחוף. לקהילת החוקרים במדעי הים תפקיד חשוב בקידום ויישום תכנית ימית לישראל שעיקריו: מיפוי וניטור המאפיינים הסביבתיים, זיהוי ערכי טבע מיוחדים וביצוע מחקרים להבנת התהליכים הטבעיים וההשפעות האנתרופוגניות במרחב הימי; פיתוח שיטות ומדדים כמותיים להערכה של השפעות אנתרופוגניות; והצגה אובייקטיבית וקליטה של ממצאי המחקר והניטור והתבונות העולות מהם למקבלי החלטות והציבור.

שינויים במפלס הים מהמאה הראשונה למאה ה-13 לסה"נ ומשמעותם האקלימית

יוסי מרט

מכון רקנאטי ללימודי ים, אוניברסיטת חיפה

התאמה בין שרידים ארכיאולוגיים ותצפיות גאולוגיות מדגישה כי באזור קיסריה שררה יציבות מבנית במהלך 2000 השנים האחרונות. היציבות הזאת, וכן הטווח המצומצם של השינוי במפלס הים בגלל הגאות והשפל היומיים בחוף הישראלי, מאפשרים לייחס משמעות אקלימית גלובלית לשחזור מפלסי הים במהלך מספר תקופות היסטוריות מוגדרות היטב. היות ומפלס הים הגלובלי משקף איזון בין כמות מי האוקיאנוסים עם כמות הקרחונים הממוקמים על היבשות, נראה כי לפני כ-2000 שנה מפלס הים הגלובלי, ולכן גם האקלים, היה דומה למפלס הנוכחי. מפלס הים היה גבוה מהמפלס הנוכחי במאות ה-VII – VIII וכנראה כי האקלים היה חם מהאקלים הנוכחי, ואילו במאות ה-XI – XIII מפלס הים היה נמוך מהמפלס הנוכחי, וניתן להניח כי האקלים הגלובלי היה קר מהנוכחי. החורבן המוחלט של קיסריה ב-1265 קטע את יכולת זיהוי מפלס הים באזור לאחר תאריך זה. השינויים במפלסי הים במיליוני השנים האחרונות הינם תוצרים של שינויים אסטרונומיים מחזוריים בגאומטריה של סיבוב הארץ סביב השמש (מחזורי מילנקוביץ'), שסגירת מצרי פנמה וצמצום מצרי מלקה העניקו להם השפעה אקלימית משמעותית. התצפיות המוצגות במאמר מראות כי ההנחה שההתחממות האקלימית הפעילה בעשורים האחרונים מקורה איננו נעוץ בהכרח בפעילות אנתרופוגנית, אולם הקשר בין נזקים כבדים שנגרמו בעשורים האחרונים לשינויות אלמוגים לבין פעילות אנתרופוגנית שגרמה לעלייה בתכולת CO₂ באטמוספירה מסתמך על עובדות מוצקות והוא סביר ביותר.

השפעות אנתרופוגניות על אוכלוסיות הפיטופלנקטון באזורי החוף של ישראל

נגה סטמבלר

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אוכלוסיות הפיטופלנקטון, המיקרופיטופלנקטון והפיקופיטופלנקטון, נדגמו בשנים 2003-2016 פעמים בשנה (סתיו ואביב). הדיגום נעשה במסגרת דרישות הניטור בעקבות התרים של משרד להגנת הסביבה להזרמה לים. הניטורים בוצעו במפרץ חיפה, בהרצליה, במעגן מיכאל ובאשדוד. אזורים בהם יש השפעה של הזרמה ממפעלי תעשייה, השפעה של נמלים, מפעל לטיהור שפכים או כלובי דגים. בכל אזור נדגמו מספר תחנות כולל תחנת ביקורת שהיא תחנה המרוחקת ממקור הזיהום. *Synechococcus* spp. (חיידקים כחולים) היא לרוב הקבוצה השליטה אפילו עד 91% מסך התאים ($1-4 \times 10^8$ תאים לליטר) מבין הפיקופיטופלנקטון בעוד Eukaryotes, ו-*Prochlorococcus* נמצאים בכמויות נמוכות. בריכוזי הפיקופיטופלנקטון יש הבדלים בין האזורים השונים, כמו כן יש שונות לא משמעותית בין העונות והשנים. מהמיקרופיטופלנקטון שכללו בעיקר צורניות ודינופלגטה נמדדו במרבית האזורים והשנים ריכוזים נמוכים של אצות ($1-6 \times 10^4$ תאים לליטר), ריכוזים האופייניים לים תיכון. מידי פעם יש פריחה של צורניות. מספר המינים במהלך השנים הוא נמוך, מבודדים עד עשרות (הרכב המינים וריכוזם מופעים בדוחות הניטור באתר של המשרד להגנת הסביבה). פרטים בודדים ממינים הנחשבים כאצות רעילות (Harmful algae) כגון, *Gymnodinium*, *Gonyaulax spinifera*, *Pseudo nitzschia*, נמצאו בכל האזורים כולל באזור כלובי הדגים. מאחר ויש אינקולום למינים רעילים בחופי הארץ חשוב לבצע מעקב רציף אחריהם ולהקטין את הלחצים האנתרופוגניים וזאת בכדי למנוע התפתחות פריחות רעילות.

טבעו של הנפט – סימביוזה בין חסרי חוליות וחיידקים בנביעות נפט וגז טבעיות במפרץ מקסיקו העמוק

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קרקעית הים טומנת נפט וגז טבעי, דלקי מאובנים בעלי חשיבות רבה בתהליכים ביוגאוכימיים בקנה מידה כלל-עולמי. מלבד ההשפעות ארוכות הטווח של השימוש בדלקי מאובנים על האקלים, דליפות מקומיות של גז או נפט משפיעות בצורה קיצונית על הסביבה. הגורם לדליפה הוא לעיתים קרובות אנושי: לדוגמא, דליפת הנפט מקידוח "Macondo" בצפון מפרץ מקסיקו (הידועה גם בשם Deepwater Horizon blowout), אשר שחררה כמות גדולה של נפט וגז טבעי לתוך עמודת המים. כמו כן, דלקי מאובנים יכולים לדלוף באופן טבעי ממאגרים בקרקעית הים בהינתן תנאים גיאולוגיים מתאימים. בדרום מפרץ מקסיקו, בעומקים של 3000 מטר, נמצאים "Campeche Knolls", אשר מהווים "הרי געש" של אספלט, עם זליגה מקומית של נפט נוזלי ובעבוע של גז טבעי, שמצטבר לעיתים קרובות כהידראט מוצק. למרות שסביבה זו נחשבה כעוינת בשל נוכחות חומרים רעילים, כגון פחמימנים פוליארומטיים (PAHs), אוכלוסיות צפופות ומגוונות של בעלי חיים נמצאו בסביבה של מקורות זליגת גז ונפט פעילים. האוכלוסיות הללו נשלטות על ידי חסרי חוליות כגון ספוגים, צדפות מסוג *Bathymodiolus* ותולעי צינור מסוג *Escarpi*. חסרי החוליות הללו חיים בסימביוזה עם חיידקים כמוסינטטיים (chemosynthetic) אשר מקבעים פחמן אנאורגאני או גז מתאן תוך שימוש במקורות אנרגיה כגון גופרית או מימן, ומהווים מקור תזונה יחידי עבור המארח. אנחנו דגמנו את חסרי החוליות ממספר "הרי הגעש", ריצפנו את כלל הדנ"א והרנ"א שלהם והשתמשנו בשיטות ביואינפורמטיות חדשניות במטרה לבדוק האם קיימים מנגנונים ביולוגיים מיוחדים המאפשרים הסתגלות לסביבה רוויה גז ונפט. לדוגמא, גילינו שספוגים וצדפות מ-Campeche Knolls חיים בסימביוזה עם חיידק מסוג *Cycloclasticus*, אשר עד היום היה ידוע בתור מפרק PAH מרכזי בסביבה מזוהמת בנפט. להפתעתנו, ה-*Cycloclasticus* הסימביוטי לא יכול לפרק PAH, אלא מתמחה בשימוש בגזים בעלי שניים עד ארבעה פחמנים (אתאן, פרופאן ובותאן), אשר נמצאים בריכוזים גבוהים באספלט רווי גז ונפט. הבנתו של מנגנון זה בחיידק הסימביוטי ומציאת דומים לו בנתונים סביבתיים, אישרו שאוכלוסיית המיקרואורגניזמים בעמודת המים המזוהמת על ידי דליפת קידוח "Macondo" נשלטה בשלבים הראשונים על ידי חיידקים מפרקי גז, ובעיקר על ידי חיידקים בעלי דמיון רב ל-*Cycloclasticus* הסימביוטי. לתגלית זו יש השלכות רבות על הבנתנו את התמודדותן של אוכלוסיות טבעיות עם דליפת דלקי מאובנים. מלבד ההקשר הסביבתי, מחקר של סימביוזה בים העמוק מאפשר להבין לעומק את שיתוף הפעולה בין בעלי החיים והחיידקים.

רבייה של האלמוג *Stylophora pistillata* ממפרץ אילת: לאחר ארבעה עשורים

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Stylophora pistillata (שיחן מצוי), הינו אחד ממני האלמוגים הנפוצים במפרץ אילת ובעל חשיבות אקולוגית רבה. בשנות ה-70 וה-80 נערכו מספר מחקרים על דפוסי הרבייה של האלמוג שהצביעו על כך שהשיחן המצוי הוא מין אלמוג הרמטיפי, דו מיני סימולטני, המבצע הפרייה פנימית שבסופה משתחררות פלנולות (לרוות) למים, כל לילה מתחילת החורף עד אמצע-תחילת הקיץ. קשר בין רבייה לבין הירח נמצא במחלוקת. המחקר הנוכחי בא להשלים מידע על תצורת רביית השיחן המצוי, לבדוק האם קיימים שינויים בעונתיות ובדפוסי הרבייה של האלמוג בארבעת העשורים האחרונים והאם יש קשר בין מספר הפלנולות למצג הירחי. כדי לענות על השאלות, מלכודות לפלנולות הונחו על אלמוגים בשתי עונות הרבייה האחרונות (2015-2016) מעט לפני השקיעה והוצאו בבקרים למחרת ובהן נספרו פלנולות מכל מושבה. ב-2015 נבחרו מושבות אקראיות ב-34 מועדים אקראיים. ב-2016 המעקב התבצע על אותן מושבות במשך כל שבוע (לפי מצב הירח) לאורך כל עונת הרבייה. תוצאות שנתיים מעקב הצביעו על התארכות עונת הרבייה בכחודש-חודשיים (עד אמצע ספטמבר ב-2015 ועד סוף אוגוסט ב-2016), ועל כך שמספר הפלנולות המשתחררות כל לילה אינו מושפע מנראות הירח, אך מושפע ממרחקו מכדור הארץ (גאות ושפל) ומהטפרטורה הסביבתית. מספר שיא של פלנולות לכל מושבה נצפה בחודשים מרץ, אפריל ומאי והוא בעל שונות גבוהה בכל לילה. מחקר זה מצביע על שינויים משמעותיים שחלו בעונת הרבייה של *S. pistillata* ב-4 עשורים האחרונים ושופך אור נוסף על עונתיות ודפוסים ברבייה של האלמוגים.

The role of ocean heat fluxes in seasonal and interannual variations of the ITCZ

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The ITCZ lies in the ascending branch of the tropical mean meridional circulation, where the meridional near-surface mass flux vanishes. The ITCZ also lies near the atmospheric energy flux equator (EFE), where column-integrated meridional energy fluxes vanish. This makes it possible to relate the ITCZ position to the meridional energy flux and its derivatives through Taylor expansion of the energy flux around the equator. Thus, the ITCZ position can be related to the energy flux and its derivatives at the equator, such as the net energy input (NEI) to the atmosphere (first derivative) and the NEI curvature (third derivative). We examine the resulting relations between the ITCZ position and the EFE in the present climate using reanalysis data. The zonally averaged ITCZ position and EFE co-vary on timescales from seasonal to interannual. Zonal variations of the ITCZ position, including traverses across the equator, coincide with zonal variations of the EFE of the divergent energy flux component. This first-order result captures the zonal-mean seasonal and inter-annual migrations and some aspects of the zonal structure of the ITCZ. A third-order expansion captures the transition from single to double ITCZ in the East Pacific. Ocean heat fluxes are found to play a critical role in ITCZ variability over the Pacific and in ENSO related variability.

Upcoming deployment of the first, deep-mooring station off the coast of Israel at 1500 m water depth, initiating a study of currents, waves and particle fluxes in the open sea

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Rising interest in the deep-sea off the Israeli coast, leading to increased funding of deep-sea instrumentation and a recently obtained, modern oceanographic research vessel (the RV Bat Galim) enabled logistic and scientific upscaling of open-sea, research projects in the Levantine basin of the eastern Mediterranean Sea. In a joint, upcoming operation, we (researchers from four different institutes) will place a mooring line for deep-sea research at seafloor depth of 1500 m, about 50 km offshore. The mooring line, which is now in final stages of assembly, will carry a large array of oceanographic instruments aimed at measuring physical traits (waves, currents, temperature, salinity etc.) as well as the determination of the export of organic matter from surface to depth by time series sampling of sinking particles along the water column and by using isotopic tracers. Particles captured in sediment traps will be analyzed for their biological, chemical and radioactive isotope (mainly Th) composition. The deployment of this complex sampling array, which is due November this year (2016), will be the first operation of its kind to take place in the EMS/Levantine basin. The first stage of this research will continue for 1.5 years with half yearly cruises for maintenance and for data and sample collections. In this talk, we will describe the instruments along the deep mooring, various technical challenges in deploying and retrieving this moored sampling station and discuss some of the research questions that we hope to answer with this setup.

Assessment of the coral holobiont through a depth gradient- Do the symbionts make a difference?

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The 'deep reef refugia hypothesis' posits that Mesophotic coral ecosystems (reef communities that flourish at depths of 30-150 meters), which are believed to be largely free from anthropogenic stress, may play an important role in the recovery of impacted reef areas. 'Depth-generalist' coral species that occur over wide depth range are the most likely to aid in shallow reef recovery. However, the issue of what defines a species as a 'depth-generalist' should be examined. Reef building corals exist in multipartite symbiosis with diverse populations of microorganisms. Any change in symbionts structure/function with depth has the potential to impact the connectivity between deep and shallow reefs. This study examined the deep reef refugia hypothesis with relation to the symbionts and their contribution to the depth distribution of species. The algae density and chlorophyll *a* content of shallow and mesophotic colonies of *Gyrosmlia interrupta*, a depth-generalist species in the Gulf of Eilat, were quantified and compared and revealed no significant differences. Nonetheless, the photosynthetic efficiency was significantly higher in deep colonies. Implicit from that is that the zooxanthellae symbionts do not play a key role in the *G. interrupta* photoacclimative response, and the augmentation in light harvesting efficiency of deep colonies is due to another component of the holobiont. There was a clear shift in the dominant bacterial classes of *G. interrupta* colonies with depth. Deep colonies were dominated by the bacterial class Cyanophyceae, which was nearly absent in the shallow colonies. The increase in the Cyanobacterial community with depth (and by proxy the concentration of any secondary metabolites produced by these organisms) is anticipated to have effects on the entire holobiont. This study suggests that Cyanophyceae, for their dominance in the bacterial communities of deep *G. interrupta* and their ability to photosynthesize well in the mesophotic depth, have significant part in these holobiont adaptation process.

Waves Analysis and Forecasting at the IMS

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A study evaluating the performance of several models in predicting significant wave heights (SWH) near the Israeli coastline is being conducted. The end goal of the study is to provide improved tools/models for the forecasters. SWH from WAM and SWAN high-resolution model outputs are compared with two wave-rider buoys located at Haifa and Ashdod. Since the accuracy of any wave forecast is dependent on the accuracy of the wind forecast, several wind forecast models are tested as input for the wave models. How good are the models compared to the buoy measurements? Very high correlations (0.90-0.99) and low bias values (within 10% of the observed data) are obtained with several thousands of hourly data pairs from analyzing five years' worth of data. Special emphasis is given to the European Center for Medium-Range Weather Forecast (ECMWF) models, which are extensively used by the IMS forecasters. Recently, ECMWF upgraded its model resolution. We will show whether the recent increase in resolution of the atmospheric model improves the wave-model accuracy. Although very good results are obtained, variations in the accuracy are found among the models. Which model should we trust more? Large uncertainties in the SWH exist near the coast due to the natural variability of the heights and due to model limitations. Model performance near the coast, where the buoys are located, might be different than at deep sea. In the future we plan to add to our model verification system deep-water buoy data. While considerable effort is devoted to achieve better agreement with the buoys, this might not be sufficient. We will discuss how we should optimally expand our validation efforts. Providing forecasts associated with well-established uncertainties is perhaps more important than convergence on its own.

Eastern Mediterranean wind-stress effect on Adriatic deep water formation

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The Adriatic Deep Water (ADW) formation inter-annual variability is studied under a realistic (Era-Interim) wind stress forcing over 1979-2014 using an oceanic general circulation model of the Mediterranean Sea. A connection between the wind-stress magnitude over the Rhodes Gyre area and the ADW outflow was found in association with the formation Levantine Intermediate Water (LIW) where the LIW formation leading the formation of the ADW by one year. In addition, it is found that the wind-stress amplitude affects the formation rate of the LIW and therefore the deep-water formation in the Adriatic. On the one hand, if the wind-stress amplitude is half its magnitude, there is not enough momentum to drive the Rhodes Gyre in which the LIW forms. On the other hand, if the amplitude is one-and-a-half its magnitude, the mostly southward wind-stress over the Aegean brings fresh water to the Rhodes Gyre area and weakens the LIW formation. Twenty random wind-stress anomaly fields were constructed based on the first 50 EOFs of the wind-stress monthly anomalies. The simulations with this artificial forcing validated the connection that was found based on the 1979-2014 simulations and also revealed a centennial internal variability that connects the LIW and the ADW outflow.

High-resolution temperature sensing in the Dead Sea using fiber optics

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The thermal stratification of the Dead Sea was observed in high spatial and temporal resolution by means of fiber optics temperature sensing. The aim of the research was to explore the dynamics of the metalimnion, including: i) short period fluctuations of the thermocline's depth, and ii) seasonal sharpening of the metalimnion and the role of double diffusion flux. A 55 m long profiling system was placed vertically through the water column with spatial resolution of 18 cm. The profiler covered the upper mixed layer (~20 m), metalimnion and the hypolimnion. Temperature profiles were recorded every 5 minutes along the stratification period (MAY-DEC 2012). The analysis of the profiles was based on defining objective key locations within the metalimnion, based on the temperature depth profile and its depth derivatives. We found strong anti-correlation of the metalimnion depth fluctuations to measured lake level fluctuations; e.g. - typical level rise of ~1 cm correlated with deepening of the thermocline by a few meters. 3D model runs (POM), using measured meteorological boundary conditions revealed similar lake level and metalimnion fluctuations. These correlations ($r=0.8$), together with similar correlations to the variations in the vertically integrated apparent heat content, suggest that we observed, 1 dimensionally, a spatial phenomena, related to internal waves in the lake. These, are the source of lateral heat advection explaining the dramatic variations in the observed heat content within the few hours scale. In the seasonal scale, the metalimnion's temperature depth profile is sharpening, starting from a gradual round temperature profile, to distinct staircases, through merging of the staircases down to a single sharp step (<1m), achieved in early fall. Additional observations pointing of heat and salt fluxes between the strata are synchronous with the metalimnion sharpening, associating those fluxes to the double diffusion phenomena, typically characterized by interface sharpening and staircases.

Current temporal asymmetry and the role of tides: Nan-Wan Bay vs. the Gulf of Elat

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Nan-Wan Bay in Taiwan and the Gulf of Elat in Israel are two different coastal environments, and as such, their currents are expected to have different statistical properties. While Nan-Wan Bay is shallow, has three open boundaries, and is directly connected to the open ocean, the Gulf of Elat is deep, semi-enclosed, and connected to the Red Sea via the Straits of Tiran. Surface currents have been continuously measured with fine temporal (less than or equal to 1 h) and spatial resolution (less than or equal to 1 km) for more than a year in both environments using coastal radars (CODARs) that cover a domain of roughly 10×10 km. These measurements show that the currents in Nan-Wan Bay are much stronger than those in the Gulf of Elat and that the mean current field in Nan-Wan Bay exhibits cyclonic circulation, which is stronger in the summer; in the Gulf of Elat, the mean current field is directed southward and is also stronger during the summer. We have compared the statistical properties of the current speeds in both environments and found that both exhibit large spatial and seasonal variations in the shape parameter of the Weibull distribution. However, we have found fundamental and significant differences when comparing the temporal asymmetry of the current speed (i.e., the ratio between the time during which the current speed increases and the total time). While the Nan-Wan Bay currents are significantly asymmetric, those of the Gulf of Elat are not. We then extracted the tidal component of the Nan-Wan Bay currents and found that it is strongly asymmetric, while the asymmetry of tidally filtered currents is much weaker. We thus conclude that the temporal asymmetry of the Nan-Wan Bay currents reported here is due to the strong tides in the region. We show that the asymmetry ratio in Nan-Wan Bay varies spatially and seasonally: (i) the currents increase rapidly and decay slowly in the northern part of the domain and vice versa in the southern part, and (ii) the asymmetry is stronger during summer.

New roles of mortalin, a stress protein, in urochordate astogeny and aging

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Botryllus schlosseri, a colonial marine invertebrate, exhibits along the entire colony life three astogenic short-lived modules (adult zooids, buds, budlets) within a repeated scheme of budding cycles, each called blastogenesis. The astogenic modules differ from each other in morphological features and developmental states; altogether blastogenesis depicts a highly ordered and continuous asexual life cycle of approximately seven days long. At the sixth day of each cycle, a radical morphological absorption of adult zooids begins, characterized by apoptosis of old zooids. This study follows the performance of an evolutionary conserved HSP70 (stress protein) member in *B. schlosseri*, called mortalin, associated in multicellular and unicellular organisms with ontogenesis, aging and stemness. *In-situ* hybridization and qPCR assays reveal that mortalin transcriptions in the astogenic modules follow the cyclic pattern of blastogenesis. Also, colonies in stage D blastogenesis signify the highest mortalin levels, where young colonial modules reveal significantly elevated mortalin levels as compare to old modules. Mortalin is also highly pronounced in male and female gonadal areas, in embryos, in the endostyle and in subsets of circulating blood cells. Manipulating mortalin by the specific allosteric antitumor drug MKT-077 led to decrease in modules growth rates, increase in senescence-like processes and to the development of abnormal somatic and germinal morphologies. We propose that mortalin in *B. schlosseri* has a significant role in astogeny and aging of colonial modules, a novel role for an old molecule.

The effect of fluorescent pigments diversity on UV induced damages in the coral *Euphyllia pardivisa*

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Solar radiation that reaches the earth's surface includes both vital photosynthetic active radiation (PAR), and harmful ultra-violet radiation (UVR). Corals at the photic zone are exposed to UVR that induces different physiological damages (e.g. production of reactive oxygen species, reduction of primary production, growth reduction). Direct UVR damages includes two of the most abundant DNA lesions: cyclobutane pyrimidine dimers (CPDs) and 6-4 photoproducts (6-4PPs). Such DNA damage cause a deformation of the DNA helix and may lead to cell cycle arrest, cell death and coral degradation. Hermatypic corals are known to possess a variety of fluorescent proteins (FPs), which are extensively used as visual markers in biomedical research; yet, their biological function is still poorly understood. Whereas it has been shown that FP production is regulated by light and, therefore, probably provides photoprotection against radiation (whether UVR or high PAR), the role of fluorescence in preventing direct UV induced damages and especially UV induced DNA damages, has not yet been studied. In this study, different natural fluorescent morphs of the coral *Euphyllia pardivisa* from the Gulf of Eilat, coupled with in-situ observations and ex-situ experiments, were used in order to investigate the changes and relationships between coral fluorescence, UVR induced damages, and UVR protection abilities. We first characterized excitation and emission spectra of different FPs found in the different fluorescent morphs that were used. Then corals were exposed to different light treatments, either exposed to or deprived from UVR. Fluorescence levels were quantified, and we analyzed UVR induced damage and UV exposure indices. We found that the intensity of fluorescence can change (either by photoconversion or expression levels) under different light regimes and that UVR induced damages varies in relation to the coral's FP arsenal, thus, suggesting that a certain FPs might give an advantage in UVR exposed environments.

Directional swimming in coral reef fish larvae and its effect on dispersal and connectivity

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Coral-reef fish larvae have been shown repeatedly to orient effectively in response to cues emanating from the reef, which may help guide their settlement. On the other hand, little is known about larval orientation and directional swimming in the open sea, away from such cues, where the larvae spend the bulk of their pelagic phase. Lacking such information, biophysical models of dispersal and connectivity typically impose non-directional larval movement - i.e. simple random walk (SRW) with zero correlation of swimming directions across time. In this study we combine field and modelling work to examine the consequences of this constraint. First, using a Drifting-In-Situ-Chamber (DISC), we tested the auto-correlation in the swimming direction of *Amphiprion ocellaris* larvae at three different scales: (1) across 30 minutes, (2) after a significant perturbation, and (3) across two consecutive days. We identified significant autocorrelation which decays after 24 hours ($r_{(1)}=0.78$, $r_{(2)}=0.46$ and $r_{(3)}=0.1$), suggesting a Correlated Random Walk (CRW) process in-lieu of SRW. Accordingly, we implemented CRW in a biophysical model of the Gulf of Aqaba, using our empirically derived parameters. We identified a consequent increase in both recruitment success (x2.5) and mean dispersal distances (x1.5); which, we believe, warrants a revision of how movement during the pelagic duration is modeled.

Reproduction of the long-spined sea urchin *Diadema setosum* in the Gulf of Aqaba - implications for the use of gonad-indexes

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As global warming and climate-change proceeds ever more rapidly, organisms depending on seasonal cues to synchronize reproduction face an unclear future. Recent studies on echinoid reproduction from the Gulf of Aqaba (GOA; Red Sea) facilitate multi-species comparisons to provide new insights into sexual reproduction of broadcast-spawning species. Here we present novel information on the reproductive biology of the echinoid *Diadema setosum* from the GOA, and demonstrate the importance comparing reproductive traits on both local and global scales. Sea urchins from the genus *Diadema* are some of the most widespread, abundant and ecologically important echinoids in tropical regions. *D. setosum*'s reproduction in the GOA is seasonal, with mature individuals occurring from July to October. Gonad indexes (GI) indicate spawning from August through December and suggests two main spawning events. Histological analysis, however, indicate that the second peak of GI values cannot be related to spawning, but rather correspond to recovering individuals. In *Diadema*, examination of GI values alone may thus lead to erroneous conclusions pertaining its reproductive cycle. GI is positively correlated with sea-surface temperatures, but not with chlorophyll-a concentrations or photoperiod. Spawning coincides with the onset of the annual chlorophyll-a increase, however, which might be advantageous for nutrition of the newly developing larvae. The first significant GI increase coincides with the shortening of day-length, which may act as a cue for gametogenesis. Gametogenesis is highly synchronised between sexes, although the mature phase of females exceeds that of males. In GOA *Echinometra* the presence of mature individuals was twice as long as that of *D. setosum* and may reflect alternative reproductive strategies. Skewed sex ratios in *D. setosum* from the GOA, expressed as almost twice as many females per males (♀:♂ 1:0.59, n=360), may be related to pollution and may serve as indication for potential detrimental processes that prevail in the environment.

Sponge associated Cyanobacteria: life inside a host cell.

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Cyanobacteria form stable symbiotic interactions with eukaryotic hosts. The symbiotic host range is wide and includes mosses, angiosperm plants, lichens, sponges and others. Given the basal evolutionary phylogenetic position of marine sponges, the sponge-cyanobacteria interaction has been suggested to be one of the oldest host-bacteria interactions, dating back more than 500 million years. Sponge-associated cyanobacteria are polyphyletic, implying that they derived from multiple independent symbiotic events. Among the various lineages, *Synechococcus*-like species are the most commonly reported and widespread in sponges. These include the widespread and extracellular *Candidatus Synechococcus spongiarium* and a less common intracellular *Candidatus Synechococcus feldmannii*. *Ca. S. feldmannii* has been detected mostly in the sponge *Petrosia ficiformis*, appears to be a facultative symbiont, is transferred horizontally, habitats inside host cells (intracellular). Whilst the symbiotic lifestyle of *Ca. S. spongiarium* was recently studied via comparative genomics, nothing is known about the adaptations and symbiotic features of *Ca. S. feldmannii*. The latter (as the majority of sponge symbiont lineages) remains uncultivated, thus I used culture independent approaches based on next generation sequencing for revealing the first genome of an intracellular sponge symbiont, *Ca. S. feldmannii*. Genomic adaptations of *Ca. S. feldmannii* to its endosymbiotic lifestyle will be discussed.

Teflon bacteria: Non-sticky cell surface allows SAR11, the most abundant marine microorganism, to evade predation

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The abundance of a species is determined by the balance between the rates of its population growth and mortality. *Pelagibacter ubiquus*, a free-living, pelagic bacterium belonging to the SAR11 clade, is the most abundant bacterium in the world's ocean. Yet, its growth rate is thought to be extremely slow, which has led us to examine low grazing rate as a possible explanation for its unusual abundance. Here we show that the non-sticky cell surface of *P. ubiquus* may provide effective protection from predation by both benthic and pelagic filter feeders. Many grazers capture their prey from the water using mucous nets. Clean underwater collection of the water inhaled and exhaled by ascidians, in situ incubations of appendicularians, and controlled laboratory experiments showed that bacteria of the SAR11 clade can evade capture by the mucus nets of these ubiquitous suspension feeders. Using affinity columns, we demonstrated that those bacteria have a less hydrophobic surface than other, heavily grazed bacteria. We propose that SAR11 bacteria have traded their ability to stick to nutrient-rich organic particles, thereby reducing their growth rate, for a "Teflon-like", non-sticky cell surface that lowers their mortality. This effective tradeoff, is likely not limited to the SAR11 bacteria clade.

Towards collaboration between underwater acoustic technology and marine science

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The seemingly different research methods and activities of marine scientists and of marine engineers, has blocked collaboration between the two disciplines. However, the combination of the two research fields can provide a complete framework to study scientific problems that are technologically challenging. Such combination would provide an attractive multidisciplinary research, and has the potential to advance marine research. Towards the aim of encouraging such collaboration, in this talk we will present the capabilities of the underwater acoustic and navigation laboratory (ANL) in the newly established Dept. of Marine Technology in the University of Haifa. We will review several past and present activities in the lab that have a potential for applications in marine biology and in marine geophysics. In particular, we will describe a system for autonomous detection of acoustic emissions to localize and track marine mammals or tagged animals, a method for blind source separation and pattern recognition for characterization of an object of interest from optic cameras, and machine learning-based analysis of large datasets to find complex relations between the propagation of acoustic and optic signals. Examples would be given from sea experiments, and the facilities of the lab will be reviewed.

Reproductive strategies of the coral *Paramontastrea peresi* in shallow vs. mesophotic reefs

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Shallow water reefs (SWRs), the “maritime rain forests”, constitute a rich research focus for many years. Only during the last two decades there has been a growing interest in mesophotic coral ecosystems (MCEs; 30-150m). At these depths, the main impediment to coral development is scarcity of sunlight. However, limited anthropogenic activity and minimal natural disturbances result in a more stable environment than that of SWRs. In view of increasing effects of global warming on coral reefs and the continuous degradation of Eilat reefs due to Man’s perturbations, the high coral diversity of mesophotic reefs raises the question of the mesophotic corals’ capacity to constitute a larval source for SWRs. Hence, the major purpose of this work was to assess the reproductive strategy of the same coral species found both in SWRs and MCEs (i.e., the depth “generalist” *Paramontastrea peresi*). During this research, 5-6 colonies from both habitats were sampled monthly between April 2015 and May 2016 at the Interuniversity institute of Eilat’s reef. Oocytes’ size and quantity and number of gonads per polyp were measured every month. Field surveys were conducted to assess the *P. peresi* living cover and abundance. In contrast to the majority of scleractinian corals at the Gulf of Eilat/Aqaba, which are summer spawners (June-September), *P. peresi* reproduces during the winter (October-December). The reproductive cycle of this species at MCEs is shorter (oogenesis commenced one month after the shallow colonies and spawning occurred one month prior). Mesophotic oocytes were significantly smaller than shallow oocytes. Furthermore, a significantly larger number of oocytes per polyp were observed in shallow colonies. Since the living coverage of *P. peresi* showed no significant differences between shallow and mesophotic depths, we conclude that fecundity of this species is higher at SWRs. Nevertheless, we suggest that *P. peresi* at MCEs may serve as a larval source for depleted shallower habitats, and perhaps signifies such a possibility for other generalist coral reef species.

The effects of SWRO desalination brine discharge on benthic heterotrophic microbial communities

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Seawater Reverse osmosis (SWRO) desalination facilities continuously discharge hypersaline brine into the coastal environment forming a plume with typical salinities of up to 10% above the ambient levels. Brine waste is often denser than ambient seawater, therefore tends to sink and flow along the seafloor at a typical range of tens of meters to a few Km away from the outfall. We surmise that saline flow over the bottom may result in accumulation of brine within the sediment, hence alter microbial diversity and activity. The Israeli shoreline is an ideal "natural laboratory" for testing brine effect due to five large scale SWRO desalination facilities producing ~600 Million m³ y⁻¹ freshwater and discharging similar volumes of brine. In this study, we examined seasonally the short (48 hours) and Long-term (weeks to years) affects of different brine scenarios on benthic bacterial abundance, diversity and activity in coastal sediments. Our results demonstrate that even a short exposure to elevated salinities (2%-20%) may trigger a decrease in bacterial abundance by ~40% in 5%-20% increased salinity above ambient level during summer, increase bacterial cell specific activity (~60%) and bacterial carbon demand (~70%). Yet, no change in microbial diversity was recorded under this short exposure in any of the salinity treatments. In contrary, long-term exposure to high salinity may cause more profound effects on benthic microbial communities. Thus, a benthocosm setup simulating brine discharge for one-month duration with elevated salinities of 2%-10% above ambient levels and control treatment was designed. Results from this experimental setup as well as from coastal *in-situ* sampling will be presented. Our results may shed new light on the effects of brine discharge on benthic bacterial communities' composition and function, and may provide valuable data for future management and regulations in the desalination industry.

Gear Selectivity and Seasonality in Israeli set net Fisheries

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Small-scale coastal fisheries are among the most common fishing techniques in the world, providing almost 50% of total world landings. Unfortunately, due to overfishing and various other anthropogenic stressors such as pollution and habitat loss, small scale coastal fisheries are worldwide on the verge of collapse. In Israel, while coastal fishing was considered to be the economically largest fishing branch, today only 30-40% of coastal fisherman are still engaged in fishing as a profession. Data on coastal fishing are scarce, with almost no record of small scale coastal fishing landings. The aim of this study was to quantify the catch of gill and trammel nets in order to establish optimum fishing methods that can benefit both local fish communities and coastal fishermen. Data was collected over 90 fishing days across 22 months. During this time 347 set nets were documented including 4 different gill net mesh sizes: 25,30,43,70 mm (knot to knot) and one trammel net 36/150/36 mm (knot to knot). We found that over the range of mesh sizes examined, smaller mesh sizes did not necessarily catch large quantities of younger individuals but rather smaller species. Hence, the proportion of juvenile fish did not differ between nets of different mesh sizes while community structure did. These results suggest that mesh size restrictions, over the range of mesh sizes examined, will not result in the decrease in catch of individuals below reproductive size but rather shift the species composition of the catch towards large bodied predatory species. This is unlikely to achieve neither the rebuilding of fish stocks nor increase in fishermen's profitability. We suggest that coastal fisheries management in our region should focus on reducing fishing pressure incorporated with ecosystem based fisheries management, such as the closures of reproductive or recruitment areas and marine protected areas.

All aboard! Marine vessels as an acute vector of invasive ascidian dispersal

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Ascidians (Phylum: Chordata, Sub-phylum: Tunicata) are considered as highly successful invaders, exploiting marine vessels as one of their paths of introduction. Non-indigenous ascidians are now commonplace worldwide, with a major impact on natural fauna, aquaculture and marine infrastructures. Our study examined the abundance and richness of non-indigenous ascidians on marine vessels along the Mediterranean coast of Israel. Our main goal was to assess the role of such vessels in ascidian invasions. The approach assumed that: (1) marine vessels are the main vector in ascidian introductions and dispersal; (2) some vessels are more susceptible to serving as ascidian vectors than others; and (3) ascidians preferentially select hidden (protected) areas on the vessels. We have monitored 45 dry-docked marine vessels, comprising recreational, commercial, and military craft, in five Israeli shipyards along the Mediterranean coast. Crafts usage, size, sailing trails, and duration in water were recorded, as well as ascidians detected and their location on the craft. Samples were taken to the laboratory for morphological and molecular identification. Non-indigenous ascidians (NIA) were revealed on every second vessel investigated. Military vessels featured the highest ascidian abundance and richness. Hidden and protected areas on the vessels such as sea chests and the propeller exhibited the largest coverage by ascidians. Overall, our findings provide strong evidence that marine vessels play a major role in NIA introduction and dispersal, with military vessels and hidden areas on all the vessels being more susceptible to serving as vectors. The discovery of a new introduced species during the surveys suggests that the monitoring of marine vessels can serve as an effective tool for the early detection of NIA. The findings from this study demonstrate the urgency of ensuring the appropriate maintenance and surveillance of marine vessels; and provide applicable recommendations for more efficient and focused treatments.

The importance of maneuver capability on the AUV ability to perform delicate survey missions

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Autonomous Underwater Vehicles (AUVs) are gaining a dominant role in the marine science, commercial and naval fields. In marine geoscience, AUVs have an important role in mapping of the seafloor morphological features and the study of underwater volcanism and hydrothermal vents. Their capability to image vast areas of the seabed at high resolution make AUVs an essential tool in deep-water archeology and offshore engineering where AUVs are successfully employed in pipeline surveys. Nowadays AUVs provide a capable platform for mine countermeasures operations (MCM). Their ability to operate autonomously in a remote and hostile environment makes large AUVs (LAUVs) a promising platform for surveillance and intelligence gathering and as a replacement for some tactical submarine operations. The performance of an AUV in most applications is considerably determined by its maneuvering precision and endurance. Estimating those is of a significant importance to a successful mission accomplishment and AUV versatility. At the University of Haifa, the Hatter Department of Marine Technology two AUVs are planned to be operated for research purposes. A medium sized AUV, 3000m depth rated, torpedo shaped hull equipped with an X-form rudder and a small, two-man portable, 200m depth rated, torpedo shaped hovering AUV equipped with two external and one cross body thrusters. The former will be mainly used for deep-sea seabed survey and large areas coverage while the latter for technology research in maneuvering and for survey in confined areas. The ability of those AUVs to perform delicate survey missions close to the object surveyed or the seabed depends, among additional factors, on their inherent maneuvering capability. Analytical models [1], [2], in particular the solution for the equations of motion for the two AUVs maneuvering in 6DoF: surge, sway and heave for translation motion and roll, pitch and yaw rates for rotational motion are presented together with the calculation of the non-linear coefficients. The simulation results are presented in light of possible survey missions with the advantages and disadvantages of each discussed.

[1] Fossen, T. I., "Handbook of Marine Craft Hydrodynamics and Motion Control". John Wiley and Sons Ltd., April 2011.

[2] Fossen, T. I., "Marine Control Systems Guidance, Navigation, and Control of Ships, Rigs and Underwater Vehicles". Marine Cybernetics, Trondheim, Norway, 2002

The Mediterranean Sea Urchin *Paracentrotus lividus*: an effective embryotoxicity model

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Evaluating the toxicity of antifouling compounds is essential in order to produce environmentally - friendly materials. Several approaches are currently in use to assess toxicity levels, assaying a variety of model organisms, including both marine invertebrates and vertebrates. By testing the toxic effects of a given compound in relation to its concentration in the early embryonic stages of a model organism, both cytotoxic and embryotoxic effects can be determined. This is in contrast to other toxicity tests that only examine organism mortality. In this study we present an embryotoxicity assay on *Paracentrotus lividus*, a temperate water sea-urchin. Eggs and sperm were mixed and inseminated in seawater with BYEFOULING test products, including nanomaterials such as carbon nanotubes and encapsulated compounds. The assay examined toxicity level, indicated by percentage of fertilized eggs cleaving to a 2-cell stage (first cleavage) and percentage of fertilized eggs reaching the pluteus larval stage. Thus, percentage inhibition of normal pluteus formation was indicative of toxicity. In addition, malformed and pre-pluteal embryos were microscopically checked. This assay is established as simple, straightforward, and swift.

Suspension feeding of ascidians at the sub-micron range

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Suspension feeding is probably the most common feeding form in the marine environment. Some suspension feeders feed by means of 'true sieving' where water is driven through a mesh like filter that captures suspended particles. True sieving mechanisms are assumed to be purely mechanic, i.e. particles are retained or evade retention based solely on their size. According to that, true sieving of smaller particles will imply a smaller filter-pore and a large increase in resistance to water flow and the energetic cost of water processing. Ascidians (phylum: Chordata, subphylum: Tunicata) are benthic suspension feeders with a 'true sieving' filtering apparatus. Their relatively simple filtering system makes ascidians a good model for studying suspension feeding. In order to characterize the size-depended retention efficiency curve of ascidians we sampled water directly from the inhalant and exhalent openings of ascidians while introducing a mixture of inert synthetic microspheres of different sizes, both in lab and field experiments. In contrast with previous studies, we found that ascidians can efficiently retain sub-micron particles. Furthermore, the retention of surfactant (Poloxamer 188) coated microspheres was significantly lower (for particles $< 1 \mu\text{m}$) than the retention of the same size uncoated microspheres, meaning that the retention of small particles depends on different particles' attributes beside size. Our findings suggest that particle surface properties (e.g. hydrophobicity and charge) have a significant role in suspension feeding at the sub-micron range.

Seasonal variations of halite saturation in the Dead Sea

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Hypersaline lakes and seas were common in the past, precipitating thick evaporitic salt deposits. The only modern analogue for the paleo-limnology of deep salt-saturated aquatic environments exists in the Dead Sea. In this study we present new insights from the Dead Sea on the role of seasonal thermohaline stratification and water balance on the seasonal and depth variations of the degree of saturation of halite (salt) and the rate of halite growth along the water column. We developed methodologies to accurately determine the empirical degree of halite saturation of the lake based on high accuracy densitometry, and to quantify halite growth rate along the water column. During summer, the epilimnion is undersaturated and halite is dissolved, whereas during winter the entire water column is supersaturated and crystallizes halite. This result is not trivial because the variations in the water balance suggest the opposite; summer is associated with higher loss of water by evaporation from the lake compared to the winter. Hence, the thermal effect overcomes the hydrological balance effect and thus governs the seasonal saturation cycle. The hypolimnion is supersaturated with respect to halite and crystallizes throughout the year, with higher super saturation and higher crystallization rates during winter. During summer, simultaneous opposing environments coexist – an under-saturated epilimnion that dissolves halite and a supersaturated hypolimnion that crystallizes halite, which results in focusing of halite deposits in the deep hypolimnetic parts of the evaporitic basins and thinning the shallow epilimnetic deposits.

Application of ecological quality assessment in the Eastern Mediterranean using live and dead molluscan assemblages

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The EU has established monitoring directives to preserve and protect marine environments around the Mediterranean in response to increasing anthropogenic stress. The directives standardize the ecological health state of seawater systems by defining an 'ecological quality status' (EcoQS) that quantifies the deviation from pre-impact reference conditions. However, in many cases information on pre-impact conditions is incomplete or missing, leading to potential bias in evaluation of environmental quality. Long-term accumulations of shells on the sea floor average out short-term variations in the community and can be used for a more complete definition of the ecological system. These death assemblages serve as a baseline for the composition and structure of live communities. This study compared live and dead molluscan assemblages across an eutrophication gradient in the oligotrophic Israeli shallow shelf. AMBI, Bentix and Shannon-Wiener indices were calculated for live and dead assemblages from polluted and control stations near the Dan Region Wastewater Project (Shafdan) to evaluate their utility as indicators of EcoQS in the Eastern Mediterranean. The AMBI index showed no change, while Bentix and Shannon-Wiener indices showed a significant decrease in EcoQS over time, from 'moderate' EcoQS in the dead- to 'poor' EcoQS in the live assemblage. Bentix was developed specifically for Eastern Mediterranean living taxa. However, it failed to show a significant difference in the live assemblage between the polluted and control stations, highlighting the importance of utilizing the death assemblage as a baseline recorder of multiannual time scales. Adjustments to the Bentix index concerning naturally abundant pollution-tolerant benthic fauna (e.g, *Corbula gibba*) of the oligotrophic Israeli coast improves its utility in monitoring shallow shelves around the Mediterranean. The Shafdan case study shows that live-dead comparisons of molluscan assemblages are valuable in evaluating ecological conditions before the onset of human activity and should be applied in future monitoring procedures.

Investigating the symbiotic relationship between the caridean shrimp *Odontonia sibogae* and its ascidian host

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The infraorder Caridea Dana, 1852 is the second most species-rich group within the Decapoda. It comprises 35 families and approximately 3,400 known species. It is well-known that some caridean species can be found in association with other invertebrates and vertebrates. For example, ascidians (Chordata, Ascidiacea) can serve as hosts for a variety of species of the family Palaemonidae. *Odontonia sibogae* (Bruce, 1972) is a common caridean shrimp in the Indo-Pacific Ocean and is known to be associated with several species of ascidians. In the northern part of Gulf of Aqaba (Elat) this species was found in the solitary ascidian *Herdmania momus* (Savigny, 1816) behind the branchial sac and adjacent to the cloacal siphon. Although this symbiotic relationship is known, its nature is unclear. In order to understand this unique association, during 2015-2016 more than 90 ascidians individuals were collected, together with more than 60 associated caridean shrimp from different locations in Elat. All the invertebrates were kept in one open water table system, in individual jars with a separating net. Several lab experiments were conducted on the associated shrimp, observing obligatory behaviour, host-symbiont dynamics, potential influence on the host, and symbiont specificity to the host. Over 40% of the collected ascidians had associated shrimp, with one to three specimens in each ascidian. The shrimp displayed a low survivorship percentage outside their host, indicating an obligatory symbiotic relationship. Though over 40% of the shrimp survived for 21 days, only 18% (9 individuals) survived up to 41 days. These experiments will provide a better understanding the role of this unique association and its potential benefit for the associated shrimp.

Marine Natural Products in 3D: Diversity, Distribution and Discovery

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The marine environment is an overwhelming source of biodiversity as well as chemical diversity. Marine cyanobacteria and algae are ubiquitous and alleged to be a treasure trove of unique chemistries and a cradle for novel natural products. Here we describe an approach that utilizes mass spectrometry based tools to explore the diversity, distribution and ultimately the discovery of natural products from a large-scale collection of marine cyanobacterial and algal environmental samples. Our results point out three key findings: 1) Comparative metabolomics analysis demonstrates the potential of marine cyanobacteria and algae as a unique source of natural products. 2) Molecular spatial mapping shows that specific geographical region present distinct chemistries and are suggested as chemodiversity "hotspots" for mining of new structures. 3) The rapid discovery of uncharacterized molecules highlights the application of molecular networking via the GNPS interface as a bioprospecting platform. This study sets the stage for an integrated approach through the creation of chemical inventory maps and the discovery of natural products, and resulted in the isolation of the new cyclic lipopeptide yuvalamide A as an example of this new approach.

Unique chloroplast-mitochondria crosstalk in marine diatoms

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The reasons underlying diatom dominance in aquatic environments are poorly understood, although it is believed that they have acquired unique and effective mechanisms enabling them to cope with changes in environmental conditions. To identify and study the function and ecological significance of these mechanisms, we aim to explore diatom stress response mechanisms, excess energy dissipation mechanisms, and the cellular mechanisms allowing them to sense and respond appropriately to changing conditions. As these processes involve a range of cellular compartments, studying their regulation and activity in diatoms may be of special interest. As a case in point we are studying the mitochondrial alternative oxidase (AOX) in *Phaeodactylum tricorutum*. We show that AOX plays a significant role in dissipating excess photosynthetic energy and controlling photosynthetic activity in the chloroplast. Data generated from wild-type and a variety of AOX mutants showed significant changes in the expression of many chloroplast targeted genes, in chloroplast redox status and other chloroplast related phenotypes, supporting the unique and strong coupling between the two organelles. Analysis of diatom AOX sequences has revealed a unique EF-hand domain, suggesting a role for calcium signaling in AOX regulation. The mechanisms controlling chloroplast-mitochondria crosstalk at the cellular level, as well as in marine ecosystems, will be discussed.

Establishing a monitoring Glider program for the investigation of watermass dynamics in the South-Eastern Mediterranean.

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The south-eastern Levantine basin encompasses a variety of mesoscale and submesoscale phenomena such as the north bound jet stream along the eastern continental shelf break, the quasi-permanent Shikmona eddy, coastal water filaments penetrating to deep waters and more. The Generation of the Shikmona eddy, from the meandering jet stream, was recently observed in the summer of 2009 (Gertman et al., 2010) and accentuated the temporal and spatial variability of these structures. Moreover, current studies have shown the thermohaline (and nutrient) dynamics of the region to be multifaceted and interrelated with the Southern Adriatic and North Ionian Seas. Data from Haifa Section Cruises (2002-2014) presented decadal variations in temperature and salinity in the Levantine Intermediate Water mass core which were generally in opposite phase with nutrient levels and integrated chlorophyll variations (Ozer et al. 2016). However the available cruises data allow analysis of variations on inter-annual time scale only and is not sufficient to resolve synoptical, short-term processes which take place in shallower water masses (Levantine Surface Water and Modified Atlantic Water). Under a joint Glider project, the first of its kind in Israeli waters, we have obtained 3 SeaExplorer gliders of ALSEAMAR with a variety of sensors. This new addition of observational capabilities enables high frequency gliders monitoring program with the aims of investigating meso and submesoscale coherent structures development on the Israeli shelf and the enhancement of observations along the historic Haifa Section.

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Bioinvasions shift reef ecosystem processes and functions

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Extensive biodiversity changes may lead to profound alterations in the functioning of ecological communities, yet knowledge of these changes, especially in the marine environment, is still rudimentary. Levant shallow Mediterranean reef communities have been drastically transformed in the past several decades due to loss of native and gain of alien species, of which, some have become invasive. On these reefs, we characterised three distinctive shallow reef communities by their dominating macroalgal forms: 1) Native Canopy (NC), small meadows of native canopy-forming algae (e.g. *Cystoseira spinosa*) that form during winter and spring, and are considered to be the closest to a pristine Mediterranean reef community; 2) Turf Barren (TB), extensive, perennial, turf barrens overgrazed by invasive rabbitfishes (*Siganus rivulatus* and *S. luridus*); and 3) Invasive Frondose (IF), perennial macroalgal patches dominated by tropical invaders (mainly *Galaxaura rugosa*). Using *in-situ* benthic incubation experiments, followed by biomass analysis, we measured what functions (production, regulation and habitat) have been lost in the transformation from NC to TB, whether some of these functions have been regained within the alien-dominated communities (IF), and their relation to community structure and biodiversity. We found that species diversity declined significantly in the transformation from NC to TB community but was regained in IF. Most measured functions followed the same trend. No correlations between functioning and diversity were found, implying that diversity poorly predicts community functioning. Moreover, carbon sequestration compared to NC was lower in TB and IF by seven- and four-fold, respectively. The sequestration form also shifted, from mainly organic carbon in NC to mainly inorganic carbon (i.e. CaCO₃) in TB and IF, indicating a shift in processes from primary production to calcification - an energetically expensive process that reduces environmental pH. These changes may have considerable ramifications for ecosystem services considering climate change (warming and acidification).

Proteomic profiling of the infectious Myxozoan polar capsules

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Until recently, the phylum Cnidaria comprised some 10,000 species of free-living corals, anemones, hydras and jellyfish. However, recent genomic data has led to the inclusion of ~2,200 parasitic Myxozoa species into the phylum as a sister group to Medusozoa. Myxozoans are obligate endoparasites whose life cycles involve spore-mediated transmission between vertebrate (mostly fish) and invertebrate (mostly worm) hosts. Myxozoans cause a devastating impact on both natural and farmed fish stocks. One of the most infectious species is *Ceratonova shasta* that infects fish from the salmonid family, causing necrosis and death. The initiation of the myxozoan infection process is triggered by the activation of polar capsules, specialized organelles akin to nematocysts, the defining organelle of free-living cnidarians. Therefore, to understand the initial steps of the infection process, we studied the polar capsule protein composition. However, each spore contained only a pair of 2-micrometer long polar capsules, posing a challenge for standard biochemical methods. For purification of intact polar capsules, we utilized a novel methodology for bio particle manipulation termed dielectrophoresis (DEP). Using a tailored design of DEP-microfluidic platform, a continuous high-yield purification of intact polar capsules was achieved for the first time. Proteomic analysis revealed that *C. shasta* polar capsules share known protein families with nematocysts of free-living cnidarians, although their main role is in anchoring the spore to the host and not injection. Intriguingly, a subset of unique proteins was found, possibly representing the adaptation of polar capsules to parasitic life. Our findings shed new light on nematocyst to polar capsule evolution in Cnidaria and may promote novel control strategies against myxozoan infection.

Reproductive strategies of the coral *Turbinaria reniformis* in the northern Gulf of Eilat, Red Sea

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The reproductive biology of the scleractinian coral *Turbinaria reniformis* in the northern Gulf of Aqaba/Eilat (Eilat and Aqaba) is described here in detail for the first time. The possibility of sex change was also investigated in individually tagged colonies followed over 12 years. *T. reniformis* was found to be a stable gonochorist (no observed sex change) that reproduces by broadcast spawning in June and July. Breeding occurs in summer along with the majority of coral species in Eilat, however it appears temporally isolated by lunar age or month from the breeding periods of most other abundant species. The relatively long reproductive cycle of *T. reniformis* compared to hermaphroditic corals may be due to the high reproductive effort of gonochoristic females associated with the production of eggs. Early stages of gametogenesis develop during cooling water temperatures, while rising temperatures may facilitate necessary physiological requirements for final gamete maturation. Spawning prior to the annual peak water temperatures may allow an escape from thermal stress early in life. During three years of observations, spawning appeared highly synchronized between individuals in the lab and in the field and commenced 5-6 days after the full moon. Sex ratio of *T. reniformis* populations in both Aqaba and Eilat deviated significantly from a 1:1 ratio. Significantly larger numbers of males than that of females in populations at both localities may provide a compensation for sperm limitation due to high dilution in the water column. We posit that such sex allocation would allow adaptation within gonochoristic species by increasing successful fertilizations in low density populations, a phenomenon that is possibly regulated by a system of chemical communication.

Illuminating an East-Mediterranean mesophotic sponge ground community and the regional sponge fauna

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Sponge species are a diverse and abundant globally in all aquatic, mostly hard-bottom, habitats. However, data regarding East-Mediterranean sponge communities are scarce, outdated, and limited to shallow water. The research aimed to expand the knowledge of the sponge fauna at different habitats along the Israeli Mediterranean. We studied shallow, and the newly-discovered mesophotic sponge ground growing on submerged sandstone ridges at 100m, explored here using a remotely-operated vehicle (ROV). In this mesophotic ecosystem sponges create complex 3D structures that attract invertebrates and fish, serving as environmental engineers. Over 100 sponge species were recorded from Israel, with above a third from mesophotic depth. The updated species list supports the hypothesis that the Levantine sponge diversity is less species-poor compared to other Mediterranean parts, than has previously been considered, but reflects the scarcity of Levant benthos research. The quantitative survey demonstrates that these sponge grounds maintain a rich and diverse community (estimated over 60 species), and high sponge coverage (over a third). For several of the mesophotic species it is their first record from Israel, while others might be novel species. Moreover, mesophotic communities might act as refugia for some sponges and other invertebrates and fish. Two such sponges that once occupied shallow habitats are now found only in the mesophotic habitat, where they are common. Consequently, exploring the mesophotic habitat revealed the necessity for protecting such diverse ecosystem. Although the mesophotic sponge grounds are currently under less stress than the shallow communities, they might be facing threats from anthropogenic activities including gas drilling and fishing close to these habitats. The Barcelona Convention for Protecting the Mediterranean Sea (1995) calls to create marine protected areas to safeguard, sensitive benthic habitats. It is argued that the mesophotic sponge grounds described here should be regarded an endangered habitat that therefore must be protected.

Underwater Multi-Platform Visual Observation Paths

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Descattering aims to overcome underwater visual degradations. Prior descattering attempts use either image post-processing, sophisticated single-platform cameras and lighting, or both. The work we present here explores two new and different degrees of freedom (see figure below): (1) varying the camera pose, in a path designed for optimal descattering and efficient coverage; (2) distributing the camera(s) and light source(s) to disconnected platforms that maneuver separately, yet cooperate. The camera must anyway vary its pose, to survey large and/or complex scenes, particularly as visibility worsens. It makes sense to optimize the camera path, such that scene information is extracted most effectively, despite wide breadth and visibility problems. Furthermore, deep underwater, man-made lighting must be brought-in. We thus also optimize the path of the light source. Actually, both camera and lighting poses affect the visibility. Hence it is desirable that all platform paths would be jointly optimized. Optimization of the coupled paths is based on an 'information gain' criterion. Operational optimal cooperation between multiple platforms is a high dimensional task, difficult for human operators. Hence we envision the method affecting future autonomous underwater vehicles (AUVs), in a broad range of applications of underwater optical imaging. Such applications include: oceanic engineering tasks, such as inspection of man-made structures (naval ship hulls, oil infrastructure, nuclear reactors etc.), geological and archaeological surveying, as well as biological surveys (monitoring coral-reef damage).

The signaling role of the algal dimethyl sulfide-releasing enzyme during predator-prey interactions

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Microzooplankton grazers occupy a key position in marine food webs as major consumers of phytoplankton biomass. Hence, unveiling the chemical signaling at the base of phytoplankton-microzooplankton interactions is critical to further our understanding of the mechanisms driving phytoplankton turnover in the oceans. The infochemical dimethyl sulfide (DMS) is a volatile released by phytoplankton in massive amounts and mediates trophic interactions across marine food webs. Coccolithophores (but not diatoms) possess the enzyme DMSP lyase enzyme *Alma1*, which converts dimethylsulfoniopropionate (DMSP) to DMS. The release of DMS from algal cells is enhanced during grazing by microzooplankton. Yet the role of DMS as a grazer- chemoattractant or repellent is still controversial. We explore this question by manipulation of the *Alma1* activity in prey cells and quantification of the impact on grazing efficiency. We showed that transgenic diatom (*Thalassiosira pseudonana*) cells, overexpressing the *Alma1* gene, were preferentially grazed over wild-type cells by the dinoflagellate *Oxyrrhis marina*. Moreover, we applied a novel inhibitor designed specifically to inhibit *Alma1* and reduce DMS production. In the presence of the inhibitor, grazing rate by *O. marina* on of the high DMS- producing coccolithophorid *Emiliana huxleyi* was significantly declined. Overall, our preliminary results indicate that DMS exudation from algal cells enhances herbivory by *O. marina*. We aim to expand our lab-based findings and examine the ecological role of DMS production by *Alma1* during natural predator-prey interactions in the Red Sea. Future work will help expanding our current understanding of the chemical language mediates microbial food-web interactions in the marine environment.

Detection of viral infections by gene expression in a North Atlantic algal bloom

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The cosmopolitan coccolithophore *Emiliana huxleyi* is a unicellular eukaryotic alga, responsible for vast blooms in the ocean and have immense impact on large biogeochemical cycles. These blooms are often terminated by infection of a specific large dsDNA *E. huxleyi* virus (EhV, Phycodnaviridae). Despite the huge ecological importance of these host-virus interactions, the ability to assess their spatial and temporal dynamics is limited by current approaches that focus on viral abundance and diversity. Here we used gene expression analysis as a sensitive tool to quantify the dynamics of host-virus interactions during natural bloom succession in the North Atlantic. Principle component analysis (PCA) conducted on expression levels of viral genes were used as an index for the level of active infection. This new infection index was highly correlated with expression of host metabolic genes known to mediate EhV infection of *E. huxleyi* cultures. Using this viral infection index (viral PC1) increased the spatial resolution of EhV detection during active infection of *E. huxleyi* bloom in the North Atlantic. We propose to use a combination of viral PC1 and viral DNA abundance to provide a novel proxy for the detection of infection phase during host-virus interactions in the ocean.

Mesophotic octocorals in Eilat (Gulf of Aqaba) feature high species richness compared to the shallower reef zones

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Mesophotic coral-reef ecosystems (MCEs), which comprise the light-dependent communities of corals and other organisms found at depths between 30 to ~ 150 m, have received very little study to date. However, current technological advances, such as remotely-operated vehicles and closed-circuit rebreather diving, now enable their thorough investigation. Following the reef-building stony corals, octocorals are the second most common benthic component on many shallow reefs and a major component in deep reefs, the Red Sea included. This study is the first to engage with octocoral community features in the MCEs based on species-level identification, and to compare them with the shallower reef zones. The study was carried out at Eilat (Gulf of Aqaba, northern Red Sea), using belt-transects at two MCE sites (30-45 m), in the reef flat and upper fore-reef zone. A total of 30 octocoral species were identified, with higher species richness being found in the MCEs compared to the shallower reefs. Although the MCEs were found to host a higher number of species than the shallower reefs, both featured a similar diversity. Each reef zone revealed a unique octocoral species composition and distinct community structure, with only 16% of the species shared by both the MCEs and the shallower reefs. This study has revealed an almost exclusive dominance of zooxanthellate species at the studied MCE reefs, thus indicating the existence of an adequate light regime for photosynthesis to occur there. The findings should encourage similar studies on other reefs, aimed at understanding the spatio-temporal features and ecological role of octocorals in reef ecosystems down to the deepest limit of the MCEs.

The spectral and spatial distribution of light pollution in the waters of the northern gulf of Aqaba (Eilat)

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One of the most dramatic changes stemming from the growth in human population and the availability of electricity is the global spread of nighttime illumination. The potential damages of that phenomenon are indicated in the very term "light pollution" or "ecological light pollution". In similarly, the urbanization of the shores of the Gulf of Aqaba, including both the Jordanian city of Aqaba and the Israeli city of Eilat, has exposed the marine domain in the gulf to strong anthropogenic light sources. This domain includes a unique fringing coral reef within a few meters from shore. We present here for the first time spectral and spatial measurements of the light field from artificial light sources at night in the waters of the Gulf of Aqaba, including its bathymetric distribution. We analyze this light field with respect to the proximity of the measurement stations to the main artificial light sources and with respect to the phases of the moon. From our *in situ* measurements, which was conduct by using a sensitive light meter (PRR-800; Biospherical Instruments Inc., San Diego), we have found that nighttime illumination in the Gulf of Aqaba is dominated by the spectral characteristics of low pressure sodium vapor lights. However, we found that the 589-nm sodium vapor light signature at the surface becomes secondary to the irradiance of blue (443 nm) light from a depth of ~7 m; we found that this wavelength light is the most penetrating wavelength in the waters of the gulf. This spectral-spatial database will enable scientists to determine the effects of light pollution on biological processes as diverse as the tuning of circadian clocks, the synchronization of coral spawning, vertical migration of demersal plankton, feeding patterns, and prey/predator visual interactions, and thereby inform the design of lighting systems in proximity to shorelines in the future.

Selective responses of benthic foraminifera to thermal pollution

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Predictions of future climate and recent observations point towards a trend of rising temperatures in the Middle East region. The temperature rise propagates into the marine environment, with shallow, coastal ecosystems being most affected. An ideal model system to study the effect of increased temperatures in coastal ecosystems is presented by benthic foraminifera. The persistence of thermohaline pollution at a site along the northern coast of Israel, attributed to a power and desalination plant, is used as a natural laboratory to evaluate the effects of rising temperature and salinity on benthic foraminifera living in shallow hard bottom habitats. Biomonitoring of the disturbed area and a control station shows that elevated temperature is a more significant stressor than salinity. The deleterious effect of extreme temperatures is indicated by decrease in numerical abundances and reduced species richness, eventually leading to substantial changes in community composition. Critical temperature thresholds were observed at 30°C and 35°C, the latter observed by the most thermally tolerant species *Pararotalia calcariformata*, the only symbiont bearing species observed within the heated area. Common species of the shallow hard bottom habitats are almost absent from the most extreme site indicating that they presently live very close to their upper temperature threshold, and that excess warming will likely impede their future survival in the Eastern Mediterranean. Several of these species are either proven or suspected to be tropical Lessepsian. Thus, considering present models of expected north-western future expansion of Lessepsian species in the Mediterranean, our study shows that it is important to consider excess warming as a major stressor that will limit their distribution.

Effect of water temperature on Mediterranean fish size

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Cold blooded organisms often attain a smaller body size when reared at a higher temperature. This phenomenon, known as the 'temperature size rule', has important consequences for global fisheries, whereby ocean warming is predicted to result in smaller fish and reduced biomass. To date, however, it is unclear whether temperature dependent size reduction is indeed visible in natural fish populations and whether all species are similarly affected. In this study we collected data from over 340 publications describing size distribution of Mediterranean fish. We obtained data on 74 fish species along a steep temperature gradient. Using mixed effect model and meta-analysis techniques we tested if water temperature is indeed a predictor of maximal size. We then tested whether species traits, such as activity level and size, shape the extent of species' responses to temperature. We show that, in general, fish indeed reach smaller sizes in warmer areas – on the average, fish will lose 5% of their maximal size with each 1^o C temperature increase. Moreover, we found, for the first time, that active fish species show a greater reduction in size compared to sedentary species. Active species reduce their maximal size by nearly 10% per 1^o C. Our results support the hypothesis that fish, in the wild, are likely to respond to warming conditions with a substantial reduction in size. Activity and size-dependent effects of temperature on species' maximal size, suggest that climate change will affect local fish communities by altering those interactions between species that are often based on body size. Our results contribute to the understanding of temperature effect on size and inter-species variation in response to temperature. Moreover, we provide results which are highly valuable for predicting future effects of global warming on Mediterranean and worldwide fisheries.

Diurnal redox patterning and susceptibility to oxidative stress in a bloom-forming diatom

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One of the key phytoplankton group in the ocean is the diatoms, often responsible for vast oceanic blooms and play significant part in global primary production. We aim to provide a molecular basis for diatoms acclimation to ever changing environment and to discover the sensing and signaling mechanisms mediating this ability. In order to shed light on the involvement of redox signals in diatom acclimation to light-dark transition and its interplay with environmental stresses and cell fate regulation, we generated transgenic diatoms expressing the redox sensitive GFP targeted to the chloroplast and nucleus of the ecologically significant diatom *Thalassiosira pseudonana*. We detected organelle specific redox patterns in response to oxidative stress, indicating compartmental antioxidant capacities. Monitoring the chloroplast redox state in high resolution over diurnal cycles revealed two phenomena: the first, a reduction in the GSH redox potential (E_{GSH}) towards the end of the light phase, suggesting anticipatory phase to darkness. The second finding was a rapid re-oxidation upon illumination, suggesting a light-dependent oxidative signal. These observations were strongly correlated with differential sensitivity to oxidative stress and induction of cell death upon light-dark transitions. We found specific sensitivity of the chloroplast E_{GSH} to oxidative stress during the dark phase which can be alleviated by illumination or by application of reduced glutathione. Thus, indicated involvement of photosynthesis and redox equivalents generation regulates antioxidant pools and stress response. Importantly, nucleus E_{GSH} was insensitive to light-dark transitions and kept constant throughout the day. We propose that chloroplast redox signals coordinates metabolism, antioxidant enzymes and protein redox modifications during these transitions. Deepening our understanding of the molecular components mediating the light-dependent redox signals and response to environmental stress could provide novel insights of cell fate regulation and its impact on oceanic bloom successions.

Microbial sulfate reduction and authigenic precipitation of carbonate minerals in the sediments of the Eastern Mediterranean

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In marine sediments, microbial sulfate reduction by anaerobic oxidation of methane (S-AOM) and by organic compounds (organoclastic sulfate reduction, OSR) creates a suit of chemical conditions, which promote the authigenic (chemical) precipitation of carbonate minerals from the pore water. Globally, this authigenic carbonate precipitation constitutes a significant sink for calcium and carbon, and therefore, plays an important role in their geochemical cycles. Nevertheless, the mechanistic understanding of authigenic carbonate precipitation is impeded by the difficulty involved in determining the specific rates of S-AOM and OSR. This difficulty stems from the fact that both processes consume and release either similar chemical constituents, or constituents that are hard to measure accurately. We show that the specific rates of S-AOM and OSR can be calculated using the pore water profiles of the dissolved inorganic carbon (DIC) concentrations, alkalinity, Ca^{2+} and Mg^{2+} . We demonstrate this calculation in pore water profiles collected from the Eastern Mediterranean continental shelf, and verify the accuracy of our obtained S-AOM and OSR rates by comparison to the reaction rates calculated from the dissolved sulfate profile, which was measured independently from the above mentioned variables. Our results show that OSR is responsible for most of the sulfate consumption in those pore water profiles, but S-AOM makes a larger contribution to authigenic carbonate precipitation. In addition, we use the calculated S-AOM and OSR rates to study the effects of carbonate precipitation and exchange of carbon isotopes (^{13}C and ^{12}C) between the solid carbonates and the DIC on the isotopic composition of the DIC and the solid carbonate minerals in the sediment.

Resistance of Marine Cyanobacteria to Generalist Cyanophages is often Intracellular

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Cyanobacteria of the genera *Synechococcus* and *Prochlorococcus* and the viruses that infect them are abundant in the marine environment. Coexistence between them is thought to be facilitated by the presence of both resistant and susceptible cells. While extracellular resistance by alterations in receptors is established, known intracellular defense mechanisms are lacking in these cyanobacteria. In order to investigate whether intracellular resistance exists in *Prochlorococcus* and *Synechococcus* we sought to identify infections that are halted inside the cell. We found that generalist T4-like cyanophages tend to adsorb to resistant hosts more often than specialist phages. We next tested DNA expression and replication of generalist and specialist phages inside resistant strains. This revealed that viral RNA of generalists and specialists was expressed. In addition, we often observed replication of viral genome in these infections. These data indicate that resistance to broad-host-range phages is often conferred inside the cell and may be due to novel intracellular mechanisms of defense.

Analyzing Distribution of Coral Recruits using Fluorescence Imaging

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Coral recruitment is a fundamental process that influences coral population dynamics as well as reef community structure. Formation of new juvenile colonies is essential for recovery and indicates good conditions for development and growth of coral reefs. To date, coral recruitment success rates are poorly described; therefore developing an effective survey method for coral recruits distribution analysis is essential. Due to the fact that corals and their symbiotic algae both contain fluorescence pigments, (chlorophyll-a and fluorescent proteins), we used the FluorIS- Fluorescence Imaging System, to develop a non-invasive method to identify coral recruits *in situ* during daytime. In this study we tested the efficiency and accuracy of this method by monitoring twenty random quadrats for eight months. Our results show that this low cost, easy to use method, reduces errors in identification formed by other fluorescent organisms (e.g. algae, sponges and worms) and/or surveyor errors. Using this time series we positively identified coral recruits as small as 0.2 cm in diameter and were able to record their settlement, growth and mortality. World's coral reefs are declining and at risk of collapse as a result of local and global stressors. We believe that our new methodology will help researchers understand the physiology and survival of coral recruits, and improve future predictions of their ability to resist, respond and recover under stress.

אפיון אוכלוסיית דגי טונה כחולת סנפיר במזרח הים התיכון

טל אלמליח, אביעד שיינין ודני צ'רנוב

החוג לביולוגיה ימית, בית הספר למדעי הים על שם לאון צ'רני, אוניברסיטת חיפה

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הטונה כחולת הסנפיר הוא מין בעל חשיבות אקולוגית, סביבתית וכלכלית רבת עוצמה, סיבות אלו הובילו אותו להיות אחד המינים הנחקרים ביותר בסביבה הימית. נושאים כמו הנדידה העונתית, אזורי רבייה, האנטומיה והפיזיולוגיה המיוחדת של דג זה וכמובן דיג היתר של המין, מהווים את עיקר העניין והמחקר שמעוררת הטונה כחולת הסנפיר.

כטורף על, לטונה השפעה מכרעת על שאר הרמות הטרופיות הקיימות ועל בריאותה ויציבותה של המערכת שנמצאת תחת סכנות ואיומים רבים.

על אף המחקר הענף בתחומים השונים, המידע אודות דג הטונה באזור דרום מזרח הים התיכון (חופי ישראל ושטחה הכלכלי הימי) דל מאד. קיים חוסר משמעותי במיוחד במחקר ארוך טווח או בתוכנית ניטור ארוכת טווח על מין זה באזורנו.

המחקר יהווה תשתית ראשונית אשר תספק מידע עדכני, חדש וארוך טווח אודות האוכלוסייה החולפת באזור חופי ישראל ויתמקד בשתי מטרות עיקריות:

בחינת מיקום הטונה כחולת הסנפיר באזורינו במארג המזון (רמה טרופית), מקורות המזון שלה והרכבה הגנטי של האוכלוסייה.

במהלך הקיץ האחרון, בתקופה בה אוכלוסייה זו חולפת באזור חופי ישראל, ביצענו עבודת דיגום במהלכה התלוונו לדייגים מקומיים, מקצועיים וחובבים, שעוסקים בדיג טונה כחולת סנפיר, ביצענו מדידות כלליות ואספנו רקמות ודוגמאות אשר משמשים אותנו לאחר מכן במעבדה לביצוע מספר אנליזות. השיטות השונות אשר משמשים אותנו במחקר יהיו:

- גנטיקה והרכב אוכלוסייה: רצפים ספציפיים מגנים מיטוכונדריאליים ונוקלאריים (CO1,ITS1) מוגברים בעזרת פריימרים מתאימים (FishF2,FishR2) לזיהוי האוכלוסיות השונות של הטונה כחולת הסנפיר.

- תזונה: בעזרת בדיקות של תכולת הקיבה נעשית הערכה להרגלי התזונה של הדג.

- זיהוי רמה טרופית ומקורות מזון: יעשה על בסיס איזוטופים יציבים של חומצות אמינו מרקמת הדג על ידי שימוש במכשיר ה-GCMS-IRMS.

המחקר בתחילת דרכו ונמצא כעת בשלב ראשוני של ניתוח הדוגמאות שנאספו בעונת הדיגום האחרונה.

מגמות רב-שנתיות בהרכב המיקרופלנקטון לאורך רצועת החוף של ישראל

נורית גורדון, איל רהב, ברק חרות

חקר ימים ואגמים לישראל, ngordon@ocean.org.il

אוכלוסיית הפיטופלנקטון בהיותה רגישה לשינויים בעומס נוטריאנטים ולזיהומים בכלל, יכולה לשמש כביו-אינדיקטור רגיש לשינויים המתחוללים במערכת האקולוגית הימית. כחלק מתוכנית הניטור הלאומית בים התיכון, מתקיים מעקב רב שנתי אחר ריכוז והרכב אוכלוסיית הפיטופלנקטון לאורך חוף הים התיכון של ישראל (2002-2015), כמו גם מדידות של יצרנות ראשונית (2013-2015). דגימות מי שטח נאספו ב-14 תחנות לאורך החוף, כולל מפרץ חיפה ושפך נחל הקישון. נמצאה מגמה רב-שנתית בביומסת מיקרופלנקטון וריכוז הכלורופיל שהיו גדולים באופן מובהק במים הרדודים (עומק קרקעית 10 מ') יחסית למים העמוקים (עומק קרקעית 30 מ') לאורך החוף. כמו כן, בתחנות הדיגום הדרומיות (אשקלון-ת"א), ביומסת מיני המיקרופיטופלנקטון וריכוזי הכלורופיל היו גבוהים משמעותית (הן במים הרדודים והן בעמוקים) יחסית לחלקו הצפוני של החוף (אלכסנדר-דדו). באופן דומה, נמדדה מגמת עלייה בביומסת מיקרופיטופלנקטון במפרץ חיפה לכיוון שפך נחל הקישון. מגמות אלה היו בהתאמה לקצבי היצרנות הראשונית שהיו גבוהים משמעותית בתחנות הדיגום הדרומיות מאשר בצפוניות. בחינה טקסונומית של מיני המיקרופיטופלנקטון מראה כי הבקטריות הכחוליות היו דומיננטיות מספרית (בממוצע 93% מריכוז התאים הכללי) ומבחינת ביומסה (בממוצע $48\% \pm 9$ הביומסה הכללית) לאורך החוף. בשפך נחל הקישון, שיעור הכחוליות היה נמוך יותר, כ- 53% מהריכוז הכללי וכ- 14% מהביומסה הכללית. ביומסת הדינופלגלטים והצורניות הייתה גדולה במים הרדודים יחסית למים העמוקים לאורך החוף, כמו גם באזור מפרץ חיפה. במפרץ חיפה מגוון המינים הקטן ביותר נמצא בפתח נחל הקישון, ובאינדקס השונות נראתה מגמת ירידה מהים הפתוח לכיוון שפך הקישון. לאורך החוף מספר המינים הממוצע במים הרדודים גבוה באופן מובהק מזה שבמים העמוקים, אולם ממוצע אינדקס השונות גדול יותר במים העמוקים. מינים בעלי פוטנציאל טוקסי נמצאו תדיר, אולם מספרם היה נמוך על פי רוב, למעט בשפך הקישון בו נמצאו ריכוזים גדולים יותר. ממצאי הניטור מעידים על נוכחות מינים טוקסיים עם פוטנציאל לפריחה באזור שפך נחל הקישון, העשרה של יצרנים ראשוניים במים הרדודים, והעשרה של הביומסה באזור הדרומי (אשקלון-ת"א) ביחס לאזור הצפוני של חוף הים התיכון של ישראל.

שונית אילת – מקור או מבלע ל-DMS ו-DMS?

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ה-DMS ותוצר הפירוק שלה DMS אלו מולקולות גפרתיות הנוצרות בים בעיקר על ידי פיטופלנקטון. פירוק ה-DMS נעשה על ידי דה-מטילציה לטובת יצירת חומצות אמינו ובניית חלבונים, או בחלוקה, שאחד מתוצריה הוא DMS. מולקולות אלה הן בעלות חשיבות גדולה במעגל הגפרית. ה-DMS היא מולקולה נדיפה אשר מעבירה את הגפרית מהים לאטמוספירה ומשם ליבשה. ה-DMS וה-DMS משמשות באצות כאוסמורגולטור ואנטי-אוקסידנט. פרט לאלו קיימים גם היבטים חוץ תאיים כגון דוחה-טריפה, מושך-טריפה, אינפוכמיקל ואף כמוסת שינויי מזג אוויר. היפותזת CLAW מאבחנת את ה-DMS כמולקולה אשר מתנדפת מהים לאטמוספירה, שם היא מתחמצנת ועוזרת בגיבוש גרעיני עננות. העננים מעלים את האלבדו של כדור הארץ ומחזירים את קרני השמש לחלל, מה שמוריד את הטמפרטורה. מחקרים בשונית המחסום הגדולה הראו ריכוזים גבוהים של מולקולות אלו במי השונית. אלמוג האקרופורה מאובחן כיצרך גדול של מולקולות אלו, המשחרר ריכוזים גדולים למי השונית. מטרת המחקר שלי היא לבחון את גרדיאנט הריכוזים של DMS ו-DMS בסביבתם של אלמוגים בודדים, כגון אקרופורה, לאיזה מרחק מגיעים הריכוזים מהאלמוג עצמו ובהתאם לכך אלו אורגניזמים מושפעים מכך. מטרה נוספת היא לבדוק האם שונית אילת מהווה מקור או מבלע למולקולות אלה. לצורך כך נאספו מים במרחקים שונים מאלמוגים שונים. בנוסף נאספו מים בלגונת השונית, בה קיים זמן שהות של מים למספר שעות ועל כן היא מהווה מצבור סיגנל לתהליכים המתרחשים בשונית, ובים הפתוח – ממנו מגיעים המים ללגונה. המדידות נערכו בעזרת GC (Gas Chromatograph). נמצא כי אלמוג האקרופורה משחרר ריכוזים גדולים של DMS ו-DMS למי הים, אך גרדיאנט הריכוזים מגיע למרחק של סנטימטרים בודדים מהמושבה ולכן יכולת החישה את אותו גרדיאנט מתאפשרת רק למיקרואורגניזמים החיים בסביבת האלמוג. אלמוגים אחרים לא הראו גרדיאנט ריכוזים כלל. בלגונה נמצא כי קיימת העשרה של DMS לעומת הים הפתוח, זאת בעיקר עקב שטף היוצא מסדימנט הלגונה, לעומת זאת נמצא כי יש גריעה של DMS בלגונה לעומת הים הפתוח, זאת בעקבות טריפת אצות המכילות DMS, ממצא זה עומד בניגוד למתרחש בשונית המחסום הגדולה.

מוקד SeaWatch – טיפול במפגעים ימיים בסיוע ניטור אזרחי

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SeaWatch הוא מוקד לטיפול בדיווחי ציבור אודות מפגעים בים התיכון, החותר לייעל ולהעצים את אכיפת החוק ומניעת מפגעים בים התיכון, על ידי הגברת מודעות הציבור ומקבלי ההחלטות לאתגרי השימור בים והעברת תלונות על מפגעים בזמן אמת אל גורמי האכיפה. המוקד פועל בשיטת community based conservation – ניטור אזרחי של מפגעים ימיים ודיווחם באופן מושכל באמצעות אפליקציה סלולרית. גורמי האכיפה נרתמו לפעילות ויחד פיתחנו נוהל לקבלת דיווחים מהמוקד והמשך התהליך לאכיפת העברות. הדיווחים מתקבלים באופן מיידי על ידי הרשויות הרלוונטיות ב SMS ומייל הכולל את כל פרטי המפגע. באמצעות האפליקציה ניתן לדווח על מפגעים ימיים: דיג לא חוקי, דיג בשמורת טבע, דיג מינים מוגנים, צב או יונק ימי פצוע, רשת רפאים, פסולת ימית, זיהום ים, ומין פולש. כל דיווח המגיע למערכת מאומת ומוערך לפי רמת הדיוק והפירוט של הדיווח ואימות העבירה המדווחת. דיווחי האמת נאגרים במסד נתונים. איכות כל דיווח נמדדת במספר קריטריונים: דיוק, דיווח בקטגוריה נכונה (משמע דיווח שנשלח לצוות התגובה הנכון), דיווח בזמן אמת ועם תמונה מתעדת. מדי שלושה חודשים אנו מפרסמים דוח ובו בסיס נתונים על עבירות בים המאפיין דפוסי עבירות (עונות, שעות, אזורים, אנשים וכו'), על מנת להכווין ולתעדף את מאמצי האכיפה ולייצר לחץ על מקבלי ההחלטות. לדוגמא, השנה הוגבל לראשונה הדיג במהלך עונת הרבייה. יותר ממאה דיווחים על דיג לא חוקי אשר הגיעו אל המוקד, שיקפו את המצב בשטח והעידו על חוסר יישום של המגבלות עליהן החליט המשרד. ממצאים אלו הגיעו לדרגים הבחירים ביותר של מקבלי ההחלטות הרלוונטיים ולאמצעי התקשורת והניעו את חקירת הנושא לעומקו. מאז השקתה בראשית חודש אוקטובר 2105 הורידו את האפליקציה 5000 איש ונשלחו יותר כ- 400 דיווחים. שיתוף הפעולה בין המוקד לרשויות התפעול מוכיח את עצמו ונרשמו מספר הצלחות כגון פתיחה בחקירות עקב דיווחים והסרת רשתות רפאים. הצלחה נוספת חשובה של המוקד (העולה ממשוברים ומדיה חברתית), היא התחושה שיש כתובת לדיווחים על מפגעים ימיים ושהשיתוף בין הציבור לרשויות מוצלח.

הבנת תהליכי ביומינרליזציה בקפודי ים בעזרת צבענים פלואורסצנטיים.

מתן יונה¹, יונתן ארז¹ ומוקי שפיגל²

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קיפודי הים "Echinoderms" נפוצים מאזורים משוונים עד לקטבים ונחשבים למשקיעי גיר (CaCO_3) עיקריים באוקיאנוס. הקבוצה מאופיינת בחלל צלום (coelom cavity), המכיל את המעי והאיברים הפנימיים והוא מלא בנוזל. שלדם הוא קלציט עשיר מגנזיום שבונה את הלוחיות, הקוצים ומערכת הלעיסה ("פנס אריסטו"). השלד כולו עטוף רקמת אפיתל חיצונית ועל כן הוא נחשב לשלד פנימי שצדו השני עטוף ברקמה נוספת המפרידה בינו לבין נוזל הצלום. תהליך בניית השלד מתחיל ביצירת קלציט אמורפי (ACC) שמתגבש לקלציט עשיר מגנזיום. הדרך שבה מגיעים יוני הקלציום והקרבוונאט אל אתרי השקעת השלד אינה ידועה אך הדעה הרווחת היא שישנה הסעה סלקטיבית של היונים בעזרת משאבות ותעלות. בעבודה זו אנו בוחנים את ההיפותיזה שמי ים מגיעים ישירות אל אתר השקעת השלד. מספר קיפודים גודלו בסמנים פלואורסצנטיים (calcein, FITC-Dex) שאינם חדירי ממברנות והם בעלי גודל מולקולרי רב. מדידות ישירות הראו שהסמנים השונים מגיעים אל חלל הצלום ומשתלבים בתוך השלד. הסימון על לוחיות השלד תואם את דפוס גדילת הלוחיות שתואר בספרות, הסימון ב"פנס אריסטו" הוא החזק ביותר תצפית המתאימה לכך שזה האתר שבו השקעת השלד היא מקסימלית. בניסויי החדרת צבענים אל חלל הצלום וגידול הקיפודים במי ים שאינם מסומנים התקבלו תוצאות סימון זהות ונראה שהסימון בחלקו הפנימי של השלד חזק בהשוואה לחלקו החיצוני. מהשוואת אנליזות כימיות של מי צלום ומי הים בהם גודלו הקיפודים רואים שכימיית שני הנוזלים זהה ביסודות עיקריים, משניים וקורט. ההתצפיות שלנו מעידות על קשר ישיר בין מי הים, חלל הצלום והשלד המושקע ומצביעות על נוכחות של מי ים באתר השקעת השלד.

שינויים מרחביים ועונתיים בתפוצת אוכלוסיות הפיטופלנקטון במפרץ אילת

נועם מזרחי

הפקולטה למדעי החיים, אוניברסיטת בר אילן

מטרת העבודה שלי היא הבנה ומיפוי של הדינאמיקה העונתית של אוכלוסיות האולטרהפיטופלנקטון העיקריות במפרץ אילת על ידי התבוננות בשינויים המרחביים היממתיים (יום ולילה) והעונתיים בעזרת שימוש בתוכנת מיפוי מרחבית (GIS). פיטופלנקטון הם יצורים מיקרוסקופיים פוטוסינטיים אשר נמצאים בשכבה העליונה המוארת של כמעט כל אוקיאנוס או גוף מים מתוקים בעולם והם נחשבים כאבני הבניין הראשונים באוקיאנוסים. מארגי מזון רבים מתבססים עליהם והם מהווים תרומה משמעותית רבה למעגל הפחמן. מפרץ אילת, שמימיו הם מהצלולים ביותר בעולם, מהווה מערכת אקולוגית ייחודית עקב התנאים הפיזיקאליים השוררים בו. השימוש במערכות מידע גיאוגרפיות (GIS) הן דרך ישומית של טכניקות מבוססות מחשב לניהול, מיפוי וניתוח הנתונים בהפנייה גיאוגרפית. השילוב בין דגימות מהשטח ושימוש בתוכנות GIS לצורך מיפוי הוא בעל חשיבות אקולוגית רחבה מאחר והוא מאפשר לנו להסתכל על הפיזור המרחבי של אותן האוכלוסיות עם ההשתנות במרחב עצמו, יהיה ניתן לזהות בצורה זו את מקורות זיהום, כיווני זרימה, פריחת אצות ועוד. מכיוון שמחקר סביבתי מושפע לעיתים קרובות בגלל הקושי שבמדידת המשתנים והפריסה שלהם לאורך הזמן, מערכות מידע גאוגרפיות אלה יכולות לשמש ככלים רבי עוצמה. עד כה בספרות לא תוארו אוכלוסיות הפיטופלנקטון במפרץ אילת מבחינה מרחבית בתנאים שונים של עונות, אירועי אבק, שיטפונות ולילה. דגימות מים נאספו על בסיס חודשי מ-19 תחנות מדידה שונות ברחבי המפרץ ועברו אנליזות. מהתוצאות החודשיות ניתן לראות כי יש הבדלים ושינויים בפיזור המרחבי של האוכלוסיות השונות לאורך השנה, וכיצד שינויים עונתיים כמו עומק הערבול וטמפרטורת המים משפיעים על האוכלוסיות של האולטרפיטופלנקטון עצמן ואיך שינויים זמניים כמו כיוון הרוח והזרם יכולים להסביר את דפוס הפיזור של האוכלוסיות הללו במרחב עצמו. מלבד ההבנה העמוקה של התנהגות אוכלוסיות האולטרהפיטופלנקטון במפרץ יתקבל מסד נתונים חיוני לחוקרים רבים בתחומי מחקר קרובים. המחקר יוכל לשמש פלטפורמה טובה לעבודות מחקר של חישה מרחוק ולאומות נתוני לוויין. מעבר לכך, מבחינה אקולוגית, מחקר זה שואף להגביר את המודעות להשפעות הסביבתיות הטבעיות והאנתרופוגניות על האורגניזמים הימיים באמצעות רגישותם הרבה של הפיטופלנקטון ולמזהמים.

Dicer knockdown in the sea anemone *Nematostella vectensis* reveals bona fide miRNAs and their role in development

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MicroRNAs (miRNAs) are small RNAs that negatively regulate gene expression in animals and plants, and by that play a role in diverse functions including development. To gain a deeper understanding of the evolution of miRNA biogenesis and miRNA-mediated post-transcriptional regulation, particularly during development, we need to look into a wide repertoire of extant species, including non-bilaterian animals. One such group is Cnidaria (corals, sea anemones, hydroids and jellyfish), an ancient lineage that diverged from the rest of Metazoa more than 600 million years ago. Earlier research revealed that the majority of miRNAs in the model cnidarian *Nematostella vectensis* are spatiotemporally regulated, suggesting that miRNAs may play regulatory roles in the development of *Nematostella*. However, annotation of *Nematostella* miRNAs is still lacking when compared to that of major animal and plant models. In order to improve *Nematostella* miRNA annotation we sequenced small RNAs and knocked down Dicer by injecting Morpholino oligonucleotides to embryos. As Dicer is an RNase III enzyme responsible for miRNA biogenesis, its knockdown will reveal bona fide canonical miRNAs and the roles of the miRNA pathway in *Nematostella* development and physiology. Our preliminary results suggest that knockdown of *Nematostella* Dicer inhibits normal development and metamorphosis to primary polyp. This is the first evidence for the involvement of miRNAs in development of a non-bilaterian animal. Overall, this study will provide an annotated set of bona fide miRNAs, which is crucial for further research of miRNA evolution as well as a first glimpse into the developmental roles of miRNAs in Cnidaria.

***Prochlorococcus-Alteromonas* co-cultures: a model for theoretical and experimental investigation of microbial interactions**

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Interactions between marine microbes may determine the dynamics of microbial communities. Understanding such interactions and predicting how they will affect marine ecosystems and biogeochemical cycles requires studying them at different scales and incorporating them into mathematical models and computer simulations. This also requires experimentally-tractable yet ecologically-relevant model systems. Here we present some initial studies of such a model system: *Prochlorococcus* and *Alteromonas*, grown alone and together in laboratory co-cultures. A classic internal stores (Droop) model of *Prochlorococcus* growing in axenic laboratory batch culture requires explicit representation of the release of organic carbon and nitrogen into the surrounding media (an important yet less-studied process) to fit experimental data. Transcriptomic studies of *Prochlorococcus-Alteromonas* co-cultures suggests that some *Prochlorococcus* strains engage in complex chemical signaling via secreted peptides. We are currently exploring the role of these secreted peptides, and working to incorporate the exchange of nutrients, carbon, macromolecules and infochemicals into mathematical models of marine microbial ecosystems. These results also highlight how much we have yet to learn about the mechanisms and molecules underlying microbial interactions.

A pathogenic bacterium switches the fate of algae-derived DMSP in the ocean

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Emiliana huxleyi is a bloom forming coccolithophore that impacts the global sulfur cycle by producing large amounts of dimethylsulfoniopropionate (DMSP) and its volatile metabolic product dimethyl sulfide (DMS). Top-down regulation of *E. huxleyi* blooms is attributed to viruses and grazers, however, the possible involvement of algicidal bacteria in bloom demise is underexplored. We isolated a *Roseobacter* strain, *Sulfitobacter* D7, from a North Atlantic *E. huxleyi* bloom. Co-culturing of *Sulfitobacter* D7 with *E. huxleyi* led to induction of algal cell death along with bacterial proliferation, exhibiting three defined phases of interaction. *Sulfitobacter* D7 consumed algae-derived DMSP and produced high amounts of methanethiol (MeSH), an alternative product of DMSP catabolism. Differential release of dissolved DMSP by *E. huxleyi* strains was highly correlated with *Sulfitobacter* D7 abundance and pathogenicity dynamics during co-culturing. *Sulfitobacter* D7 was highly prevalent during an oceanic *E. huxleyi* bloom and its abundance correlated with dissolved DMSP concentration. We propose that *Roseobacters* have an important role in *E. huxleyi* bloom demise mediated by metabolic requirement for algae-derived DMSP, thereby switching the fate of DMSP away from DMS towards MeSH. The balance between these competing DMSP catabolic pathways, driven by microbial interactions, may regulate oceanic sulfur cycling and feedback to the atmosphere.

What is the space of light attenuation coefficients in underwater imaging?

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Color in underwater photographs is distorted because of wavelength λ and distance z dependent attenuation of light. The wavelength dependency is related to the presence of bio-pigments, and has led to the classification of water types based on their optical properties¹. When an underwater scene is photographed, radiance $R(\lambda)$, which is the product of reflectance $\rho(\lambda)$ and attenuated light $E_d(z, \lambda)$, is reduced to an RGB triplet based on the spectral response of the camera sensor $S_k(\lambda)$, where $k = R, G, B$. Thus the attenuated RGBs in a given color channel is found as: $RGB_k = \int \rho(\lambda)E_d(z, \lambda)S_k(\lambda)d\lambda$. Here, the attenuated light profile is: $E_d(z, \lambda) = E_d(0, \lambda)e^{-K_a z}$. Many practical underwater imaging applications require the recovery of unattenuated RGB values, those that would have been captured under the unattenuated light $E_d(0, \lambda)$ at the surface, but to do so accurately, attenuation coefficients need to be estimated or calibrated in situ², requiring additional hardware³. Here, we study the interaction between water types ranging from clearest to turbid and the spectral response of consumer camera sensors, and constrain the locus of physically feasible attenuation coefficients. This locus improves estimation methods for these coefficients. The RGB values on this locus constitute the ground truth values for underwater color correction and dehazing algorithms for a given water type, as well as a dictionary for realistic computer-generated imagery and rendering of natural waters.

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Plankton and nutrients dynamics in the Gulf of Elat: biophysical feedbacks vs. internal dynamics

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The marine ecological system in the Gulf of Elat exhibits temporal and spatial variability due to physical (e.g. deep mixing) and biological (e.g. predator-prey interactions) processes. Annual variability of phytoplankton concentration in the gulf consists of a spring bloom, similar in some aspects to that observed in the North Atlantic. Despite the significance of this phenomenon, the mechanisms governing the spring bloom initiation are controversial. Hypotheses emphasizing various physical or biological forcing contributions have been proposed. Large spatial horizontal variability in surface chlorophyll a is visible in satellite imaging of the gulf, yet we lack spatial in situ measurements to explain these variations. We use a general circulation model (MITgcm) with an embedded simple ecological model and a set of sensitivity experiments to test the different hypotheses for the spring bloom initiation, and to study the processes that control the ecological system variability in the southern vs. the northern ends of the gulf.

High-resolution temporal dynamics of planktonic foraminifera assemblages from sediment traps in the Gulf of Aqaba waters

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Planktonic foraminifera (PF) provide a highly sensitive proxy of marine environmental conditions, and their accumulated carbonate shells in sediments are often used to reconstruct the history of oceans. Previous studies of PF in the Gulf of Aqaba (GOA) focused on standing-stocks and species assemblages obtained from plankton tows and cores, yet information of the open water population dynamics are nonetheless still very poorly constrained. Here, we report the first systematic time-series of open-water PF assemblages in the Gulf of Aqaba, north Red-Sea, collected using sediment traps. The traps, deployed vertically at five different depths (600m water-depth), provide monthly resolution from January 2014 until present. These efforts aim to characterize the interplay between PF fluxes and species assemblages in the context of nutrient availability, water column stratification and terrigenous fluxes. The most significant PF size fraction in terms of mass and fluxes is in the range of 63-125 μm (87%, compared to 13% and 0.28%, for the 125-500 μm and of 500-1000 μm size-fractions, respectively) which has not previously been studied in this area. The results demonstrate strong seasonality of PF fluxes, whereby low fluxes are observed during the spring-summer months ($31\pm 35 \text{ Ind.m}^{-2} \text{ d}^{-1}$), gradually rising to higher fluxes during the autumn-winter ($1570\pm 790 \text{ Ind.m}^{-2} \text{ d}^{-1}$). This pattern follows the development of the mixed-layer depth, but does not correspond to previous studies of the PF standing stock in the GOA from 1974-1976, possibly reflecting a change in the PF population over recent decades; indeed, a notable example of such a change nowadays is the total absence of *G. sacculifer*, despite the fact that it used to be the most dominant species 40 years ago. These discrepancies may also stem from the very limited knowledge of temporal and spatial PF distribution patterns in the GOA, emphasizing the importance of the current study, in documenting the baseline properties of PF assemblages.

The effect of depth on the biomineralization process in stony corals

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The biomineralization process is the process in which organisms control or direct mineral formation. While some knowledge on the process does exist, the biochemical mechanism remains enigmatic. The coral *Stylophora pistillata* demonstrates phenotypic plasticity over a depth gradient at the macro-scale. The colony shape vary from lumpy in 5m to spread in 60m. Here, preliminary results reveal micro and nano-scale changes to the shape and characteristics of the skeletal crystals over a depth gradient, and further examine the influence of varying depths on the biomineralization process in corals in gene expression, morphology and organic matter composition. In addition, seeking to find novel ways to characterize the skeletal crystals.

Alien species dominate the benthic foraminifera assemblages on Levant rocky reefs

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Benthic foraminifera constitute an important part of the rocky reef ecosystem, and are known to be sensitive ecological indicators for the ecosystem state. However, on the Israeli coast our knowledge on the ecology (community structure, dynamics and interactions) is still rudimentary. To study their community status, during 2013-15, different macroalgae species and their associated foraminifera were sampled twice a year on the Akhziv (AK) rocky reefs and seasonally on the Carmel Head (CH) at three depth strata between 2-18 m. The foraminiferal numerical abundance ranged between 12-4855 specimens per 10cc algal volume with no significant difference in abundance between regions. Due to the very high variability among samples, multivariate analysis was unable to detect significant differences in assemblage composition, except stations SP1 (18 m) and RD1 (7 m) at CH that were very different from the rest of the stations, presumably due to their unique environmental conditions. 68 epiphytic foraminiferal species were identified, including 8 symbiont-bearing species. Species richness varied between 3 and 42, with highest values found at RD1 on the brown macroalgae, *Halopteris scoparia*. Six benthic species dominated the assemblage: *Amphistegina lobifera*, *Textularia agglutinans*, *Pararotalia calcariformata*, *Hauerina diversa*, *Sigmamiliolinella australis* and *Tretomphalus bulloides*. All, except *T. bulloides*, are non-indigenous, mostly of Lessepsian origin, and often constitute near 100% of the assemblage. The most common invasive species in 2013-14, *A. lobifera*, was replaced during 2015 in some sites by other species such as the invasive *P. calcariformata* and *H. diversa* or the native *T. bulloides*, suggesting considerable dynamics in foraminifera populations on this coast. More work is needed to test the relationship between the foraminifera and the algae, and their mutual spatio-temporal dynamics, as well as the ecological consequences of the shift in domination from native to invasive species, which may also be facilitated by the changing climate.

Effects of nutrient-rich water mixing on surface microbial biomass and activity in the Eastern Mediterranean Sea

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Winter overturning circulation carries to the upper layers not only nutrient-rich water but also mesopelagic bacteria that can interact with surface microbial populations. These interactions can potentially shape bacterioplankton production and affect its biomass, and thus play a key role in the marine carbon cycle and carbon sequestration. In this study, we assessed the role of microbial communities collected from the Levantine intermediate water (LIW, ~400 m) on the activity and biomass of Levantine surface (LSW, 0.5 m) microbial populations. We show that heterotrophic bacteria originating from the LIW outcompeted phytoplankton from the LSW for resources, resulting in lower chlorophyll-*a* levels and primary production rates. These results suggest that even following winter mixing, which replenishes the surface water with potentially limiting nutrient such as N and P, phytoplankton cannot form blooms in the Eastern Mediterranean Sea (EMS). In contrast to the autotrophic microorganisms, heterotrophic bacteria in the LSW were less affected by the LIW bacteria and their biomass and production rates remain overall unchanged, suggesting synergistic interactions between communities. Our study highlights the importance of LIW heterotrophic bacteria in controlling the activity of phytoplankton in the EMS.

Underwater Optical Imaging for Quantifying Sediment Resuspension

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We are developing an underwater optical imaging system to reconstruct the three dimensional (3D) distribution of sediment resuspension from the seafloor. To recover a 3D volumetric matter distribution, an object is imaged from multiple directions and locations. Using these images, tomographic computations seek the distribution. We estimate sediment clouds using linear tomography. At this point, our imaging system is developed in controlled lab experiments. Such experiments involve a transparent water flume and a controlled particle injection system which simulates sediment plume evolution. We use naturally buoyant hollow glass spheres and heavy silica particles to simulate sediment particles. During plume evolution, the plume is imaged against a diffuse light source. Under the assumption that off-axis scattering is negligible relative to the transmitted radiance, the acquired image indicates the attenuation map. From the attenuation map, the optical distance on the line of sight can be extracted per pixel. Assuming a known effective extinction cross section of the particles, the injected particle quantity can be estimated.

Millennial Environmental and Climate Variability across the Mediterranean Basin from Vermetid Reefs

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Natural, marine conditions, such as SST, productivity, precipitation and dust fluxes along with anthropogenic stress, affect seawater chemistry and are recorded in the shells of marine calcifying organisms. The reef builder vermetid, *D. petraeum* is a sessile gastropod, secreting its aragonite shells in the tidal zones of the warm belt of the Mediterranean Sea, a region under high anthropogenic stress, thus a hotspot for climate change studies. Similar species are also abundant along the coasts of Florida, Bermuda and Brazil. We obtained cores of from vermetid reefs across the Mediterranean Sea (Israel, Crete, Sicily and Tunis), dated to the last millennium. We subsampled these cores at resolution of 3-6 years, and analyzed them for aragonite $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ by mass spectrometry, and for 22 elements (Ca, Na, Sr, Mg, Al, K, Mn, Fe, Cu, Zn, Ba, U, Cr, Co, Ni, V, Rb, Pb, Li, B, Mo, Cd) by ICP-MS. $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ from the eastern Mediterranean were used to reconstruct seawater carbonate chemistry and SST following (Sisma-Ventura et al. 2014). Element to calcium (el/Ca) molar ratios of recent samples are mostly in agreement with known values for marine biogenic aragonites. The trace elements results show a general partition to two major groups. The largest group of elements (Al, Fe, Mn, Co, Ni, Li, Ba, Mo, V, K, Rb) is associated with terrestrial sources to seawater such as atmospheric dust deposition, silicate erosion and fluvial input. Most of these elements show general decreasing trends of El/Ca ratios during the last millennium. The second group (Sr, U and Mg) exhibits temporal variability which resembles the Eastern Mediterranean SST trend for this period. The results of some elements show spatial variability across the Eastern and Central Mediterranean Basins. Pb/Ca of Israeli and Tunisian cores follow the known trend of anthropogenic lead pollution, while the Sicilian and Cretan cores show non-anthropogenic signals. $\delta^{18}\text{O}$ follows a clear east to west gradient, resembling that of the temperature gradient in the Mediterranean basin.

Reconstructing a flash flood record from the late Holocene in sediment cores from the Gulf of Aqaba (Eilat)

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Episodic rainfall over the hyperarid desert may cause flash floods in ephemeral rivers surrounding the Gulf of Aqaba-Eilat. These floods constitute an essential factor in the region's ecology but may also damage infrastructure and risk lives. Some floods reach the head of the Gulf of Aqaba and their sediments deposit on the shelf where they play an important role in structuring the ecosystem, such as limiting the distribution of coral reefs. Much of these sediments are later transported further offshore to the deep basin. To date, there is no continuous record of flash floods that may provide a long term perspective of the frequency and magnitude of flash floods in this region and their shifts over time; anticipation of future risks caused by local flash floods (or prolonged droughts) is therefore largely speculative. This ongoing study aims to reconstruct to the best possible resolution a late Holocene flood record in the GOA and trends therein. The methodology includes chemical and physical characterization of the flood deposits and to recognize them in the microstratigraphy (1 cm intervals) of dated cores from the shallow and deep seafloor. Our preliminary results show that characteristics of suspended flood sediment, e.g. grain size distribution and elemental composition are distinguishable and recognizable in the stratigraphy of the cores. Flood sediment stratigraphy in a 312 cm long pneumatic core (from the shelf at 13 m depth in front of the floods' drainage outlet) shows recurring fluctuations, but also three more long term environmental shifts that require further explanation. These promising results will be complemented with more chemical and micropaleontological analysis of the cores as well as additional dating to reconstruct a long term record of floods and related climatic conditions in the area of the GOA making it available to hydrologists, oceanographers, decision makers and the public.

Isolation and characterization of oligotrophic bacteria from the Eastern Mediterranean Sea

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The Eastern Mediterranean Sea is one of the most oligotrophic oceanic regions on Earth. Not much is known about its water column microbial community composition. Marine microorganisms play an important role in marine ecosystems by converting solar energy to chemical energy, catalyzing biogeochemical transformations of all nutrients and trace elements that sustain life in the ocean. There is a great anomaly between the amount of marine microbes that exist in the environment and that the amount that can be grown on agar plates (usually <0.1 % cultivated). The aim is to isolate oligotrophic bacteria from the Eastern Mediterranean Sea by mimic the environment, characterize their phylogenetic, morphology, physiology and eventually their functional, using whole genome sequencing. High throughput dilution-to-extinction culturing (HTC) method was performed. Seawater sample was diluted with sterile seawater supplemented with nutrients and inoculated into 24 well Teflon plates to obtain a small and known number of cells per plate well (~3 cells per well). Out of the total measured number of cells in the sea water collected for this experiment about 1.67% of the total cell species were cultivated, including several new species of bacteria. Most of the species were related to the Alphaproteobacteria clade SAR11, the most abundant heterotroph in marine euphotic zones worldwide. Others were identified as a novel Verrucomicrobia (one of them found with 88% 16S rRNA gene identity to its nearest cultivated representative, *Pelagicoccus croceus* N5FB36-5(T)). Physiological and growth optimization experiment for Verrucomicrobia showed Glucose as main carbon source with highest yield of biomass. Presence of Proteorhodopsin gene in several isolates suggesting them as a Photoheterotrophs. The phylogenetic and physiology results so far providing life evidences to the diversity and the complexity of marine microbial community in one drop of water in one of the most oligotrophic and P starved oceanic regions.

The role of GABA-B receptor in nervous system development and metamorphosis of the sea anemone *Nematostella vectensis*

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Sea anemones are among the first organisms to evolve a nervous system. Although simple and non-centralized, their nervous system shares most of the components and associated genes with those of higher organisms, including humans. In this study, we use *Nematostella vectensis* as a model for studying the role of GABA-B receptors during planula-to-polyp transformation and specifically in neural development. GABA-B receptors play key roles in synaptic neurotransmission and during brain development. We found that GABAergic genes are present in *Nematostella* and that GABA-B receptor is activated by its specific agonist. Addition of the agonist caused reversible arrest of planula mobility, development and metamorphosis. c-AMP analogue restored planula mobility but not metamorphosis, suggesting a complex GABA-B signaling cascade. Transcriptomic profiling by RNA-seq showed that *antHOX* and *Fox*, genes involved in body plan regulation, are down-regulated upon agonist treatment, as are neural development genes *Sox*, *Otx*, *Pax*, and *Elav*, and genes that are important for stem cell pluripotency such as *Sox2*, *Pl10* and *Vasa1*. These results reveal an ancestral role of GABA-B receptors as negative regulators of stem cells, neural precursor development and neural cell differentiation.

Annual population dynamics of T7-like cyanophages and their hosts in the Gulf of Eilat, Red Sea

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Synechococcus and *Prochlorococcus* are the numerically dominant primary producers in the oceans and contribute significantly to global primary production. They are infected, among others, by T7-like cyanophages. Two discrete T7-like lineages are known, clade A and B. Phages from clade B encode the host-like photosystem II gene, *psbA*, and infect either *Synechococcus* or *Prochlorococcus*, whereas clade A phages lack *psbA* and primarily infect *Synechococcus*. However, no method exists for the accurate quantification of bacteriophages that infect a particular microbial taxon. To overcome this problem we developed a novel, quantitative, culture-independent, solid-phase PCR method called polonies for this purpose. Using this method we found that T7-like cyanophages were highly abundant over all seasons, with maximal abundances of up to $\sim 1.3 \cdot 10^6$ phages \cdot ml $^{-1}$ in summer-autumn when cyanobacterial abundances were also greatest. The clade B phages were at least an order of magnitude more abundant than clade A phages in the Red Sea along depth profiles collected monthly during 2013. The abundances of T7-like cyanophages from clade B were strongly correlated with *Prochlorococcus* during periods of stratification. Furthermore, at least in spring, clade A and *Synechococcus* abundances were highly correlated. These findings indicate that the clade B T7-like cyanophages that carry the *psbA* gene and infect either host genus are highly abundant throughout the year in the Red Sea.

Combatting fouling on fish cages in three seas: towards protocol for long term static immersion tests

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The mariculture industry is one which has been growing rapidly and has become a principle contributor to the world's food supply. One of the primary costs and concerns affecting the growth of this industry is the problem of biofouling. If not addressed, continued build-up of fouling can result in numerous deleterious consequences, including the loss of fish stock due to oxygen deprivation or disease, as well as increased costs for the cleaning, replacing or repairing of nets. One way to decrease the severity of fouling affecting the mariculture industry is to coat the cages before use with an antifouling paint. Although effective in mitigating the rate of fouling if reapplied regularly, these paints are most often copper based and have their own negative consequences on non-target organisms as well as on the farmed fish. As new environmentally friendly antifouling strategies are being developed, there is a need to standardized experimental procedures. Static immersion testing has been employed in the Red Sea (Eilat, Israel), central Mediterranean Sea (Malta) and the Atlantic (Spain) to test different antifouling shelf products (FlexGard Original, Flexgard Superior, FlexDip and Notorius1). Two underwater structures containing fourteen 15x15 cm net squares for each type of paint, as well as sixteen uncoated controls nets were deployed. Nets were photographed monthly and analyzed to determine percent net occlusion over time, and samples were removed every 4 months in order to determine taxa composition, biomass accumulation and chlorophyll content. The performance of the antifouling paints was then compared in all three locations. Our experimental approach provides a protocol to test the efficacy of newly developed antifouling paints for use in the mariculture industry.

A long term study of microbial and environmental dynamics in an intensely impacted aquaculture ecosystem.

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Water quality, agriculture and human health are inextricably linked through aquatic microbial populations. One of the aquatic ecosystems most impacted by human influence is that of high-density aquaculture facilities, due to high fish biomass and intense feeding. Under these conditions pathogens and massive algal blooms, including those of toxin-producing strains, can cause fish stress and mortality. To understand the dynamics of such intensely impacted ecosystems and evaluate the influence of anthropogenic and environmental effects on microbial populations, we have been following the microbiome of two fish ponds and an operating reservoir over more than two years at the Dor Aquaculture Research Unit. The concentrations of NO_3 , NO_2 , NH_4 and PO_4 in the ponds increase during winter months, whereas fish biomass typically peaks during the spring, suggesting that rainwater runoff from the surrounding agricultural fields is the major source of inorganic nutrients. Microbial population dynamics, assessed by 16S Illumina sequencing, indicate seasonal patterns characterized by high abundances of proteobacteria and bacteroidetes during autumn and winter and a shift towards cyanobacterial dominance during spring and summer. The cyanobacterial population includes *Microcystis* sp., potentially responsible for high concentrations of cell-bound microcystins. No clear differences were found between the fish ponds and the operating reservoir which receives recirculated water, despite major differences in fish biomass. These results suggest that even in highly impacted ecosystems, natural seasonal rhythms dictate microbiome dynamics to a larger extent than human influence. Ongoing metagenomic analysis will shed light on the genetic underpinnings of these changes in community structure and, potentially, function.

Novel experimental study of bioturbation activity in flood-like sediments in the northern Gulf of Eilat-Aqaba, Red Sea

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In the hyperarid environment of Eilat, Israel, ephemeral flashfloods can occur in the winter months, transporting the majority of sediment into the Red Sea. This study focuses on identifying conditions for flashflood deposit burial and preservation in the shallow Gulf of Eilat- Aqaba (GOA). The rate and depth of surface sediment movement via bioturbation is being quantified in this study through an *in situ* experiment, to help infer the conditions for flashflood deposit preservation. Sediment movement was tracked using 1.5g of luminophore tracers (fluorescent sediment) <63 μm , resembling the grain size of flood sediments. Sediment cores (diameter= 4.5cm, length= 30cm) were collected from the study site, at 13 m water depth. On 27 cores, tracers were positioned on the surface, and for 9 other cores, tracers were placed at 25cm depth (below mixing depth). Three cores with surface tracers and one core with a bottom tracer were transplanted into the seafloor at 9 study sites, leaving nothing but the sediment and tracers in the seafloor. A novel sediment core transplant instrument was created and used in this study, to ensure the core liner would be removed upon transplantation. The location of each core transplant was marked using a plate with one hole in each corner. Sediment cores with surface tracers were recovered at three intervals ($t=1$: 1 week; $t=2$: 19 days; $t=3$: 6 weeks) at each station. Cores with bottom tracers were recovered after three months, to measure net sediment removal or accumulation rates. Each core was sliced at cm resolution, and representative subsamples were analyzed under a microscope to quantify the presence of tracer vertically down each core. In this talk I will present this novel core transplanting methodology, show preliminary results quantifying vertical luminophore movement, and discuss its role in general research.

High and Dry: Light effects on epilithic algae in the upper zone of littoral caves

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In light of global ocean acidification processes, it is important to study the biodiversity of the chalk littoral caves. Chalk littoral caves are important habitats in the heavily exploited littoral zone, mentioned in the UNEP-MAP Coastal Area Management Program. The upper mediolittoral zone of littoral caves is located high above sea-level and exhibits a dry, low light environment that only few algal species can overcome. With high tolerance to desiccation and low light, epilithic algae are important contributors to the cave flora. By settling on the bare cave walls they create new niches and enhance biodiversity. Rosh HaNikra cave, carved into a chalk cliff next the Lebanese- Israel border, is the only large littoral cave in Israel. The cave has a flora of unidentified epilithic algae in the mediolittoral zone. The goal of this study at Rosh HaNikra littoral cave was to qualify the natural light, identify the epilithic algae and study the effects of natural light on the epilithic algae. Methods included seasonal and daily light measurements as well as chemotaxonomy and microscopy. We found that the light spectra changes in quantity as well as quality when entering the cave, constraining the epilithic algae communities. We also described for the first time the epilithic algae community of Rosh HaNikra littoral cave, consisting of Rhodophyta, Chlorophyta and Cyanobacteria and an a surprising occurrence of *Hildenbrandia spp.* above sea-level. *Hildenbrandia* was reported only once in a submerged reef in Israel, 50 km away and 40 years ago. Location of *Hildenbrandia* in the upper mediolittoral could be attributed to the light spectra of the littoral cave. Results from this study provide not only a baseline for any future algal researches on this site, but would also help monitor the algal biodiversity of the marine reserve of Rosh HaNikra.

Effects of roughness on microbial settlement and community composition in artificial reefs

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The extent of microbial colonization appears to increase as the surface roughness increases. This study aims to correlate surface roughness at the micro meter scale to the variance among and within the microbial community that adheres to a surface. Artificial reefs are manmade constructions that are deployed in the marine environment and allow the settlement of sessile organisms. The materials found to be most effective for settlement include terracotta plates, metal and concrete. "ECONcrete" is a Company that develops innovative concrete structures which are ecologically active and are designed for marine constructions. 80 coupons framed in a silicone hose made by "ECONcrete" Company were ordered. 40 coupons were treated by polishing using 1000p grit sand paper roughness showed $Ra^*=19\mu\text{m}$. 40 coupons which were untreated showed roughness of $Ra^*=28\mu\text{m}$. roughness was measured by a contact profilometer. Treated and untreated coupons were placed randomly and set vertically in two plastic plates welded plates. On June 14 2016 at 11:00AM Plates were set in two meter depth in front of the Inter-University Institute of marine science in the gulf of Eilat (IUI) (29°51'N, 34°94'E). Coupons were sampled after 24hours, one week, on month and three months. During each sampling 8 treated and 8 untreated coupons were removed randomly from plates. 16 treated and 16 untreated Samples were analyzed by scanning electron microscope (SEM). DNA was extracted from 16 treated and 16 untreated samples. 16S and 18S rRNA genes were amplified and sent to sequencing using next generation sequencing MiSeq technique. Microbial diversity analysis will be performed using QIIME, which is an open-source bioinformatics pipeline for performing microbiome analysis from raw DNA SEQUENCING data. Alpha and beta diversity tests will be performed for the environmental sample, principal component analysis plots will be generated in order to visualize the distances between samples.

Tracking the Early Events of Mineral Formation during Coral Development

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Scleractinian corals are one of the most important mineralizing organisms in the ocean, which produce $1012\text{kg}\cdot\text{year}^{-1}$ of calcium carbonate reefs (CaCO_3). These fragile ecosystems are threatened with extinction in the coming century, due to the ocean acidification, which may affect the skeleton formation. Although coral biomineralization have been studied for decades, mostly on adult corals, the basic mechanism remains enigmatic. Corals have a biphasic life cycle with planktonic larval stages and benthic adults, which separated by settlement and metamorphosis. After its metamorphoses, the juvenile polyp immediately initiates the formation of the calcium carbonate exoskeleton. This suggests an immature mineral phase (presumably amorphous calcium carbonate - ACC) in the pre-settled planulae. To elucidate the key mechanism that facilitates the initial rapid calcification, we correlate cryo-scanning electron microscopy (SEM) with cryo-energy-dispersive X-ray spectroscopy (EDS) and fluorescence techniques on coral planulae, which froze in high pressure. We used the cryo-SEM with both secondary electron and backscattered electron (BSE) detectors. The elements that are present in the mineralized regions are detected by EDS under cryogenic conditions. The fluorescence platform helps to identify auto-fluorescent symbionts and to detect mineralized regions in the developing planula via calcein blue staining. Our results indicate that first mineral deposition already starts at the pre-settlement. Immature minerals can vary in shape, Mg content and crystallinity. After settling, the aboral epidermis is attached to the substrate and begins skeleton formation. The first calcareous elements after settling are circular platelets and rod-shaped granules, which aggregate to form the primary septa, followed by the formation of the basal disk.

The impact of airborne microbes on the Southeastern Mediterranean surface seawater following a dust storm event

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Aerosols are regularly transported across marine systems, contributing limiting macro and micronutrients to the surface seawater. Aerosols may also supply a high diversity of airborne microbes, which can affect surface microbial composition, function and biological production. This is why the impacts usually observed following aerosol deposition in seawater are diverse and cannot account for a "fertilization response" alone. This study explores the potential impacts of airborne microbes deposited into the surface southeastern Mediterranean Sea (SEMS) on marine autotrophic and heterotrophic production. For that, we compared *in situ* changes in autotrophic and heterotrophic microbial abundance and production rates before and during an intense dust storm event in early September 2015. Additionally, we measured the activity of microbes associated with atmospheric dry deposition in sterile SEMS water using the same particles collected during the dust storm. A high diversity of prokaryotes and a low diversity of autotrophic eukaryotic algae were delivered to surface SEMS waters by the storm. Autotrophic airborne microbial abundance and activity were low, contributing ~1% of natural abundance in SEMS water and accounting for 1-4% to primary production. Airborne heterotrophic bacteria comprised 30–50% of the cells and accounted for 13–42% of bacterial production. Our results demonstrate that atmospheric dry deposition may supply not only chemical constituents but also microbes that can affect ambient microbial populations and their activity in the surface ocean. Airborne microbes may play a greater role in ocean biogeochemistry in the future in light of the expected enhancement of dust storm durations and frequencies due to climate change and desertification processes.

The role of viable airborne microbes delivered by desert dust into the SE Mediterranean Sea: Potential ecological implications

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Aerosol deposition may supply a high diversity of airborne organisms including fungus, bacteria and viruses, which can affect surface microbial diversity, abundance and function. We show that these airborne organisms may become active once deposit in seawater and interact (whether positively or negatively) with the native microbial populations. For example, experiments supplemented with dust collected during a large storm that was originated from the Sahara desert indicate that airborne microbes caused a specific and rapid decrease in *Prochlorococcus* abundance (max change ~60%). However, phytoplankton abundances have not declined and primary production and total bacterial production increased. In parallel, the addition of UV-killed aerosol resulted in a weaker decrease in *Prochlorococcus* (max change ~30%), likely due to some chemical toxicity effect. We hypothesize that the rapid demise in *Prochlorococcus* cells is likely attributed to airborne viral infection or airborne bacterial predation on the *Prochlorococcus* cells. Our results demonstrate that dust-born organisms can become viable in surface seawater, interact with the surface populations and should thus be considered experimentally and ecologically.

The effects of well-amelioration brine on coastal microbial populations in the SE Mediterranean Sea

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Well amelioration brines (WAB), rich in nitrate and silica, are being discharged continuously into Israel's oligotrophic coastal waters. The effects of this nutrient-rich groundwater desalination brine on coastal microbial communities are unknown. Such nutrient amendments may alter microbial community compositions, production rates, nutrients recycling, etc. and hence the ecology of the coastal waters. In this study, we conducted two mesocosm (1-m³ tanks) experiments (summer and winter) that examined the short to medium term effect(s) of WAB under different scenarios, including the regulatory standard applied in Israel, on ambient coastal Mediterranean waters. Our results show that both the autotrophic biomass and primary production rates were significantly enhanced by the addition of WAB, corresponding with nitrate and silica uptake. Specifically, autotrophic community composition altered from being dominated by picophytoplankton to being dominated by larger microphytoplankton such as diatoms, dinoflagellates and chlorophytes. Species diversity decreased due to a pronounced increase in Chaetocerotaceae and Kareniaceae. Unlike the strong response of autotrophic communities to WAB addition, heterotrophic bacterial abundance, species diversity and production rates were not noticeably affected by WAB supplements. The results suggest that nitrate and silica act as co-limiting factors for different autotrophic coastal populations. Therefore, WAB discharge may alter the balance within the microbial community, causing the microphytoplankton to bloom followed by an increase in the heterotrophic bacterial community that utilizes the excess organic carbon. This study, coupled with field-based monitoring of discharge sites, will enable a better, science-based environmental policy of WAB discharge.

Changes in the macromolecular composition of *Prochlorococcus* as it grows and dies

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Every living cell is composed of macromolecules such as proteins, lipids, carbohydrates, DNA, RNA and pigments or cofactors. The ratio between these macromolecular pools is associated with growth rate and mortality of the organism, and determines its nutritional value within the food chain. Describing and modeling cells at the resolution of these macromolecular pools will help bridge the gap between detailed studies of organismal physiology and predicted biogeochemical cycles of elements such as carbon, nitrogen and phosphorus. Here, we present detailed measurements of the macromolecular composition of *Prochlorococcus*, a globally abundant marine primary producer, as it grows and dies in laboratory batch cultures. Our results show that the macromolecular composition of *Prochlorococcus* differs from that of most other phytoplankton, and that this composition changes between different physiological states. A significant amount of the carbon fixed by *Prochlorococcus* is released under these conditions into the growth media as dissolved organic carbon, potentially feeding, in the oceans, the surrounding heterotrophic community. Ongoing work aims to identify the mechanistic reasons for the changes in macromolecular composition and to develop mathematical models at this resolution that can be incorporated into global ocean models.

Has microbiota facilitated the invasion of *Spondylus* oysters in the Mediterranean Sea?

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Suitable microbiota may contribute to the thriving of marine species through different means, such as the provision of growth factors and antimicrobial agents. The gill tissue of bivalve mollusks may host a diverse symbiotic bacteria, featuring a relatively high metabolic activity. The spiny oyster *Spondylus spinosus* is a Lessepsian invasive species that has become highly abundant along the Eastern Mediterranean Sea (EMS) coastline, but is scarce in the northern Red Sea (NRS), its indigenous region. The composition and seasonal dynamics of the gill microbial communities of *S. spinosus* were examined in both regions, as well as two other Red Sea *Spondylus* species, using 16S rRNA gene amplicon sequencing. We conducted mesocosm experiments in a flow-through system in the EMS in order to examine the effect of temperature as a key factor shaping the bacterial composition of *S. spinosus*, including extreme temperature regimes. Significant differences were observed between microbial communities of the EMS *S. spinosus* and the three NRS species. Bacteria from the family *Hahellaceae* dominated the communities of the EMS *S. spinosus* and the NRS *S. avramsingeri*, yet were rare in the NRS *S. spinosus* and *S. pickeringae*. Interestingly, the two former oyster species have been the most abundant in their respective habitats, while the latter two- very rare. The mesocosm experiments revealed a relation between the wellbeing of the oysters and the persistence of *Hahellaceae*. These findings suggest a potential contribution of *Hahellaceae* to the host fitness and thus may help explain the oyster's successful invasion to the EMS.

Behavioral responses of reef-associated fish, prawn gobies (*Amblyeleotris steinitzi* and *Amblyeleotris sungami*) to anthropogenic diver disturbance

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Coral reefs make up the most biologically diverse shallow marine ecosystems on Earth. Coral reef communities are highly susceptible to anthropogenic disturbance by divers. Noisy divers can have an effect on reef fish communities, but little is known about the ability of these fish to adapt to long-term diver presence. This study aims to examine the effect diver disturbance has on reef fish by focusing on two species of prawn gobies, *Amblyeleotris steinitzi* (Klausewitz 1974) and *Amblyeleotris sungami* (Klausewitz 1969). Gobies at both undived and heavily dived sites were disturbed by dropping a weight near the burrows they share with their prawn partners ensuring they disappeared into their burrows. Their latency periods – time until first re-emergence – were then measured. Estimations were also taken of their flight initiation distances by measuring the distance an approaching diver was from the goby when the goby disappeared into its burrow. It was hypothesised that both of these variables would be lower for the gobies that were accustomed to diver disturbance. In the anthropogenically disturbed areas, the gobies had lower latency periods; a significantly higher proportion of gobies that did not return before the imposed 7 minutes latency limit; and significantly shorter flight initiation distances (FIDs). However, one of the undived sites - a steep gravel slope at which gobies were accustomed to rolling gravel - showed the same trend of a short average latency period. The gobies from this site also followed the trend of the undived sites having a longer flight initiation distance. Therefore, the gobies at anthropogenically disturbed sites that had lower latency periods and shorter FIDs exhibited riskier behaviour, especially in relation to predation. Thus, divers have an influence on fish behaviour which in turn can lead to riskier anti-predation tactics.

Development of a Novel Sea-Surface Imaging Microscope for Quantification of Micro Plastic

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Recent studies increasingly point to the sea-surface which is an important biological habitat and a collection point for anthropogenic material such as the micro plastic. Monitoring the abundance and weight of floating micro plastic using net tows is difficult and time consuming; hence there is lack of data. We are developing a novel sea-surface microscopic imaging system in a bright-field optical configuration (white and UV). The system configuration includes a submersed imaging component that points towards the surface, while the illumination is held in air and point directly towards the field-of-view. This is nontrivial as the water surface refracts light. In addition, focusing precisely onto the sea-surface that is influenced by wave and wind motion is extremely challenging. We solve this problem by combining a precise floatation system with active electronic focusing. As first application we aim to use the system to quantify the abundance of micro-plastic in situ. The significance of this development lies in paradigm shift from "bringing the ocean to the lab" to "bringing the lab into the ocean". Conducting measurements directly in situ simplifies the process, enables an order of magnitude more sampling points, lowers costs in the long run and thus has the potential to substantially increase our knowledge about the sea-surface.

Role of dTDP-L-Rhamnose-deficient lipopolysaccharide in symbiosis between cyanobacteria and sponge

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Sponges are filter feeders that take up microorganisms from seawater and digest them by phagocytosis. At the same time, many sponges are known as hosts to a wide diversity of bacteria. The coexistence of food bacteria and symbiotic bacteria inside the sponge raises the question about mechanisms of differentiation between them. A previous study compared symbiont genomes to those of free-living cyanobacteria, and potential adaptation mechanisms to life inside the sponge were revealed. One of these mechanisms was the common loss of genes involved in the production of dTDP-L-rhamnose (which is a residue of the O antigen of lipopolysaccharide) in symbiotic cyanobacteria. The purpose of this project is to perform knockout to the gene dTDP-4-dehydrorhamnose reductase (*rfbD*, EC 1.1.1.133) in the free-living cyanobacterium *Synechococcus* sp. WH8102, and so to disrupt the formation of normal dTDP-L-rhamnose in this bacterium. To obtain a knockout mutant we have constructed a donor bacterium, which contains a mobilizable suicide plasmid with an interrupted version of the gene that will be transferred to *Synechococcus* sp. WH8102 by conjugation, thus replacing the wild type gene. The knockout cyanobacterium will then be fed to sponges and its retention and phagocytosis will be compared to that of the wild type cyanobacterium. Our hypothesis is that the mutated free-living cyanobacterium will not be recognized as food, due to lack of the typical O antigen, and thus will not be digested by the sponge cells, and rather be stored inside the sponge.

Mechanisms of *Trichodesmium* demise within the New Caledonian lagoon

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The globally important marine diazotrophic cyanobacterium *Trichodesmium* is abundant in the New Caledonian lagoon (southwestern Pacific Ocean) during austral spring/summer. We investigated the cellular processes mediating *Trichodesmium* mortality from large surface accumulations (blooms) in the lagoon. *Trichodesmium* cells (and associated microbiota) were collected at the time of surface accumulation, enclosed under simulated ambient conditions, and sampled over time to elucidate the stressors and subcellular underpinning of rapid biomass demise. Metatranscriptomic profiling of *Trichodesmium* biomass, 0, 8 and 22 h after incubations of surface accumulations, demonstrated upregulated expression of genes required to increase phosphorus (P) and iron (Fe) availability and transport, while genes responsible for nutrient storage were downregulated. Total viral abundance oscillated throughout the experiment and showed no significant relationship with the development or demise of the *Trichodesmium* biomass. Enhanced caspase-specific activity and upregulated expression of a suite of metacaspase genes, as the *Trichodesmium* biomass crashed, implied autocatalytic programmed cell death (PCD) as the mechanistic cause. Genes associated with buoyancy and gas vesicle production were strongly downregulated concomitant with increased production and high concentrations of transparent exopolymeric particles (TEP). Our results suggest that, whatever the ultimate factor, PCD-mediated death in *Trichodesmium* can rapidly terminate blooms, facilitate aggregation, and expedite vertical flux to depth.

Exploring intra-colonial variability in the branching coral *Stylophora pistillata*

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Corals are colonial invertebrate organisms, comprised of many individual polyps. Each polyp is exposed to a slightly different environment morphology of the colony and its location and orientation relative to predominant currents, light and other reef organisms. We hypothesize that the coral colony, therefore, can be divided into, functionally distinct regions, for example the tips the bases of the same branch or the outer branches compared to inner branches. To test this hypothesis, we are characterizing, at high spatial resolution, the physiology and gene expression in different regions of a single colony of the branching coral *Stylophora pistillata*. We are measuring, physiological parameters such as the concentration of protein and chlorophyll, the density of zooxanthellae and their photosynthetic efficiency. We are also measuring aspects related to the ability of the coral to catch prey and defend itself from predators, such as the number and type of nematocytes and the toxic- hemolytic activity. CT-micro scans are being used to determine whether there are differences in skeletal density and porosity between the distinct regions. Finally, whole transcriptome sequencing is used to measure gene expression in each distinct region. Together, these measurements will generate the first high-resolution functional map of a coral colony.

Polydisperse particle-driven gravity currents in non-rectangular cross-section channels

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Particle-driven gravity currents are suspensions of dense particles that spread into an ambient fluid due to the difference between the density of the suspension and that of the ambient fluid. During the evolution of the current, particles continually sediment and are deposited from the flow. Particle-driven gravity currents are important in many environmental situations (volcanic ash flows, turbidity currents). In most of the analytical works, it has been assumed that the suspension of particles possess a single settling velocity. However in many situations this is a considerable simplification and in virtually all real situations there is a range of particle sizes, and hence settling velocities. In the present work we consider the propagation of a high-Reynolds-number gravity current driven by a polydisperse distribution of N types of particles in fluid of density ρ_i propagating along a channel into an ambient fluid of the density ρ_a . The bottom and top of the channel are at $z=0, H$, and the cross-section is given by the quite general $f_1(z) \leq y \leq f_2(z)$ for $0 \leq z \leq H$. The flow is modeled by the one-layer shallow-water equations. We solve the problem by the finite-difference numerical code to present typical height $h(x,t)$, velocity $u(x,t)$ and volume fractions of particles $\phi_i(x,t)$ ($i=1, \dots, N$) profiles. The methodology is illustrated for flow in typical power-law geomet

