UNIVERSITY OF CRETE
BIOLOGY DEPARTMENT

GRADUATE PROGRAMME
"ENVIRONMENTAL BIOLOGY-
MANAGEMENT OF TERRESTRIAL AND MARINE RESOURSES"

4th Annual Meeting on
Graduate research in Environmental Biology

Department of Biology-Institute of Marine Biology of Crete-Natural History Museum of Crete

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Book of Abstracts

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ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΕΚΠΑΙΔΕΥΣΗΣ
& ΑΡΧΙΚΗΣ ΕΠΑΓΓΕΛΜΑΤΙΚΗΣ ΚΑΤΑΡΤΙΣΗΣ
ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΔΙΑΧΕΙΡΙΣΗΣ ΕΠΕΑΕΚ

ΥΠΟΥΡΓΕΙΟ
ΕΘΝΙΚΗΣ ΠΑΙΔΕΙΑΣ
& ΘΡΗΣΚΕΥΜΑΤΩΝ

ΕΥΡΩΠΑΪΚΗ ΕΝΩΣΗ
Συγχρηματοδότηση
Ευρωπαϊκό Κοινωνικό Ταμείο (Ε.Κ.Τ.)

Το έργο συγχρηματοδοτείται κατά 75% από το Ευρωπαϊκό Κοινωνικό Ταμείο (ΕΚΤ) και κατά 25% από Εθνικούς Πόρους (ΥΠΕΠΘ/ΕΥΔ ΕΠΕΑΕΚ)

ANNUAL MEETING 2003

Scientific Programme, Abstracts

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INTRODUCTION

Graduate Program in

"ENVIRONMENTAL BIOLOGY – MANAGEMENT OF TERRESTRIAL AND MARINE RESOURCES"

This Graduate Program is a joint effort of the Department of Biology of the University of Crete, the Institute of Marine Biology of Crete, and the Museum of Natural History of the University of Crete. Teaching support is also provided by the Departments of Chemistry and Economics (University of Crete), the Polytechnic University of Hania, Crete and the Biology Departments of the University of Patras and the University of Thessaloniki. Furthermore scientists from the national and international scientific community give a series of seminars of the latest progress in subjects pertinent to the Graduate Program.

The Graduate Program leads to a Master of Science (M.Sc.) and to a Doctor of Philosophy (Ph.D.) degree in Management of Terrestrial and Marine Resources. The duration of graduate studies leading to a M.Sc. degree is four (4) semesters and no more than six (6). For the Ph.D. degree the time limit is not less than five (5) and not more than eight (8) semesters after awarding of the M.Sc. degree by the Department of Biology of the University of Crete; this includes the writing of the Dissertation.

Course work. Graduate course work must consist of a minimum of two hundred (200) classroom hours. The core courses (120 hrs) must be taken by all students admitted to the Graduate Program. Additionally, elective courses (at least 80 hrs) must be taken by the graduate students who may attend other courses in a relevant field within the Department of Biology or in other Departments as well, subject to approval by the Graduate Committee. Any prerequisite courses specified by the Graduate Studies Committee at the time of student's admission are not included in the calculation of the two hundred hours of credits required for the M.Sc. degree.

Rotations. In addition to the course work, the graduate student must complete three laboratory research projects (rotations). The duration of each laboratory research project (rotation) is two to three months.

Master research project. The graduate project must be original or demonstrate a good knowledge and in-depth understanding of a specialized topic of current research or technical interest. The graduate project is carried out under the supervision and guidance of a supervising professor, member of faculty or senior researcher of the collaborating Institutes, and approved by a two-member Examination

Committee (appointed by the Graduate Studies Committee) which includes the supervising professor and one other member of the faculty or senior researcher of the collaborating Institutes.

Additional requirements for the doctoral degree

General Graduate Examinations (Qualifying). The student must take the General Graduate Examinations (G.G.E.). If unsuccessful, the student has the right to try once more.

Doctoral dissertation. Following successful G.G.E. the student is declared to be a doctoral candidate and undertakes the completion of a doctoral dissertation under the supervision and guidance of a supervising professor, a member of the faculty. Monitoring of the doctoral candidate's progress is the responsibility of a three-member advisory committee. A yearly report answering specific questions is completed by the committee on December.

Defense of the doctoral dissertation. Upon completion of the thesis, the doctoral candidate must present his/her dissertation in a seven-member Examination Committee, which will evaluate the originality of the thesis and whether it constitutes a substantial contribution to the field.

The scope of the graduate program includes:

- Integrated knowledge in the biology and management of terrestrial and marine resources.
- Integrated knowledge in management of terrestrial and insular ecosystems.
- Theoretical and applied knowledge in Aquaculture science and technology.
- Training in laboratory techniques and introduction of students in research after participating in three (3) rotations in research laboratories of the Department of Biology, the Institute of Marine Biology of Crete and the Museum of Natural History of the University of Crete.
- Advanced knowledge in technology of protection and management of coastal ecosystems and fisheries resources.
- Research activity and publication of results.
- Attendance of scientific seminars, advanced research workshops, intensive courses etc.
- Training in writing scientific papers.
- Participation of graduate students in local and international scientific congresses on topics related to management of marine and land-living resources.

ABSTRACTS

- Rotations -

"EFFECT OF METHANOL ON THE INCREASE OF MICROALGAE BIOMASS"

Apostolaki, Evgenia

Supervisor: K. Kotzabasis

University of Crete, Department of Biology

Low methanol concentrations induce great biomass production in microalgae cultures, through a light-dependent mechanism. In order to define the optimum concentration of methanol, which causes the maximum biomass production, autotrophic cultures of *Scenedesmus obliquus* were used. A total of five cultures with different methanol concentrations added (0.1, 0.3, 0.5, 1 and 2%) and a reference culture were incubated for 72 hours in a temperature-controlled water bath at 30^{o}C, in front of a set of white fluorescent lamps. Data analysis revealed that 1% methanol causes the greatest mass production, in terms of packed cell volume (PCV). The PCV of the specific culture was 3-fold higher than that measured at the reference culture. Photosynthetic rate was greater and Chla/Chlb ratio was two times higher than the reference. Significant increase in biomass was also measured at the culture inoculated with 2% methanol. Insufficient replication averted the determination of the optimum methanol concentration.

"MATRIX POPULATION MODELS: AN APPLICATION ON THE GRIFFON VULTURE (*Gyps Fulvus*) POPULATION OF CRETE"

Barboutis, Christos

Supervisor: K. Lika

University of Crete, Department of Biology

The need to describe a population as a distribution of individuals in the population among the possible categories of important individual differences in the population, has led people to use and develop Structured Models. The Structured Population Models are nothing more than a mathematical rule that specifies the change over time of distribution function, which specifies the number of individuals in each of the stages considered. The aim of this project was the development of a Matrix Population Model which would describe the projection of the Griffon Vulture (*Gyps fulvus*) population of Crete. Available data from 1996 to 2002 was used for the estimation of the model parameters. The population was considered as a closed one without any important emigration or invasion from any near by populations. The constructed model consists of six age classes with the last class to enclosure all the individuals over 5 years old. The population was examined under two cases, the case of density-independence and the case of density-dependence. In the first case the initial growth rate and initial population structure were estimated as well as elasticity and sensitivity of λ to all vital rates and sensitivity of both corresponding eigenvectors to all vital rates. In the latter case a density-dependence equation was added to the fertility of the 6th age class and the population was projected into time.

"YAWNING BEHAVIOR IN THE DUSKY GROUPER (*Epinephelus marginatus*)"

Dimitriou, Georgia

Supervisor: A. Eleftheriou

University of Crete, Department of Biology

Yawning has received little attention in behavioral sciences and even lesser research has taken place of the study of yawning in fish. Yawning behavior has been described in several species and researchers have come to the conclusion that it is a potentially important and largely overlooked behavior that serves some physiological and/or communicational role among individuals. Thus, knowledge of yawning behavior constitutes an important step in understanding higher order or more complex behavioral patterns. The aim of the present work was to describe yawning behavior in the species *Epinephelus marginatus* or commonly known as the dusky grouper and to establish whether or not and in what way is associated with some behavioral, physiological, or pathological state of the organism. This was accomplished by monitoring the fish in different times of the day both before and after they were fed, in order to determine if there is a relation with these parameters, which in tern affect the yawning behavior, frequency or duration. According to the observations and results of this study yawning does not seem to relate with the time of day nor with a feeling of repletion or hunger, in spite the fact that it gave us the impression that anticipation of food or ending of the feeding time respectively, causes an increase in frequency of yawning. Conclusively, yawning has been shown to have a reciprocal relationship with the overall activity level of the individual: before the performance of a yawn the kinetic activity of the fish is low, while after yawning activity increases.

"MICRO-PALAEONTOLOGICAL STUDY IN GELA SECTION, AREA OF PETRAS, SITEIA (EAST CRETE, GREECE)"

Fanouraki, Eleftheria

Supervisor: C. Fasoulas

University of Crete, Department of Biology
Natural History Museum of Crete

A partial deinothere skeleton, comprising seven cheek teeth, two rib bones, an atlas, a radius and a body of vertebra, was excavated last year in Gela section, Siteia area. The accurate dating of the findings was not possible using common radiochronological methods because of the way of preservation. Thereby the dating was estimated by comparative stratigraphic studies. According to those the age of Gela section is middle Tortonian (8 – 9 mya), which corresponds to MN10-MN11, Neogene Mammalian bio-zones. In order to get a more accurate dating of these sediments, a micro-palaeondological study took place searching for guiding fossils (terrestrial or marine), and especially micromammal fossils indicative of the MN10-MN11 bio-zones. However, such micromammals weren't found. The most interesting findings are 2 shells of Prosobranhia, Gasteropoda. One belongs to the species *Crepidula crepidula unguis* coming from the fossiliferous horizon. The other finding is a shell belonging to a species of the genus Gibbula and a lot of operculum of the same shell, all coming from the excavation's material. These are not guiding fossils and thus not helpful for indicating a more accurate dating of the sediments, but the existence of the *Crepidula crepidula unguis* species confirms that the sediments of the fossiliferous horizon are of upper Miocene age.

"A STUDY ON THE INFLUENCE OF FISH FARMING ON THE BENTHIC MACROFAUNA IN THE AREA OF LESVOS"

Kaltsas, Dimitrios

Supervisor: I. Karakassis

University of Crete, Department of Biology
Institute of Marine Biology of Crete

The purpose of this study was to find out if fish farming had any influence on the benthic macrofauna near Lesvos island. The sediment that was examined in this study was sampled relatively near the farming cages (1-5km) and far from them (5-15km) and was sieved successively through 2mm and 0.5mm mesh. Macrofauna was sorted out and the main taxa found were Polychaeta, Sipuncula, Crustacea, Mollusca and Echinoderma. Afterwards the wet biomass was measured separately for every taxon at an accuracy of 0.0001g.

The results showed that Polycaeta was the dominant taxon in the sampling area. In all taxa the biomass of large individuals (Sieve 2mm) was higher than smaller ones (Sieve 0.5mm). Statistical analysis showed that the small animals had the same biomass near and far from the cages, whereas the larger ones far from the cages had above than twice the biomass of those near the cages.

There was no statistical differentiation between the biomass of all taxa near and far from the cages, probably because the samplings near the cages were actually done far from them, and not just a few meters, as in many previous studies, which proved statistical differentiation due to anoxic conditions, which led to primary and secondary disturbance. The basic cause of differentiation in the present study possibly lies on the composition of the sediment, and not on the fish farming itself.

"GEOGRAPHIC AND ALTITUDINAL VARIATION OF MORPHOMETRIC CHARACTERISTICS IN *Euscorpius carpathicus* (Euscorpiidae, Laurie 1896)"

Katsimanis, Nikolaos

Supervisor: A. Trichas

University of Crete, Department of Biology
Natural History Museum of Crete

Several morphometric characteristics were measured for 403 individuals of *Euscorpius carpathicus,* which had been collected with pitfall traps from several altitudes (200-2000m) of 4 mountains of continental Greece (Ossa-Thessalia, Rodopi-Macedonia, Erymanthos and Chelmos – Peloponnese) and 3 mountains of Crete (Idi, Dikti and Lefka ori). The aim was to study the morphometric variation in these populations. Specifically, we took measurements of the body length (prosoma, mesosoma, metasoma – continuous variables) as well as of the number of trichobothria of the pedipalp tibia (TPT) and the number of pectinal teeth (discrete variables). We also calculated the P/M index (prosoma/mesosoma length ratio), which is supposed to be a good predictor of the food availability in the scorpions' environment. Using multivatiate analysis (Principal Component Analysis and Cluster Analysis), we resulted in 3 distinct geographic groups: 1. Ossa and Rodopi 2. Peloponnese mountains and 3. Crete's mountains (with 2 subgroups – 3a. Idi and Dikti and 3b. Lefka ori). On the other hand we didn't obtain such a clear grouping for the altitude. We also found a remarkably high value for P/M index in Lefka ori population possibly reflecting the the unfavorable trophic conditions of this mountain.

"SKIN MELANIN CONTENT IN COMMERCIALLY IMPORTANT SPARIDAE WITH REDDISH COLORATION"

Konsolaki, Marina

Supervisor: M. Pavlidis

University of Crete, Department of Biology

The aim of this study was the determination of skin melanin concentration in two commercially important Sparidae, in order to describe the melanin distribution pattern. Species were provided from the local market. Twenty individuals were examined, divided in three groups, A: *Pagrus pagrus,* body weight 149.0±9.0 gr (x±SEM, n=10), B: *Pagrus pagrus,* body weight 543.0±203.7 gr (n=5), and C: *Dentex maroccanus,* body weight 660.0±98.40 gr (n=5).

Skin samples were taken from different body areas of the right side of the fish and the tail. The area of each skin sample was measured by employing a video- image processing adapted to stereoscope. Skin samples pretreatment was according to Wilson and Dodd (1973) and Sugimoto (1993). Melanin concentration was determined by measuring the absorbance of the supernatant at 340 nm against a sepia melanin synthetic standard (Sigma, M-2649).

Results showed that there were differences both in the total skin melanin content and the distribution pattern between all groups. Higher total melanin was observed in group C and lower in group A. Concerning the distribution pattern, there was no statistical significant differences among the areas tested in group C, while higher melanin content was observed in the tail and lower in the ventral area, in groups A and B.

In conclusion these data provide the bases for a better understanding of the macroscopically observed skin color differences among the examined fishes.

"THE EFFECT OF FISH DENSITY ON THE ADAPTATION OF JUVENILE GILTHEAD SEA BREAM *Sparus aurata* TO USING SELF-FEEDERS"

Madi, Katerina

Supervisor: P. Divanach

University of Crete, Department of Biology
Institute of Marine Biology of Crete

The gilthead sea bream (*Sparus aurata*, Linnaeus, 1758) is considered as a widely raised species both under intensive and extensional conditions of stockfarming. It is still a highly relevant fish for research, as many elements of its biology, that ultimately could help improve its conditions of stockfarming, remain poorly studied.

In the present study 1870 individuals of gilthead sea bream (*Sparus aurata*) were used, with initial lengths of 23.37 mm (±1,94) and weights of 0.14 mg (±0.08). Prior to the beginning of the experiment the fish had not come in contact with manual feeders, but only with automatic feeders. The fish were placed in cylindrical-conical 50 l tanks and they were fed by self-feeders throughout the duration of the experiment. The number of fish per tank was 5, 10, 20, 50, 100, 250 and 500 individuals with two duplicates of each. The aim of the experiment was to study the learning abilities of gilthead sea bream, in regards to the use manual feeders mainly examining the effect of fish-density in the process of learning.

Throughout the duration of the experiment a line of abiotic parameters (consumption of food per fish, oxygen, temperature and salinity) was measured. The principle result of the study was that a positive correlation exists between the consumption of food per fish and fish-density. This correlation remains statistically significant even after various factors such as oxygen, temperature, etc. are accounted for. It has been shown that learning is faster in the bigger teams of fishes (tank A250), which is basically due to the powerful sovereign hierarchies that were developed between the individuals.

"THE RATE OF CROSS-SPECIES MICROSATELLITE AMPLIFICATION SUCCESS IN RANID FROGS"

Papadakis, Ioannis

Supervisor: E. Zouros

University of Crete, Department of Biology

The number of amphibian species declines globally. At the same time we experience the discovery of new amphibian taxa even from relatively well studied regions. This has prompted an interest in population and conservation genetic studies of amphibians. This discovery is owed to the use of suitable molecular genetic markers, such as microsatellites and their identification. The initial studies were focused on the use of many of such microsatellites aiming to select the most suitable, as far as the rate of amplifying the results of PCR in crossed types of ranid is concerned. However, it has been observed that the results of PCR are further amplified also with regulation of the conditions of PCR.

The aim of this work is focused on the identification of the most characteristic microsatellite loci from those studied and to estimate the optimum conditions for PCR amplification. Different green frog taxa were studied from the Balkan Peninsula. Two pairs of microsatellite loci were checked (Res20 and Res22) and optimised for different conditions.

"EFFECT OF AQUACULTURE ON THE GROWTH OF THE BROWN SEA COMBER (*Serranus hepatus*)"

Polychronidis, Lysimachos

Supervisor: A. Machias

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Institute of Marine Biology of Crete

Ten trawl samples of the brown comber *Serranus hepatus* (Linnaeus, 1758) were collected during experimental surveys carried out from the 14th to the 31st may 2001 in the South Euvoic Gulf and around the island of Lesbos in the Aegean sea. Trawls were conducted in sites that were in close proximity to aquaculture installations and in sites away from them. A total of 1187 specimens 50 – 105 mm in total length were analyzed to study the possible biological effects that are imposed in fisheries by aquaculture activities. The relationship between the total length of the fished samples and their eviscerated weight was calculated, and by utilizing the saggital otoliths an age-length key frequency was produced. Furthermore, the distributions of the total lengths of the fish were compared for samples taken far and near aquaculture installations. Results demonstrate that there is a difference in size and vigor between individuals fished near and far from aquaculture installations.

"COMPARISON OF FOREST ECOSYSTEMS IN EAST AND WEST CRETE, BASED ON BIOTOPIC DISTRIBUTION OF GROUND BEETLES"

Sfakianaki, Georgia

Supervisor: M. Mylonas

University of Crete, Department of Biology
Natural History Museum of Crete

The main object of this rotation is to analyse the biotopic distribution of the beetles in the different ecosystems of Crete. (fauna composition relations and biodiversity per each group of beetles, with the equivalent biotopical type).

All the data were collected with the method of sampling in 14 different forest biotopics in East and West Crete. They were used ''ground'' traps, so to be able to understand 1) the number of the species per trap and per sampling station 2) the total numbers of species per ecosystem and per season. Finally it was examed 70 totally samplings in all stations. Six (6) in East Crete and in the reagions of Selakano, Krousta, Prina-Messeleri, D. Village. where the dominant specie is the Pinus brutia in dry soils with less demants and the rain percentage is low. In the opposite, in the West Crete were occured eight (8) samplings in the the regions of Askifou, Saint Titos, Kardaki, Saint Fotini, Rouvas, Krapi, Armeni and Kastellos, where the rain percentage is higher and the biodiversity of the vegetation is better. It is consisting mainly with forests of Quercus and Cypressus.

- Master Theses-

"POPULATION STRUCTURE OF THE EUROPEAN HARES OF GREECE"

Antoniou, Aglaia

Supervisors: J. Papamatheakis, A. Magoulas

University of Crete, Department of Biology
Institute of Marine Biology of Crete

The European hare, *Lepus europeus* has been hunted from humans since the beginning of their existence. During the last decades population translocations have been practiced in some European countries. Although hare populations are not endangered, their study is interesting from a conservation-related point of view. They occur at both cultivated and non-cultivated spacious landscapes, not only in the mainland but on islands as well. Greek populations of the European hare were studied by means of nuclear markers. The general phylogeographic structure obtained from microsatellites studied raise the question of the manner in which genetic structure is created and maintained suggesting the critical role of behavior and population dynamics in evolutionary procedures. Population studies of insular and continental parts of Greece reveal the important role of islands as absolute barriers and a major effect of geographical distance. Nuclear genetic variation is in accordance to the pattern of mitochodrial divergence revealing the presence of two divergent and geographically distinct clades that overlap in northeastern part of Greece and Bulgaria. The strong genetic structure of apparently continuous populations in continental Greece might be related to Pleistocene subdivisions and isolation by distance. The genetic structure observed in Greek populations is over against the almost complete absence of genetic structure observed in a larger geographical scale like that of central and northern Europe. This is in accordance to the hypothesis of the European hare differentiation in isolated refugees of the Balkan Peninsula during the last glaciation.

"DIURNAL TIME - ACTIVITY BUDGETS FOR FOUR ANATIDAE SPECIES IN THE ARTIFICIAL LAKE OF BRAMIANA DURING THE WINTER"

Arvanitis, Pantelis

Supervisor: M. Mylonas

University of Crete, Department of Biology
Natural History Museum of Crete

Diurnal time - activity budgets, were compiled for four Anatidae species, Mallard *(Anas platyrhynchos)*, Teal *(Anas crecca)*, common Pochard *(Aythya ferina)* and Ferruginous duck *(Aythya nyroca)*, at their two most important wintering areas, artificial lake of Bramiana (Ierapetra) and the lake of Agia (Chania) in Crete, during November 2001, December 2001 and February 2002.

Diurnal time - activity patterns varied among and within the four Anatidae species depended on both the species and the season. Physiological - social status of birds and environmental conditions during wintering time influenced behavior patterns.

According to our data, ducks spent most of their daily time resting and feeding, for the whole wintering period. Generally dabbling ducks and common Pochard spent much of their daily activity resting, while Ferruginous duck feeding.

Generally, ducks demonstrated a greater activity in the morning and the afternoon, where they spent most of their time on locomotion and feeding. Resting peaked, for all species, in the middle of the day.

The lake of Bramiana and Agia are exploited by the birds as a diurnal roost for both feeding and resting. Bramiana lake, apart from an area of intermediary stations during immigration time, constitutes the most important wetland for wintering *Anas crecca, Anas platyrhynchos, Aythya ferina and Aythya nyroca* in Crete.

Sudden rise of water level during the winter at the dam of Bramiana forced mainly Pochard species, to leave early. For this reason it is necessary to create special protection areas in the lake which will both maintain the desirable level of the water and will supply Nonbreeding Anatidae with enough food.

"FEEDING ECOLOGY AND DISTRIBUTION OF BATS (MAMMALIA: CHIROPTERA) OF CRETE"

Georgiakakis, Panagiotis

Supervisor: M Mylonas

University of Crete, Department of Biology
Natural History Museum of Crete

Feeding ecology of bats is a top priority research field for the past decades across the globe. Apart the important information about the animals' ecology and biology, it reveals knowledge essential for the planning of management strategies for some of the world's most threatened mammal species belonging to this order.

In the present study bat activity was surveyed in 17 sites located in 3 mountain areas on the island of Crete (South Leyka Ori, North Leyka Ori and North Psiloritis). 2Km transects were walked and emitted echolocation calls were converted in the human audible sound range via an ultrasound detector. Converted calls were stored in an DAT recorder and assigned to species or species groups with the use of appropriate software.

A total of ten of the fourteen bat species recorded from Greece so far and one species group comprising one to three species were located in the three study areas. Data processing showed significant variety in the abundance of the recorded species and their activity patterns in different ecosystem types, elevations and recording dates. The european free-tailed bats (*Tadarida teniotis*), Kuhl's (*Pipistrellus kuhlii*) and common pipistrelles (*Pipistrellus pipistrellus*) were the most abundant and widespread in the sites inspected, while *Rhinolophus* species (*R. hipposideros*, *R. ferrumequinum* and *R. blasii)* and lesser mouse-eared bats (*Myotis blythi*) were the most rare. Villages and low elevation coniferous forests seem to support higher bat diversity and abundance, while alpine scrublands seem to have the lowest significance among all ecosystems examined.

"PHYTOGEOGRAPHICAL STUDY OF THE SOUTH AEGEAN ISLAND ARC"

Kagiampaki, Anna

Supervisor: M. Mylonas

University of Crete, Department of Biology
Natural History Museum of Crete

The current bibliography concerning the flora and vegetation of 37 large islands and small islets of the South Aegean island arc was used to create a database, in order to examine the plant species - area relationship. The application of the logA – logS model (where A is the area of each island and S is the number of plant species on each of them) to these 37 large and small islands, plus 11 small islets situated around Karpathos, revealed a rather high adaptation to the model for the large islands. As for the small islets, the "small island effect" is observed. The same logA – logS model was applied for the species of selected plant families. The results of this application where compared with the species – area curve for the total of the islands' plant species, using the two parameters of the species – area equation, in order to examine whether specific patterns are observed.

"STUDY OF THE DIFFERENTIATION AND PHYLOGENY OF POPULATIONS OF GENUS *Rana* IN GREECE WITH EMPHASIS IN THE SOUTH AEGEAN ARC, BASED ON BIOACOUSTIC AND MOLECULAR INDICATORS"

Mandalou, Georgia

Supervisor: M. Mylonas

University of Crete, Department of Biology
Natural history Museum of Crete

Genus *Rana* is a cosmopolitan genus. In Europe it is represented by several species, which are separated in two distinctive groups: brown and green frogs. These two groups differ from each other due to ecological, morphological and molecular characters as well as in the reproducing manner.

Rana ridibunda is a species that belongs to green frogs. Till recently (1984), because of the morphological resemblance among the Greek populations, it was believed to be the only green frog in Greece. Today there are thought to exist four different species: *Rana ridibunda (continental Greece)*, *Rana epeirotica (*west continental Greece*)*, *Rana cretensis (Crete)* and *Rana cerigensis (Karpathos and Rodos)*. *Rana cretensis* and *Rana cerigensis* are thought to be new species since 1994 as a result of a study in allozymes and bioacoustics.

This study hopes to confirm the former deficient result using not only the reproducing croaking which must differ between discrete species but also comparing the sequences of two mitochondrial genes, cytochrome b and 16sRNA. We also hope to obtain a more clear view of the phylogenetic relations among Greek populations we included in this study.

"STUDY OF SOMATIC AND REPRODUCTIVE GROWTH OF FEMALE AND MALE POPULATIONS OF EUROPEAN SEA BASS (*Dicentrarchus labrax*) DURING THE SECOND YEAR OF LIFE"

Nitadoraki, Liliana

Supervisor: M. Pavlidis

University of Crete, Department of Biology
Institute of Marine Biology of Crete

European seabass (*Dicentrarhus labrax*) fry with high male occurrence (up to 95%), pose an important problem for aquaculture, due to the lower growth rate of males compared to females. The present study, contributing to the knowledge of the influence of sex to the physiology and growth of seabass, examined the somatic and reproductive growth of a male-dominant and a female-dominant population during the second year of life, aiming to 1) identify differences in their growth rate, 2) monitor reproductive maturity and 3) correlate growth differences with endocrine factors (T_3, T_4 και IGF-1). Using intensive size grading from day 56 post spawning, an initial population composed of 59% females has been used to create a population with large individuals (L, 96% females) and one with small individuals (74% males). On a monthly basis, both populations were sampled for blood, length/weight**,** feed consumption and conversion, specific growth rate, reproductive maturation, and plasma levels of T_3, T_4 και IGF-1.

"CORRELATION OF GONADAL STEROIDS AND SEX DIFFERENTIATION IN THE EUROPEAN SEA BASS (*Dicentrarchus labrax)*"

Papadaki, Maria

Supervisor: C. Dermon

University of Crete, Department of Biology
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The aim of the study was to investigate the correlation between plasma sex steroid levels and sex differentiation in the European sea bass (*Dicentrarchus labrax*). Based on the assumption that females grow faster than males from very early in development, intensive grading was used to separate large fish (presumed females) from small fish (presumed males), in order to create female- and male-dominant populations. The intensive grading protocol applied led to the production of the two desired groups, with the "large" population consisting of 96% females and the "small" one containing 74% males. The first histologically recognizable signs of sex differentiation were visible on day 150-post hatching. Females grew faster than males and reached a body weight of 2x of males on day 300 ($P<0.01$). Males matured on the first year of life, especially the largest ones, where maturation reached 100%. A sexual dimorphism was apparent in the plasma levels of the androgens (testosterone and 11 – ketotestosterone), but not in the ones of the estrogen, estradiol - 17β. The increased levels of androgens on day 300 after hatching coincide with the presence of premature males in the populations. It still remains unclear, however, if steroid production precedes or follows gonadal differentiation.

"MODELING PHOTOSYNTHESIS AND GROWTH OF PHYTOPLANKTON IN LIGHT- AND CO_2 -LIMITED CONDITIONS"

Papadakis, Giannis

Supervisor: K. Lika

University of Crete, Department of Biology

Phytoplankton can be used for the absorption of polluting carbon dioxide (CO_2) with the aim of controlling the greenhouse phenomenon.

In this work we formulate a Dynamic Energy Budget model of phytoplankton growth which explicitly account for the light and dark reactions of photosynthesis, as well as for the variation in carbon cell quota with photon flux density and ambient carbon dioxide concentration.

The state of a cell is characterized by two components, permanent biovolume and a transient carbon pool. The model uses the concept of synthesizing unit to quantify how an individual cell absorbs and uses light and carbon dioxide for carbohydrate production and laws of thermodynamics to quantify the utilization of assimilated energy for growth and maintenance. Assimilation acts to increase the transient carbon pool, whereas maintenance and growth both act to decrease it. Light reactions (oxygen production, NADPH, dissipating light, etc.) are expressed in terms of the photon flux density and the state of the cell and the dark reactions are expressed in terms of the photon flux density, the CO_2 concentration and the state of the cell.

The model accurately describes experimental data for the photosynthesis- irradiance curve, for cells that are photo acclimated to low light as well as to high light conditions.

The main goal of the model is to predict the optimum combination of light flux density and carbon dioxide concentration for which total biomass production and photosynthesis are maximized.

"DYNAMICS OF THE MACROBENTHIC COMMUNITIES OF THE LITTORAL ZONE OF THE SANDY STRETCHES OF CRETE"

Papageorgiou, Navsika

Supervisor: A. Eleftheriou

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The aim of this project was the study of the community dynamics and the biological interactions in the mid- and sublittoral ecosystems of the sandy shores of Crete through the study of the macrobenthic invertebrates. The littoral zone which has not been fully known in the Eastern Mediterranean presents special interest not only from the scientific point of view but also for practical reasons in ecological management. Towards this seasonal samples from the littoral zone of three sandy beaches of Crete were collected on an annual cycle. The analysis of the macrobenthic data was counted at the level of the main taxonomic groups with emphasis on the Polychaets, the most abundant group in these areas. Accordingly to the season, the degree of exposure, the position of the sampling station and the sediment depth, the fauna showed spatial and temporal fluctuations in the abundance and the composition of the community. In general the highest abundance was found in the top 10cm of the sediment in the areas having the least exposure and showing the highest sediments stability. The study of the biotic and abiotic factors as well information on the dynamics and biodiversity of the sandy beaches is essential in areas of environmental instability affected by anthropogenic influences from the several stakeholders in the use of the coastal environment (tourism, urbanization, coastal works etc).

"ASSESSMENT OF THE ABUNDANCE AND BIOMASS OF A WILD FISH POPULATION AROUND MARICULTURE CAGES WITH THE USE OF STEREO VIDEO"

Pavlidis, Andreas

Supervisor: A. Eleftheriou

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A stereo - video device was used for the assessment of the abundance and biomass of a wild fish population around mariculture cages. It consisted of two CCD (charge-coupled device) cameras, placed in water-proof housings and bounded together on a base-bar at inward angles. The identification, counting and length measurement of the fish that were recorded is done with the VMS computer program. The synchronization of the two camera tapes was done with the aid of sound signals, transmitted by a single MP3 device.

Four transects took place: two in 2 m depth and two in 8m around the same cages. During the video analysis the collected data were divided into sub-transects or lines that actually correspond to different edges of the fish cages. In this way we hope to discover, along with the overall abundance and biomass, which parameters, if any, affect the distribution of different fish species around the cages (e.g. correlation with fish that are fed in each cage, depth, orientation, physical parameters etc.). The statistical analysis is still in progress.

"EFFECTS OF AQUACULTURE ON GROWTH OF FOUR FISH SPECIES"

Pinakis, Eleftherios

Supervisor: M. Kentouri

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Aquaculture has had a rapid development during the past 15 years in the Mediterranean region. In the present study, the effects of aquaculture on wild populations of four fish species (*Mullus barbatus*, *Serranus hepatus*, *Lepidotrigla cavillone*, *Spicara flexuosa*) are investigated. Sampling took place at three different regions of the Aegean Sea (South Evoikos Gulf, Lesvos, Chios) during two research surveys that were held on May 2001 and September 2002. In each region three hauls were made near to the aquaculture sites (1 – 2 nm) and three far from them (15 nm). Total length (TL, mm), total weight (TW, g), eviscerated weight (EW, g) and gonad weight (GW, g) were measured. Age was determined based on otoliths. Length frequency distributions, length – weight relationships and von Bertalanffy growth curves were produced for each species. Preliminary results for *Mullus barbatus* have shown that no statistical difference was observed between the near and far sampling sites. Individuals of age 2 dominated *Mullus barbatus* catches. For *Serranus hepatus, Lepidotrigla cavillone* and *Spicara flexuosa* the analysis is in process.

"DEVELOPMENTAL DETERMINATION OF ADAPTIVE FUNCTIONALITY IN FISH"

Sfakianakis, Dimitris

Supervisor: M. Kentouri

University of Crete, Department of Biology

The swimming performance of sea bass juveniles, *Dicentrarchus labrax* L. (24-44 mm total length, TL) in respect to their developmental temperature was studied, in order to establish development's subsequent effect on the swimming ability of fish. Fish ontogeny proceeded under two developmental temperatures (15 and 20 ºC), after which fish were moved to a common temperature (maintenance temperature, 18.5ºC). Swimming trials were conducted in four different swimming temperatures (15, 20, 25 and 28 ºC) and their relative critical swimming speed ($RU_{crit}=U_{crit}$ TL^{-1}) was used as a measure of their swimming performance. At the lower swimming temperature, the performance of the two populations was not significantly different ($p>0.05$). On the other hand, fish developed at 15 ºC exhibited in all other swimming temperatures (20, 25 and 28 ºC) higher RU_{crit} values than fish developed at 20 ºC ($p<0.05$, in all cases). The estimated maximum RU_{crit} for fish developed at 15ºC (10.6 TL s^{-1}) was achieved at 27.2 ºC, whereas for those developed at 20ºC (9 TL s^{-1}) was achieved at 26.1 ºC.

"COMPARISON OF FERTILITY AND REPRODUCTION CAPACITY OF TWO FISH SPECIES (*Mullus barbatus & Serranus hepatus*) NEAR TO AND FAR FROM FISH CULTURES"

Stamataki, Charikleia

Supervisor: M. Kentouri

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The aim of this project is to compare the fertility and reproduction capacity of the species *Mullus barbatus* and *Serranus hepatus*, at close and far distances from fish cultures, in three different areas. Specifically, individuals of these two species were examined from fish cultures in Southern Evoikos Gulf, Chios and Lesvos. Sampling took place in May 2001 in the context of the AQCESS program with the research vessel "Filia" of I.M.B.C.. The production capacity of South Evoikos Gulf fish culture reaches 1.300 tones, of Chios 3.000 tones and of Lesvos 700 tones. In each area three sampling stations were used at distances of 1-2 miles from the fish cultures and three control stations at distances of 10-15 miles. The two species showed great abundance in all three areas.

Until this moment, tissue sampling was accomplished for both species as well as the identification of the maturity stages of the individuals of *M. barbatus*. The measurements of the fertility capacity of both species are in progress and is done with the hydrated oocyte method. This method is gravimetric, based on the use of preweighted gonad sub-samples. The preliminary results of the *M. barbatus* show that 90% of the samples were hydrated, while no significant difference in fecundity was observed between the individuals that were fished at close and far distances. The completion of the analysis will show if the presence of fish cultures has an effect on the reproduction of the species.

"ENDOCRINE REGULATION OF EARLY DEVELOPMENTAL STAGES IN MARINE FISH - THE ROLE OF THE THYROID HORMONES"

Szisch, Vera

Supervisor: M. Pavlidis

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The thyroid gland produces and secretes mainly two hormones (THs), triiodothyronine (T_3) and $_L$-thyroxine (T_4), which regulate a wide range of developmental, metabolic and homeostatic processes in fish, such as metabolism, development, reproduction, metamorphosis and behavior.

In fish the transformation of larvae into juveniles is frequently termed metamorphosis. Metamorphosis arises from a series of regulated processes that involve tissue differentiation, biochemical, molecular and physiological changes. The most dramatic manifestation of this is the classic metamorphosis of flatfish (*Pleuronectiformes*) in which bilaterally symmetric pelagic larvae convert into asymmetric benthic juveniles with both eyes on the same pigmented side of the body. The role of THs in metamorphosis of flatfish today is well understood, but relatively little attention has been paid to the role of THs in the change from larvae to juvenile in other species, which have a less dramatic transition than the flatfish. For instance there are no data on the role of thyroid hormones in metamorphosis of the gilthead sea bream (*Sparus aurata*) larvae.

The aim of the project is to investigate the role of thyroid hormones in the regulation of early developmental stages in *Sparus aurata*, a model species for Mediterranean mariculture. The objective was to develop and evaluate a method for the determination of THs in eggs and larvae, and to determine the pattern of changes in THs concentrations from the fertilized egg to fry.

"THE BIOLOGY OF THE *WOLBACHIA* TRANSINFECTED FLY *C. Capitata*"

Theodorakopoulou, Marianna

Supervisors: A. Economopoulos, C. Bourtzis

University of Crete, Department of Biology

Wolbachia is an obligately intracellular, widely distributed and maternally inherited bacterium that causes a number of reproductive alterations in its eukaryotic hosts. Such alterations include the induction of cytoplasmic incompatibility, parthenogenesis, feminization and male killing. Cytoplasmic incompatibility leads to embryonic mortality which occurs when infected males mate with uninfected females or females with a different *Wolbachia* strain.

Wolbachia bacteria may infect as many as 76% of all insect species. Individual host insects can harbour more than one *Wolbachia* variant and while most infections are thought to be single, multiple infections are increasingly being documented. These important bacteria may play a role in rapid speciation in insects. There is growing interest in their potential uses as tools for biological control and genetic manipulation of pest and disease vectors.I will present data from transinfected populations of *Ceratitis capitata* with a *Wolbachia*, originated from the dipterum *Rhagoletis cerasi,* referring to:

- the **possible alterations** at the behaviour of the infected and uninfected insects
- the **distribution** of the bacteria at the embryos, the testes and the ovaries of the infected insects
- **cloning and molecular characterization** of an unknown strain of *Wolbachia*.
- the **co transfer** of the symbiont *Wolbachia* and the host mitochondial haplotypes

"IMPLICATIONS OF mtDNA RECOMBINATION IN THE EVOLUTIONARY DYNAMICS OF THE DUI SYSTEM IN *Mytilus galloprovincialis*"

Theologidis, Ioannis

Supervisor: E. Zouros

University of Crete, Department of Biology

The bivalves of family Mytilidae show an unusual pattern of mtDNA inheritance. Female individuals inherit an mtDNA type that derives from their mother (F type). Male individuals, however, also inherit their father's mtDNA (M type). This system of mtDNA transmission has become known as Doubly Uniparental Inheritance (DUI).

The observation that the mussel mtDNA recombines raises the possibility of presence in the population of mosaic mtDNA molecules (molecules containing pieces of sequences from both types). The possibility was tested in male and female gonads by examining four regions (COI, COIII, 16S rRNA, ND5) at disjoint parts of the circular molecule through RFLP (Restriction Fragment Length Polymorphism) scoring of the PCR product.

In males, we found that the majority (70%) of paternally transmitted molecules were pure M type, about 10% were mosaics and the remaining (20%) had the F RFLP type in all regions examined. Contrary to the finding of mosaic M molecules in males, only pure F types were recovered in females.

These observations agree with what we know about DUI, according to which mtDNA recombination is possible only in males, where the two types coexist. From these males, recombinant molecules have to be transmitted though the sperm, i.e. they have to behave as M type molecules. This confirms that the maternally transmitted mitochondrial genomes behave as independent lineages whose evolution is not affected by events occurring in the paternal lines. Because the exact opposite occurs with the paternal molecules, we conclude that DUI imposes a one-way flow of genetic information, i.e. from F to M molecules.

"SPECIES RICHNESS, HABITAT DIVERSITY, AND AREA: A TEST OF CHOROS MODEL"

Triantis, Konstantinos

Supervisor: M. Mylonas

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The aim of the present work is to study the behaviour of the choros model, which combines the effects of both habitat diversity and area on species richness, in an archipelago with specific measure of environmental heterogeneity.

A survey of the land snail species was carried out on 12 islands of the Skyros' archipelago in the central Aegean Sea, during three expeditions. The different types of habitats were defined based on the ecology and biology of each species distributed in the archipelago. In total, 43 different land snail species were found living in ten different habitat types.

The choros model displayed better fitness compared to the classic species-area model both for all the islands of the archipelago as well as for the small islands alone. It has the ability to describe the species addition in islands taking into account the effects of their size and their environmental diversity. It can also most effectively approach the small island effect.

The direct effects of area and habitat diversity on the species richness have almost the same direct effects. However, the total effects of the area exceed those of habitats. In small islands there is a reduction of the total effects of area when the effects of habitat diversity are increased.

Both z-values from choros model and the classic species-area relationship, place the archipelago, in the within biogeographic province category, mainly due to the "recent" formation of the archipelago. This "recent" formation resulted into an island group, comprised of small islands that still "behave" as parts of a continuous landmass.

"TYPES OF mtDNA THAT ARE TRANSMITTED VIA SPERM AND THE RELATION TO DOUBLY UNIPARENTAL INHERITANCE OF MTDNA IN MUSSEL *Mytilus galloprovincialis*"

Tsagkarakis, Defkalion

Supervisor: E. Zouros

University of Crete, Department of Biology

Doubly uniparental inheritance of mitochondrial DNA (mtDNA) is an unusual feature found in marine mussels and a few other bivalve species. These species have two types of mitochondrial DNA: one that is transmitted from mother to both female and male offspring (F type) and one that is transmitted from the father to sons only (M type). The two molecules have, therefore separate transmission routes, one through the female and the other through the male lineage. In most cases the two molecules differ by more than 20%. But there are exceptions in which the M genome is very similar with the F genome. This is referred to as "masculinization" of the F genome and might lead to a "role reversal" in which an old F genome enter the male lineage displacing M type molecules and setting the differentiation time of the two lineages to zero.

Recent evidence exists that mtDNA undergoes homologous recombination. This led to the hypothesis that the so called "masculinized" F genomes are actually recombined molecules that acquired those specific sequence from the M genome that specify the characteristic M behavior.

The present thesis tries to obtain direct evidence whether F or recombinant mtDNA molecules are transmitted via sperm to the next generations, whether mtDNA recombination is a general or restricted phenomenon, and the relation of recombination with the phenomenon of "masculinization". Sperm from 38 different male mussels was examined. The analysis was focused mainly on the large region of the mtDNA genome with no known function (UAR), which is suspected to carry the specific sequence that modify the behavior of M molecules.

The results support the view that there is a strong mechanism that excludes the presence of F molecules in the sperm. In addition it seems that there is also a mechanism that prohibits the recombination between F and M molecules in typical male individuals.

- Doctoral Theses -

"BIOGEOGRAPHICAL ANALYSIS OF THE GROUND SPIDERS GNAPHOSIDAE (ARANEAE) OF CRETE AND ADJACENT ISLANDS"

Chatzaki, Maria

Supervisor: Mylonas

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Gnaphosidae is a spider family that presents high diversity and abundance in the Mediterranean region. It shows a clear preference to sunny, open grounds in arid environments. Species catalogues and data on their distributions in the whole area of the Mediterranean is far from thorough.

Results from the biogeographical analysis included in the phd thesis of the author are presented, namely the species distributions along the main axes of Crete and in comparison with the islands Antikythira, Karpathos, Kos and the satellite islands of Crete, Dia, Gavdos and Gavdopoula.

In total view, the xerophilous character and the wide ecological tolerances of the members of this family account for the distributions of its species along the island of Crete, much more than historical reasons relating to the formation of the island or ecological gradients along its main axes.

Comparing Gnaphosidae of Crete with the rest of islands under investigation, Crete holds its isolated, central position, leaving the rest of islands divided to groups that follow the geographical map.

The satellite islands of Crete are mainly composed of species that occur on Crete, without any taxonomical differentiations. The fauna of Gavdos as a whole is more similar to that of Crete, due to the greater size and heterogeneity of its landscape that permits more species to occur on it, but presents differences in the community structure and species composition.

"DISTRIBUTION OF MEIOBENTHOS IN THE DEEP EASTERN MEDITERRANEAN SEA, WITH SPECIAL REFERENCE TO FORAMINIFERA"

Chatzigianni, Eleni

Supervisor: A. Eleftheriou

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In order to study the distribution of meiobenthos (metazoa and foraminifera) in relation to the prevailing environmental parameters in the deep Eastern Mediterranean Sea, sediment samples (down to 6cm) were collected from different areas, in depths ranging from 582 to 4617m.

Within the meiobenthos community (>32μm), nematodes represented the most abundant group, followed by foraminifera. Total standing stock of benthic metazoa and foraminifera varied significantly among the sampling stations, being lower at the abyssal zone. The foraminiferal community consisted of both hard-shelled (calcareous/agglutinated) and soft-shelled (allogromiids and saccaminids) species, the latter of which constituted a significant part of the total assemblage. The levels of metazoan and foraminiferal standing stocks and the differences marked among the stations are strongly related to the oligotrophy of the eastern basin of the Mediterranean Sea and the different levels of productivity among the sampling sites. Moreover, the topographic and the sedimentological peculiarities of the sub-basins influence the spatial variability of the environmental parameters and thus the distribution of meiofaunal groups. Significant relationships were found between the abundances of major meiofaunal groups and the sedimentary chloroplastic pigments, indicating that food availability is a major factor controlling the distribution of meiobenthos.

""THE WATERBIRDS OF THE CRETAN LAKES AND RESERVOIRS: PATTERNS OF ABUNDANCE AND DIVERSITY IN RELATION TO THE ECOLOGICAL PARAMETERS OF THE BIOTOPES"

Dretakis, Michalis

Supervisor: M. Mylonas

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Cretan wetlands are well known as stopover and wintering sites for waterbirds but data is sparse and incomplete. Aims of this study were to improve knowledge for the waterbirds use of the wetlands and to estimate the relative importance in relation with their ecological parameters giving emphasis to new reservoirs. I studied population and seasonal patterns of six waterbird groups as well as breeding habitat selection and I compared them to ecological parameters. The largest Cretan wetlands (three artificial, one natural) have been selected for the counts and six more for comparison in breeding behaviour.

Qualitative data after six years study: 84 bird-species of waterbirds recorded, 50 regular. 9 species are seen all year round but only 4 are regular breeders. 27 species have been found during winter, 63 are mainly passage migrants and 6 only vagrants. Bramiana (largest artificial lake) and Agia (old semi-natural lake) hold more species and have high degree of regularly found species. The seasonal presence–absence tables give interesting findings like: large stay period of some species, presence of ducks during moult-migration and status change for certain species (occasional breeders to the island, have become regular, vagrants became regular visitors). Drop of water level has positive effect to species number in all seasons. No significant differences were found among the six studied years but were found among sites, especially in Charadriiformes.

Quantitative results. Waterfowl: There is an impression of gradual increase, which is significant in *Aythya ferina* case. *Fulica atra* and *Anas crecca* are common species and *Aythya nyroca* is now regular in good numbers. Bramiana reservoir is the best site for wintering and migrating waterfowl on the island. It is characteristic that small reservoirs could sustain more wintering waterbirds than some traditional sites. Most wintering species start to depart already from January but stay longer at Agia. Increase of water level has negative effect to numbers of some diving species. There

is a degree of preference for some species at traditional sites. Other waterbirds: mostly found at the migration seasons. Some heron species have two maximum curves in spring. Waders recorded mostly in May and in August-September taking advantage of the water decline.

Breeding activity results. There is a significant increase in the case of Agia although the nesting activity in the 4 wetlands is largely depending on water conditions. Breeding season seems to start very late. Breeding success is very low at Bramiana where there is no shelter. *Tachybaptus ruficollis* and *Gallinula chlroropus* used straightway the new reservoirs for nesting with high success.

"STUDY OF THE PARAMETERS AFFECTING THE HORIZONTAL DISTRIBUTION OF THE SMALL PELAGIC FISH IN THE GREEK SEAS"

Giannoulaki, Marianna

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Acoustic data, from six research surveys (4 in summer and 2 in winter) in Aegean and Ionian Seas, were used to illuminate the horizontal distribution of small pelagic, anchovy and sardine.

Geostatistical techniques were applied, in order to visualize the spatial structure of anchovy and sardine in the area. The effect of certain topographic characteristics (i.e. bottom depth, area size & the degree of land enclosure), on fish spatial structure was studied by multiple regression analysis. Results suggested that environmental spatial heterogeneity was mainly reflected to the way schools were organized into aggregations rather than the maximum size of the area occupied by these aggregations. Fish formed heterogeneous spatial structures in closed sub-areas during both seasons. During the winter period, more heterogeneous spatial structures were predicted for both species in small-sized sub-areas than in large sub-areas. This is explainable in terms of the increased fish density in small gulfs during the winter along with the peculiarities of each species' biology and the patchiness of the suitable fish habitats. The opposite was observed during the summer, when the spatial structures of anchovy and sardine were more homogeneous in small-sized sub-areas than in large sub-areas.

In addition, acoustic data were combined with hydrological and biotic parameters to examine the relationships between the spatial distribution of anchovy and sardine with environmental regimes. For this purpose Cumulative Distribution Functions analysis and Generalized Additive Models were applied. A consistent trend of increasing anchovy biomass towards areas of high productivity was observed independently to sampling periods and season. The thermocline depth and temperature were the factors mostly affecting anchovy's biomass during the summer. During the winter period, differentiations in habitat preferences were observed between anchovy of different length classes. Similarly, sardine in Central Aegean Sea during the summer was associated to the more productive inshore waters, whereas the

opposite was observed in Ionian Sea. During the winter, a consistent preference was observed towards areas of high productivity such as river runoffs.

In conclusion, productivity mostly, as well as temperature, thermocline depth and bottom depth consisted the main environmental factors that define anchovy and sardine's habitat in the Greek Seas. These environmental factors along with the complex coastal topography of the Greek Seas, affected the organization of the small pelagic fish spatial structures

"EFFECTS OF TOWED FISHING GEARS ON HYPERBENTHIC COMMUNITIES"

Koulouri, Panagiota

Supervisor: A. Eleftheriou

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Many studies have shown that otter trawls, commonly used for demersal fishing, disturb, damage or kill a variety of epi- and infaunal benthic organisms and that this may lead to increased opportunistic feeding by invertebrate and fish predators. However, we have found no reports on the effects of demersal fishing gears, particularly otter trawls, on hyperbenthic fauna. This lack of information contrasts with the importance of hyperbenthos to fisheries, in that the hyperbenthic communities act as a food resource for many commercially exploited demersal fish and epibenthic crustaceans. We studied these effects in the continental shelf of Heraklion Bay (Cretan Sea) using a novel apparatus to simulate and quantify the direct effects of the contact of otter trawl groundrope with the seabed on the hyperbenthic fauna. Preliminary results revealed that trawling causes significant perturbations in the structure of hyperbenthic communities.

"ASSESSMENT AND RISK MANAGEMENT OF COLLISIONS AIRCRAFTS TO BIRDS AT CIVIL AERODROME OF KAVALA (NE. GREECE)"

Lykos, Vasileios

Supervisor: A. Eleftheriou

University of Crete, Department of Biology

Collisions between aircraft and birds (bird strikes) are a concern throughout the world because they threaten passengers safety, result in loss of revenue and costly repairs to aircraft and can also erode public confidence in the air transport industry as a whole. This study funded by the Hellenic Ministry of Transportations and Hellenic Aviation Authority, concerns aerodrome of Kavala which is adjacent to Nestos' wetlands, one of the most fundamental refuges for migrating avifauna in Greece. According to International Civil Aviation Authority (I. C. A. O.) data, this airport runs greater risk of having a bird strike (39%) among all the civil airports in Greece, with an increase between May to September. This on going study, estimates bird abundance, distribution, movement patterns and their habitat attractors at Kavala airport and within an 8 km radius, which is the "bird critical zone", with a view to assess current air-strikes hazards on real time and also to provide wildlife hazard management plans through the modifications of habitat and food sources potentially related with bird hazards. The detection of birds on real time depends on time – area field surveys and also on the development of a prototype modified surveillance radar for obtaining ground track data and consequently, bird temporal and spatial flight patterns. This research is under the supervision of the supreme independent national Committee for flight safety and investigation of aviation accidents.

"DEVELOPMENT OF MICROSATELLITE MARKERS IN THE FRESH WATER TURTLE *Mauremys rivulata* (Valenciennes, 1833) (Testudines: Bataguridae)"

Mantziou, Georgia

Supervisor: M. Mylonas

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Tandemly repeated DNA sequences of 1-6 bp are referred as microsatellite loci. Microsatellite loci often exhibit many alleles per locus, high levels of heterozygosity and have become a widely used marker for population genetic structure. A microsatellite – enriched DNA library was developed from the genome of *Mauremys rivulata* following the protocol by Hamilton *et al.* (1999) with small modifications. We describe the development of four microsatellite loci, which will be used in population – level analysis for *Mauremys rivulata*.

"DISPERSAL, DENSITY, SPATIAL DISTRIBUTION, NEIGHBOURHOOD SIZE AND HABITAT PREFERENCE OF TWO SYMPATRIC *Mastus* (GASTROPODA, PULMONATA, BULIMINIDAE) SPECIES"

Parmakelis, Aristeidis

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Two sympatric *Mastus* species, *M. butoti* and *M. cretensis* both endemic in the island of Crete, were investigated regarding density, spatial distribution, neighbourhood size and movement patterns of their individuals in order to obtain basic information on their population biology. The study was carried out for three years at a site situated about 10 Km east of the city of Irakleio (Crete). Two methods, namely capture –recapture and quadrat sampling were employed. The neighbourhood size was estimated based on the distances dispersed by the individuals within a period equal to the generation time of each species.

The mean monthly distance dispersed by the individuals of *M. butoti* was estimated to be 0.5 m, while *M. cretensis* individuals exhibit a mean monthly dispersal of 1 m. The individuals of both species appeared to disperse towards a preferred direction and sequential movements were highly correlated. The densities were estimated to be $\rho=2.59 \pm 0.52$ and $\rho=0.74 \pm 0.17$ individuals/m2 for *M. butoti* and *M. cretensis* respectively. Both species exhibited a tendency to aggregate in the field and at the same time they seem to prefer the same habitats. The preferred habitats changed throughout the active period. The neighbourhood sizes of the species were not greater than 150 individuals.

"MOLECULAR PHYLOGENY AND BIOGEOGRAPHY OF THE WALL-LIZARD *Podarcis Erhardii* (SQUAMATA: LACERTIDAE)"

Poulakakis, Nikolaos

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Erhard's wall lizard, *Podarcis erhardii* (Sauria: Lacertidae), is highly diversified in Greece and especially in the southern Aegean region. Out of the 28 recognized subspecies, 27 are found in Greece from the North Sporades island-complex in the North Aegean (grossly south of the 39th parallel) to the island of Crete in the South. The species exhibits great morphological and ecological plasticity and inhabits many different habitats from rocky islets and sandy shores to mountaintops as high as 2000m. By examining intraspecific variability at a segment of the mitochondrial gene cytochrome *b* we have found that extant populations of *Podarcis erhardii* are paraphyletic. Furthermore, we have found that subspecies previously defined on the basis of morphological characteristics do not correspond to different molecular phylogenetic clades, so that their status should be reconsidered. The DNA based biogeographical and phylogenetic history of *Podarcis* in Southern Greece is congruent with available paleogeographic data of the region, which supports the view that DNA sequences may be a useful tool for the study of palaeogeography.

"THE GREEN WATER FROG SYSTEMS IN THE BALKAN PENINSULA"

Radojicic, Jelena

Supervisor: E. Zouros

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The hybridization of European green water frogs under the sympatric conditions has been of the special interests. The water frogs can reproduce by hemiclonal reproduction where hemiclonal interspecific hybrids eliminate the genome of one parental species from the germline prior meiosis and clonally transmit the genome of the other parental species. In Europe two hybridogenetic systems are known: *Rana esculenta*, a hybrid between *Rana ridibunda* and *R. lessonae*, which are widely distributed along Europe and a hybrid between the Balkans endemic species, *Rana epeirotica* and *Rana balcanica*, that have as yet not been subject of detail genetical research.

Genetic analysis of the two hybridizing systems includes standardizing conditions for the suitable polymorphic microsatellite markers that show the cross-species amplification success. Four microsatellite loci (Res15, Res20, Res22, RtCa9) have been analysed on the somatic and gonads tissue from the *Rana* taxa from four Balkan different localities. Mitochondrial DNA digestion profiles (cytochrome B gene) are used to determine the pure species restriction types from the hybrids haplotypes. The differences and variation among observed genotypes and haplotypes will be used for taxonomical analysis of the pure species and types of the hybrids, for the biogeographical distribution analysis of the Rana taxa in the Balkans and to compare two green frog hybridizing systems.

"STUDY OF THE MATING BEHAVIOUR OF WILD AND LABORATORY STRAINS OF THE OLIVE FRUIT FLY *Bactrocera oleae* (Gmel), RELATED TO THE STERILE INSECT TECHNIQUE (SIT)"

Reboulakis, Polychronis

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Aim of this study is to determine the factors that lead laboratory-reared and wild strains of olive fruit fly *Bactrocera oleae* (Gmel.) to mating isolation under field conditions, resulting in failure of Sterile Insect Technique for this species.

For this purpose, mating experiments were conducted with both strains under different photoperiod conditions in bioclimatic chambers and in greenhouse. Results showed that when insects are under long artificial daylight status (long day simulation), mating performance increases, and distribution of matings during the day spreads. The opposite occurs when insects are under short day status, with a compression of matings at the end of photophase. That fact proved to be true for both laboratory and wild insects, despite the different distribution pattern of matings during photophase, that is still present under all light conditions (wild insects in general, mate later than artificially reared).

Also, when insects that had been exposed to a given photoperiod for the first days of adult life moved to a new photoperiod, the mating rhythm showed to be adapted to the new photoperiod within 2 days. This clue shows that there is a relative flexibility in mating rhythm within the adult life. Further research is organized to determine exactly the necessary time that is needed from the insect, in order to adapt its mating rhythm to the new photoperiod.

"THE SANDY BEACH MEIOFAUNA OF CRETE: PRELIMINARY RESULTS"

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In the context of a project for the development of an essential plan for the management of the coasts in the Eastern Mediterranean and the creation of an environmental monitoring database, the dynamics of the meiofaunal community of medio- and sub- littoral zone of two sandy beaches in Crete was investigated. The faunal data were analyzed on the basis of the main taxonomic levels with emphasis given on the assemblages of harpacticoid copepods, which represent the most abundant meiobenthic taxon of the mediolittoral zone. The distribution pattern of total meiofauna and copepods varied both between seasons and between zones, while fluctuations were observed on the vertical profile of the mediolittoral stations. At Elafonissi beach, a characteristic example of a sheltered beach, peaks of total meiofaunal abundance could be seen at the mediolittoral stations during summer, while in winter the pattern was reversed. However, regarding the copepods assemblage, higher abundance was always observed at the mediolittoral zone for both beaches. The community structure in relation to environmental variability was investigated.

"SYSTEMATICS, BIOGEOGRAPHY AND ECOLOGY OF CENTIPEDES IN SOUTH AEGEAN ISLANDS"

Simaiakis, Stylianos

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The main aim of the present work is the study of systematics, biogeography and ecology of centipedes (Uniramia: Chilopoda) of the south Aegean islands. Up to now twenty-seven islands have been included in this study and 55 taxa (species and subspecies) have been identified. In forty-five days of fieldwork more than 150 samplings have been fulfilled during the wet period. Moreover, based on the rich centipede collection of the Natural History Museum of Crete as well as the recently revised literature quotations the authors draw new distributional maps (complete as possible) for most of the Aegean centipede species.

"HISTORICAL AND ECOLOGICAL BIOGEOGRAPHY OF SCORPIONS OF THE SOUTH AEGEAN REGION"

Stathi, Iasmi

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The phylogenetic analysis of the family Iuridae (Scorpiones) and the morphological differentiation of *Euscorpius carpathicus* (Linnaeus, 1763) (Scorpiones: Euscorpiidae) at the islands of the Aegean Sea, Greece, will be presented.

The results show that the two East-Aegean Iurid genera *Iurus* and *Calchas* are the oldest of the family, whereas the other three *Hadrurus*, *Caraboctonus* and *Hadruroides* are distributed at the Western American continent. The DNA analysis of *Iurus* will show if there are one or two species in the south Aegean arc.

Euscorpius carpathicus shows high morphological differentiation among its populations on different islands. Almost 200 individuals have been measured and 32 measurements are taken on each sample. Differentiation has been revealed using multivariate analysis and will be confirmed using molecular techniques as well.

"COMPARATIVE MORPHOLOGICAL STUDY OF REARED AND WILD RED PORGY (*Pagrus pagrus*, SPARIDAE) BASED ON SKIN MELANOPHORES"

Sterioti, Aspasia

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Red porgy, *Pagrus pagrus*, candidate for aquaculture, presents a number of advantages for rearing but it develops a dark body coloration as opposed to the aesthetically pink colour of wild caught fish. In order to quantify the morphological differences between reared and wild populations, individuals of both groups were investigated. Three body areas (dorsal, lateral, ventral, all left side) each one divided in 5 sub-areas (along the anterior-posterior axis) and the tail area (5 random sub-areas) were chosen and the melanophores were counted, cell size was measured and the cell area coverage was calculated. The results showed a decrease in number from 85 (dorsal area) to 26 cells/mm^2 (ventral area) and from 85 (dorsal) to 15 cells/mm^2 (ventral) for reared and wild individuals respectively. In addition, melanophores of reared fish were larger than those of wild individuals, and this difference was more evident in the ventral area (up to four-times). As a result, melanophore coverage in different body areas (basic cause of darkening) ranged from twice as large (dorsal area: reared 85%, wild 30%) up to 6 times larger (ventral area, reared 20%, wild 3.5%). Morphological differences within the red porgy (reared, wild) and causes are discussed.

"ECOLOGICAL STUDY OF KOURNAS LAKE (CHANIA) WITH EMPHASIS IN FISH FAUNA"

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The ecology study in the unique natural insular lake of Kourna in the entire Mediterranean Sea appear particular interest because of the presence there of aquatic species like riverblenny (*Salaria fluviatilis*) and sandsmelt (*Atherina boyeri*). The first has an enigmatic circum-mediterranean presence and the second has been established in the lake long before the blocking of the lake with a small dam. In the lake lives also the glasshrimp (*Palaemonetes antennarius*) which lately was announced that it might be another species. Indeed the area is of special interest for the waterfowl gathering during the year.

Two other introduced fish-fauna species are also present, the mosquito fish (*Gambussia affinis*) and the goldfish (*Carassius auratus*). The last was introduced by accident 5 years ago. It is certain that its presence will provoke serious problems in a small lake like Kournas with a lot of tourism. That was the reason for the funding of a short research program by the local municipality. The program ended by February and it's expected to be renovated by the new Authorities.

In the mean time water sampling and fishing effort for fish specimens was carried on. Deep samples were taken using a 5L Ruttner bottle from April 2002 until now. Analysis of the stomach contents from all the available fish specimens was continued.

One of the most interesting finding came from the food analysis of 3 waterfowl stomachs from the black ducky, *Podiceps nigricolis*. All of them contained only glasshrimps in considerable numbers.

From last March the sampling protocol has changed. Water (for productivity estimations) and zooplankton samples (with the use of a 250 μm bongo net sampler) were added from 3 stations.

"THE ECOLOGY OF EURASIAN GRIFFON VULTURE (*Gyps Fulvus*) ON THE ISLAND OF CRETE"

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Οι τροφικές ανάγκες ενός αναπαραγωγικού ζευγαριού Όρνιων στην Κρήτη συμπεριλαμβανομένου του σταδίου ανεξαρτητοποίησης του νεοσσού εκτιμήθηκαν σε 424 Kgr ετησίως με μέση ημερήσια κατανάλωση 1162 gr τροφής. Όσον αφορά συνολικό πληθυσμό για την περίοδο 1997-2000 η ποσότητα τροφής που κατά μέσο όρο κατανάλωσε για να διατηρηθεί και να αναπαραχθεί το είδος υπολογίστηκε σε 68.7 τόνους ετησίως από τους οποίους οι 21.9 Kgr (31.8%) καταναλώθηκαν για αναπαραγωγή. Παράλληλα η τροφή που είναι θεωρητικά διαθέσιμη για τον πληθυσμό του Όρνιου στην Κρήτη εκτιμήθηκε στους 316.5 τόνους και είναι αρκετή για να συντηρήσει πολλαπλάσιο αριθμό ζευγαριών από τον ήδη υπάρχοντα (δηλ. 140 ζευγάρια). Συγκεκριμένα η νεκρή βιομάζα που υπολογίσαμε είναι 4.6 φορές περισσότερη από αυτήν που κατανάλωσε κατ' έτος ο πληθυσμός του είδους την περίοδο 1997-2000 και επαρκεί για την διατήρηση ενός συνολικού πληθυσμού 1783 ατόμων ή 740 ζευγαριών. Συμπερασματικά η ποσότητα της τροφής που καταναλώνουν τα Όρνια στην Κρήτη αποτελεί το 22% της νεκρής βιομάζας που παράγεται ετησίως από τον ζωικό κεφάλαιο του νησιού. Η τεράστια διαφορά που διαπιστώσαμε μεταξύ της ποσότητας τροφής που χρειάζεται ο πληθυσμός ετησίως και αυτής που είναι διαθέσιμη οφείλεται κατά κύριο λόγο στην απουσία πρόσβασης που έχουν τα πουλιά στην τροφή (δηλ. στο 50% των πτωμάτων).

"CNS PLASTICITY MECHANISMS REGULATING SEXUAL INVERSION AND DEVELOPMENT IN SPARIDAE HERMAPHRODITE TELEOSTS: ROLE AND INTERACTIONS OF AMINERGIC, NITRIC OXIDE SYSTEMS AND CELL PROLIFERATION"

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Neural mechanisms underlying sex reversal are being studied in hermaphrodite Sparidae species. The red porgy *Pagrus pagrus* is a protogynous whereas the gilthead sea bream *Sparus aurata* is a protandrous species thus allowing the comparison of the two opposing sequential hermaphroditic models. Sterile hybrids of the aforementioned species are also used as asexual controls. The study of widespread, multifunctional and conserved among vertebrates systems such as the noradrenergic (NA) and nitric oxide (NO) systems in addition to the in depth study of brain plasticity mechanisms such as cell proliferation is imperative in order to understand the functional organization of the teleostean brain and to elucidate some interactions and mechanisms involved in the sex changing processes. It seems that a transient increase in the levels of α_2 and β adrenergic receptors in hypothalamic and ventral telencephalic areas that are highly innervated by NO fibres triggers the onset of sexual inversion. Masculinization or feminization of hermaphrodite teleosts also involves a significant increase in the rate of hypothalamic cell proliferation with the addition of newborn nervous cells to the already existing cell populations. The close relationship of central nervous and endocrine system plasticity mechanisms is strengthened by the absence of such findings in the sterile hybrid populations highlighting the important role of brain-gonad interactions, which in turn determine sex reversal and reproductive behavior in hermaphrodite fish.