Monitoring Climate-related
responses in Mediterranean Marine
Protected Areas and beyond:

FIVE STANDARD PROTOCOLS

How to cite these protocols:

Foreword

Global warming is having observable effects on the abundance, distribution and survival of living organisms worldwide, with serious consequences on the functioning of coastal ecosystems and the services that they provide to our societies. These effects are particularly alarming in the Mediterranean Sea, which is warming faster than the global oceans.

Documenting these changes is a key task to support Integrate Coastal Zone Management (ICZM) and to inform maritime spatial planning (MSP). Nevertheless, the complexity of ecological transformation along with inadequate human and financial resources typically hampers our observation capabilities.

This series of standard protocols provides a practical guidance to track climate-related impacts in Mediterranean Marine Protected Areas (MPAs) and beyond. The guiding principles and architecture of these tools respond to the requirements of the Ecosystem Approach undertaken under the auspices of UNEP/MAP Barcelona Convention, with the ultimate objective of achieving the Good Environmental

Status (GES) of the Mediterranean Sea and Coasts. Technically these tools are inspired to the concept of Essential Climate Variables and focus on a restricted set of simple measurements to capture greater dimensions of environmental change. Indicators have been chosen on the basis of their scientific relevance, feasibility and cost effectiveness. The engagement of local stakeholders is another key ingredient in some of these methodologies. Adopting these protocols, allow participants to join to a common and consolidated strategy to track climate change effects. This will improve, complement or extend the ongoing monitoring initiatives in the different Mediterranean countries.

Mediterranean MPAs as long-term designations can play a primary role in providing a systematic and harmonized observation system, translating principles already consolidated in the political framework, to the real world. The resulting outputs are key information to support mitigation strategies and effective adaptation plans.

Monitoring temperature conditions

PROTOCOL 1: Monitoring temperature conditions

RATIONALE

The proposed method is issued from scientific and field experience gathered in the T-MEDNet network over the past 18 years. It is designed to acquire long-term and high resolution information on temperature conditions along the depth gradient in coastal waters. In this protocol we propose characterize sea water temperature conditions recording temperature every hour using data loggers deployed and recovered over an annual or a semi-annual basis. Data loggers are placed every 5 m from surface down to 40 m or deeper in order to acquire information about seasonal stratification dynamics and temperature conditions at depth. Run over the long-term these data series build robust baselines and track hydrological changes (e.g. warming, heat waves, shifts in seasonality, stratification) to better understand the impacts of climate warming on marine coastal biodiversity.

OBJECTIVES

☑ Setup temperature data loggers to obtain hourly data series on local temperatures along the depth gradient

☑ How to operate with temperature data loggers

☑ Upload temperature records on the T-MEDNet web platform
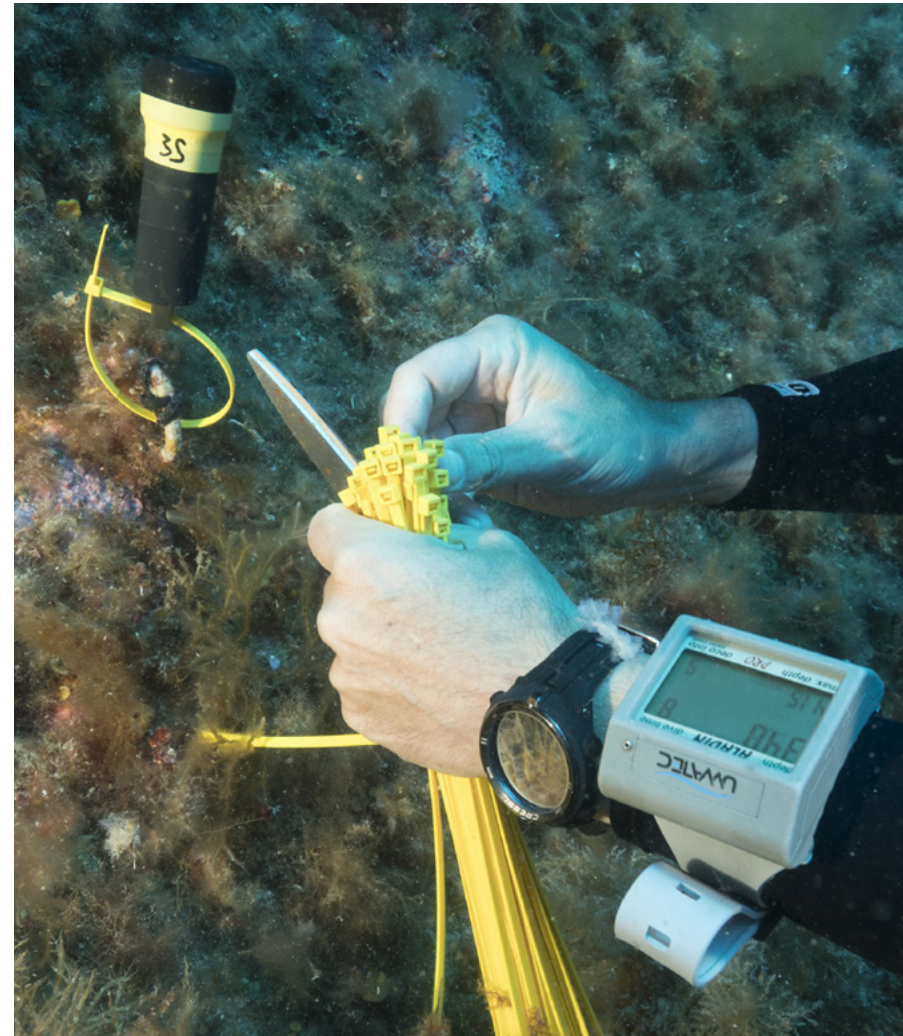
PROTOCOL 1: Monitoring temperature conditions

MATERIALS

Materials for data collection include:

- ☑ **Temperature data loggers**
  HOBOTidbit v2 or HOBO-U22 **(a)**

- ☑ **Fixation kit**
  Colson rings, ankles Colson **(c)**, putty for underwater sealing **(b)**, plastic gloves and bag

- ☑ Tool to scratch the rock prior fixation (e.g. **diving knife**) and a cutting **pliers or scissors**

sensor **(a)**
comunications window
mounting hole

(b)   **(c)**

DETERMINATION OF FIELD WORKERS SPECIALIZATION

Temperature monitoring can be conducted by certified scuba divers, working in couple.

STUDY SITE LOCATION AND DEPTHS

- ☑ The study site should be characterized by rocky bottoms with steep slope, facing open sea, to be exposed to dominant currents

- ☑ Standard depth levels to set up data loggers are every 5 m, from 5 to 40 m depth or more. However, different depth levels can be included if standard depths are not found at the study site

- ☑ Avoid known diving sites and inform diving centres about your data collection site

PERIOD OF DATA LOGGER SETUP AND RETRIEVAL

Setup/retrieve data loggers every 6 months, generally before and after the warm season (e.g. May, November). Yearly periodicity can be adopted for remote sites. Avoid interruption in data acquisition, particularily during the warm season. Ideally, using 2 sets of data loggers allows simultaneous recovery/setup in a single dive.

PROTOCOL 1: Monitoring temperature conditions

HOW TO OPERATE DATA LOGGERS:

DATA LOGGERS LAUNCHING

☑ Use Hoboware software, base station and the appropriate coupler to launch the temperature data loggers

☑ Set recording interval to 1 hour. Save logger's name as (site_yearmonth_depth)

☑ Label data loggers with depth of destination

DATA LOGGERS OFFLOADING

☑ Use Hoboware software, base station and the appropriate coupler to offload data from the loggers

☑ Make a backup copy of the data on external device (USB, hard drive)

☑ Warning, the loggers will need to be launched with correct parameters prior being placed again in the field

Aling arrows then insert firmly

Optic base and coupler used for HOBO-U22 data logger launching and offloading.

PROTOCOL 1: Monitoring temperature conditions

HOW TO SETUP A NEW STUDY SITE:

STUDY SITE LOCATION AND DEPTHS

☑ Prepare the putty on boat, right before diving, using wet gloves

☑ Mix equal amount of the blue and yellow putties till it gets homogeneously green

☑ Keep putty in a wet plastic bag (e.g. ziploc). It is preferable to use it within 20 minutes

SEALING OF DATA LOGGER'S FIXATIONS

☑ Fixations should be set at standard depths (every 5 m from 5 to 40 m depth)

☑ To secure the temperature dataloggers set 2 fixations for each logger

☑ Find a natural hole or small crevice on the rocky substrate where the 2 fixations can fit

☑ Scratch the substrate to bare rock and insert the putty to fill the hole/crevice. Press firmly the putty to increase adherence

☑ Insert the 2 fixations firmly. Press the putty around the fixations for robust sealing

☑ Let the putty harden 12 h before attaching the loggers

☑ Draw a plan to facilitate future finding of the different fixation points

Top view

Side view

To ensure good fixation, fill the hole with putty before putting the screw and cover up to indicated level ( )
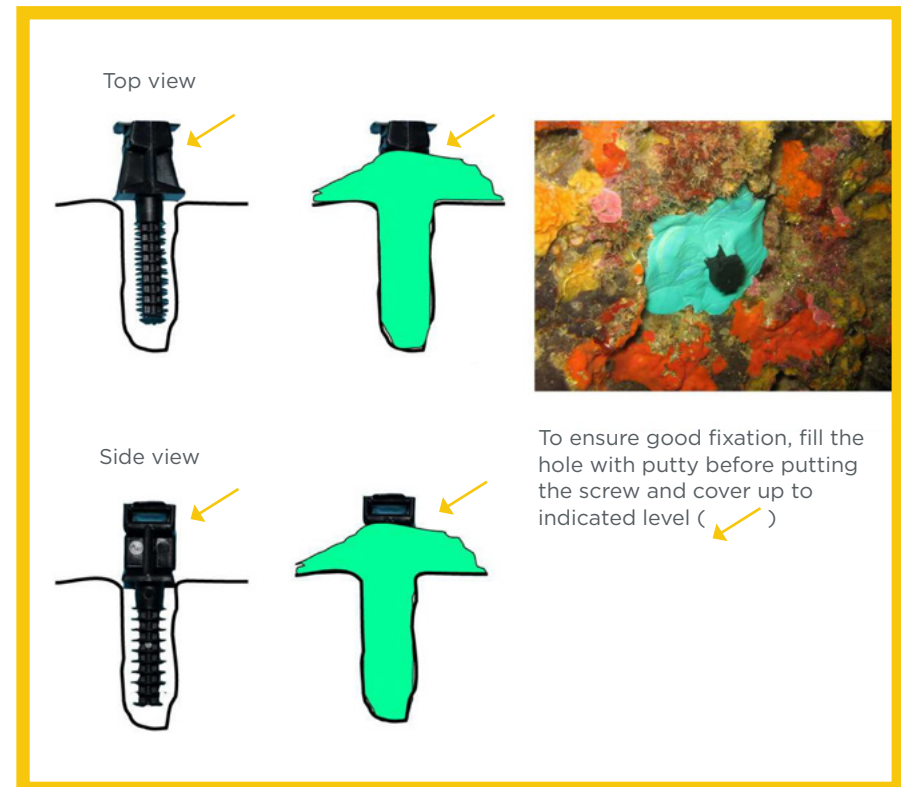
PROTOCOL 1: Monitoring temperature conditions

DEPLOY/RECOVER THE DATA LOGGERS AT DEPTH

☑ Attach loggers to the fixation using Colson rings

☑ Retrieve data loggers using cutting pliers or scissors

☑ Warning: HOBO-U22 data loggers float!

☑ Keep note of date and time at which loggers were deployed/recovered at depth

☑ Check the the videotutorial for ilustration on the procedure link to the video tutorials

DATABASE AND REPORTING

Register on the T-MEDNet platform. Declare new monitoring site or modify site/editor settings using online form. Upload raw data files using the dedicated interface. Receive notifications on data qualification and reporting. Access report on temperature conditions dedicated to each monitoring site. Video tutorials and presentations are available from the T-MEDNet web platform describing the different actions to implement the protocol.

Check the videotutorial and related documents on the temperature web platform Link www.t-mednet.org/observation-system/thermal-environment.

Assessment and monitoring of mass mortality

PROTOCOL 2: Assessment and monitoring of mass mortality

RATIONALE AND OBJECTIVES

The proposed protocol stems from the scientific and field experience gathered during the impact assessment of mass mortality events in different areas of North-Western Mediterranean. The protocol focuses mostly on some gorgonian species dwelling in shallow waters (0-50 m) of North-Western Mediterranean. However, it can be adapted to assess the impact on other macrobenthic species (e.g. sponges, corals, bryozoans). The protocol aims to set the conservation status of surveyed populations, while gathering baseline information to assess the impacts of mass mortality events when they occur. Annual surveys at selected sites will provide the baselines from which evaluate the impacts.

TARGET SPECIES

The protocol aims to monitor mass mortality events on some target species, notably:

- ☑ **Gorgonian species**
  Paramuricea clavata, Eunicella singularis, E. cavolini, Corallium rubrum, Leptogorgia sarmentosa

- ☑ **Corals**
  Cladocora caespitosa, Oculina patagónica, Astroides calycularis

- ☑ **Sponges**
  Ircinia fasciculata, Sarcotragus spinosulus, Spongia spp., Ircinia variabilis

- ☑ **Bryozoans**
  Myriapora truncata, Pentapora fascialis

- ☑ Criteria to select other target species: i) they have to be abundant in the study area and ii) easy to identify underwater

MATERIALS

Data collection will require the following materials:

- ☑ A **plastic board** to collect data underwater

- ☑ Diving **computer** to keep the **depth** of the survey

- ☑ A **reference** (e.g. a quadrat 50 x 50 cm or 25 x 25 cm, a bar 50 cm)

PROTOCOL 2: Assessment and monitoring of mass mortality

DETERMINATION OF FIELD WORKERS SPECIALIZATION

Fieldwork can be carried out by trained professional scuba divers, working in couple, as well as by recreational divers who received adequate training.

PERIOD OF MONITORING

Every 12 month after summer, from mid-September to mid-October. If this period is not possible you can also perform mortality assessments at any other time of the year, or in case of observed mass mortality.

SAMPLING SITES

Select 3 sites within the MPA separated by a minimal distance of about 0.2-0.5 Km. At each site select the upper distribution limit of the selected species to conduct the mortality monitoring surveys. However, it is recommended (when possible) to include a second mortality survey for each selected site below the seasonal thermocline depth. The selection of depth levels should correspond whenever possible to the depths where the temperature data loggers are setup (i.e. every 5 m from 5 to 40 m depth).

The goal of the surveys is to observe a minimum of 100 colonies per mortality survey. To avoid bias in data collection use a reference (e.g. quadrat, bar, line) and define a criteria for the observation. For instance, using a bar, one could only the colonies in contact to the bar or all inside an imaginary rectangle formed as a basis the length of the bar and the height of 10-15 cm. Surveys should be carried out around the selected depths (± 1 m).

In the surveys do not take into account small colonies or specimens (e.g. < 15 cm in height for gorgonians), since looking for small colonies it is not straightforward during the sampling.
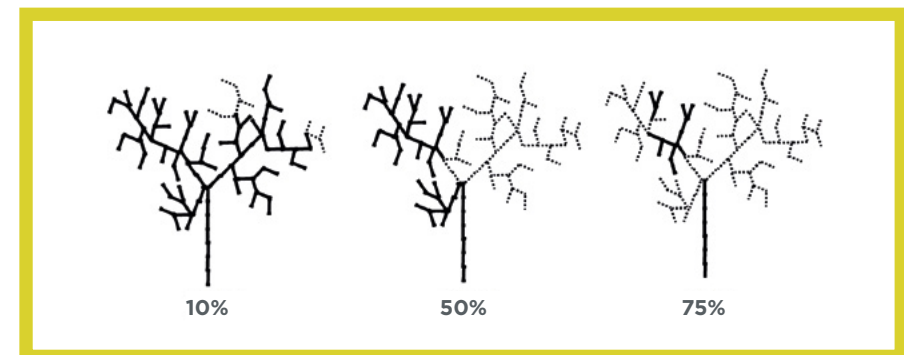
Estimation of the colony's extent of injury (adapted from Perez et al. 2000). According to the proposed protocol, colonies with >10% injured surface are considered as affected.

PROTOCOL 2: Assessment and monitoring of mass mortality

During the surveys, for each observed colony (specimen) determine whether or not is affected by mortality. For gorgonians species we considered an affected colony when the colony displays ≥ 10 % of tissue/skeleton necrosis/epibiosis. For other macroinvertebrate species, in general, if they display necrosis they should considered as affected (e.g. denuded skeletons of horny sponges). Field observations can be collected through photoquadrat sampling for species displaying small-sized colonies (e.g. Astroides calycularis).

Besides, for gorgonian surveys, for each affected colonies it should be also noted whether the mortality is: i) recent i.e. colonies showing presence of recent necrosis and/ or denuded skeletons and/or skeletons colonized by pioneering species such as hydrozoan species; ii) old i.e colonies displaying skeleton covered by epibionts species with thick calcareous skeletons such as bryozoans, calcareous algae); iii) or both with the features of recent and old mortality signs (see above, indicating that the colony suffered recent and past impacts of mortality). Examples of the three considered types of affected colonies are shown in the underwater board. More examples on healthy and affected colonies are displayed at the end of the protocol description.

Check the mortality assessment videotutorials for operational details.

Underwater board template for mortality assement monitoring protocol.

DATABASE AND REPORTING

Upload the data collected for each site and depth in the T-MEDNet web platform. Video-tutorials and presentations will be available at the T-MEDNet web platform describing the different actions to conduct mass mortality assessments monitoring protocols from data collection to data reporting.

PROTOCOL 2: Assessment and monitoring of mass mortality

Ilustration of healthy (✔) and affected (✖) gorgonian and coral colonies and sponge specimens.

Red gorgonian *(Paramuricea clavata)*
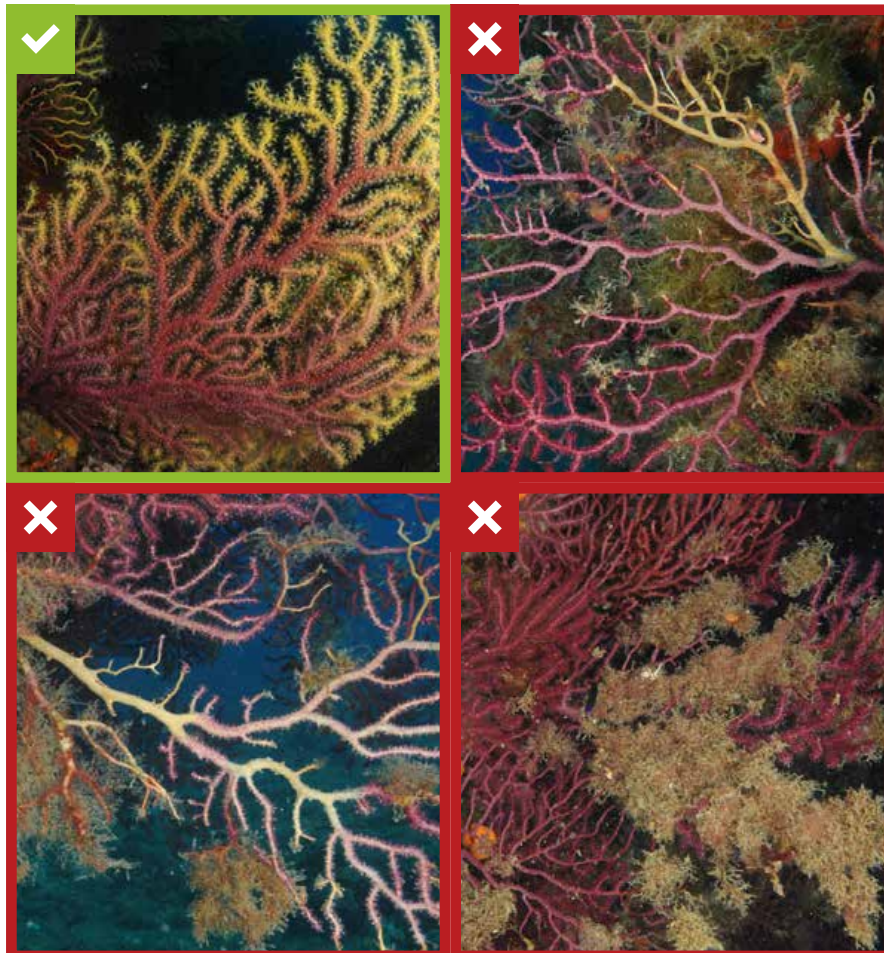
White gorgonian *(Eunicella singularis)*
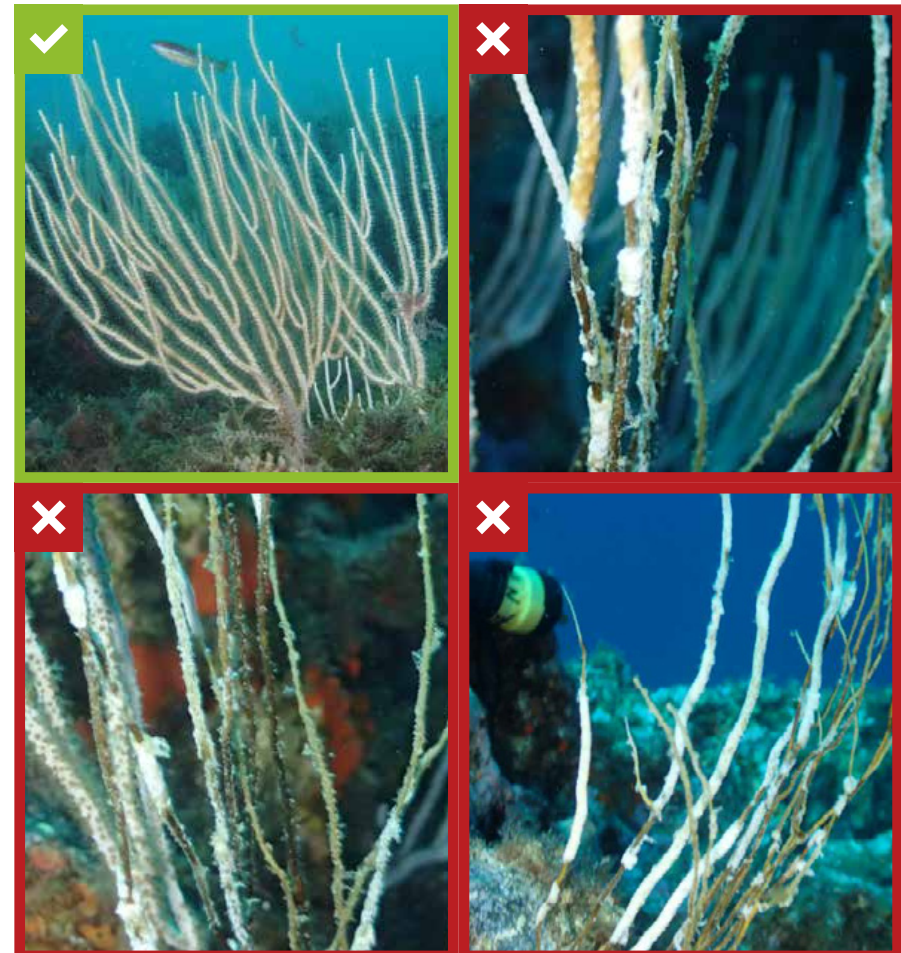
PROTOCOL 2: Assessment and monitoring of mass mortality

Yellow gorgonian *(Eunicella cavolini)*

Cushion coral *(Cladocora caespitosa)*

PROTOCOL 2: Assessment and monitoring of mass mortality

Spongia SPP.

Ircinia variabilis
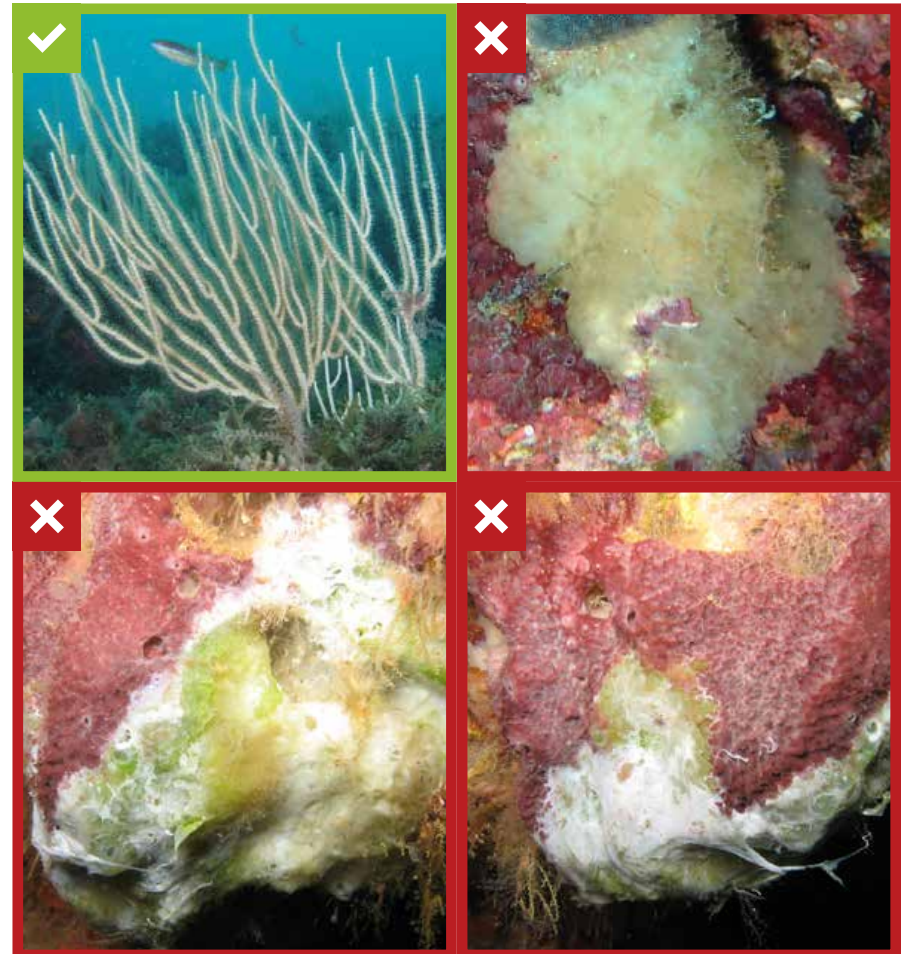
PROTOCOL 3

LEK-1: exploring Local Ecological Knowledge to reconstruct historical changes

PROTOCOL 3: LEK-1: exploring Local Ecological Knowledge to reconstruct historical changes

RATIONALE AND OBJECTIVES

Local Ecological Knowledge is the information that people have about the ecosystems where they spend most of their time. This knowledge is gained by individuals during their daily activities, like fishing. The following protocol can be used to interview experienced fishermen or other sea users, to reconstruct historial changes in species abundances and distribution. It can also be used for the early detection of new species. For periodical monitoring, please see **protocol LEK-2**.

Note: You can use the same questionnaire to track historical trends of species that changed the most in their abundances: new, increasing, severly declining and disappearing species.

MATERIALS

- ☑ Printed copies of **QuestionnaireLEK1.pdf**, to carry out interviews

- ☑ A **field guide** or **pictures** of fish and other marine species, to assist species identification

- ☑ An **excel file** where to input data taken through **QuestionnaireLEK1.pdf** (see **DATA_LEK_1.xls**)

PROTOCOL 3: LEK-1: exploring Local Ecological Knowledge to reconstruct historical changes

INTERVIEWS

Interviewers should be practitioners skilled in species identification and with a good knowledge of local fisheries. Respondents should be selected among experienced fishermen or other sea users, like divers or recreational anglers with more than 10 years of activity in the area where the interview is performed.

APPROACHING RESPONDENTS

Fishermen can be interviewed during their land activities, while they are cleaning the nets or when they are fixing their boats. Considered that fishermen could distrust researchers and practitioners, special attention should be paid to the approach used during the interview. Remember: i) to be humble, ii) to behave like a facilitator and not an expert, iii) to show a genuine interest towards what respondents say but iv) to keep the interview on track and v) to critically review the received information.

SAMPLING LOCATION, MONITORING PERIOD AND SAMPLE SIZE

Interviews can be performed at any location, any time of the year. Interviewers may ask small scale fishermen, recreational anglers and spear fishermen, as well as scuba divers. It is recommended to interview at least 20 respondents at each location.

AN EXAMPLE

You are interviewing Pino, a professional fisherman, who began fishing in 1973.

☑ Draw a vertical line at 1973

YOU: *Do you know any species which increased or appeared in your fishing area?*

PINO: *Oh, everything decreased, but actually a few species increased in their abundance... the bluefish is one of them!*

☑ Verify the correct identification of the species (check, with the help of pictures, that the mentioned species is actually the bluefish, *P. saltatrix*)

PROTOCOL 3: LEK-1: exploring Local Ecological Knowledge to reconstruct historical changes

✓ Take note of the perceived trend: Pino says the species is increasing and you write "(I)"

YOU: *Can you help me reconstructing how the abundance of bluefish changed in time?*

PINO: *Yes, I did not notice it until early 1990s, let's say 1992 when I got married. Then, the species remained occasional for a few years and in the last 10 years it became very, very, common.*

✓ Take note of the historical trends, according to 6 ranks of abundance: 0=ABSENT, 1=RARE (once in a year), 2=OCCASIONAL (sometimes in a year), 3=COMMON (regularly in a year), 4=ABUNDANT (regular in captures and abundant), 5=DOMINANT (always in captures and with great abundances)

YOU: *Which was your maximum catch, in a single day of fishing?*

PINO: *Oh, well, in a single day during Summer 2011, I caught about 20 fish, for a total of more or less 25 kilograms, with hooks.*

✓ Write down these numbers, in the **Max day capture field**

YOU: *Do you know any other species that recently appeared in the area or increased in its abundance?*

PINO: *Oh, yes, I kow a new fish... the trumpetfish! I saw it for the first time in 2010, but then it disappeared for a few years.*

YOU: *Do you think that this species is increasing?*

PINO: *No, it is a new species but I don't think it is increasing right now.*

PROTOCOL 3: LEK-1: exploring Local Ecological Knowledge to reconstruct historical changes

☑ You identify the bluespotted cornetfish (*Fistularia commersonii*). Rank it as "Fluctuating" (F) and keep interviewing Pino to reconstruct its historical timeline, as for the bluefish

When Pino has listed ALL the new or increasing species, you might keep interviewing him about the disappearing ones. Rank them as "Declining" (D) and proceed as before, reconstructing their change in time.

YOU: *Thanks Pino. Are you sure there is no other species which is increasing in the area? In this case, could you please tell me if any species disappeared from here? (…)*

DATABASE, REPORTING AND DATA POLICY

Input data to **Data_LEK1.xlsx**. First, insert the interview number, which can be recalled from the drop down menu. Then, compile the spreadsheet, inserting information on historical trends and records, if available. See the figure below. Collected data can be used for your needs, but they can also be shared with the LEKTeam, by sending them to: lek@isprambiente.it

PROTOCOL 3: LEK-1: exploring Local Ecological Knowledge to reconstruct historical changes

QuestionnaireLEK1.pdf

1_HISTORICAL TRENDS

OUR QUESTION: *'What species have been increasing in the last decades? Are you fishing or observing species, which were not present before?'*

INTERVIEW NUMBER…………..…............... DATE…….…............ COMPILER……………………………… Location……………….. Country………………

NAME INTERVIEWED………………………………….Age………………SINCE (year)……………………….PROFESSIONAL ☐ SPORTIVE ☐

Scuba diver ☐ *Spear fishing* ☐ *Net* ☐ *Purse seine* ☐ *Traps* ☐ *Longlines* ☐ *Hooks* ☐ *Trawl* ☐ *Others* ………..…

TRUSTWORTHINESS OF INTERVIEW	
HIGH (VERY TRUSTHWORTHY)	☐
MEDIUM (ACCEPTABLE)	☐
LOW (DOUBTFUL)	☐

0=ABSENT; **1**=RARE (once in a year); **2**= OCCASIONAL (sometimes in a year); **3**= COMMON (regurarly in a year); **4**=ABUNDANT (regularly in captures and abundant);
5=DOMINANT (always in captures and with great abundances)

I Increase, F Fluctuant, S Stable, D decreasing

(I/F/S/D)

SPECIES	RANK	<1970	1970 (70 71 72 73 74 75 76 77 78 79)	1980 (80 81 82 83 84 85 86 87 88 89)	1990 (90 91 92 93 94 95 96 97 98 99)	2000 (0 1 2 3 4 5 6 7 8 9)	2010 (0 1 2 3 4 5 6 7 8)
	5						
	4						
	3						
	2						
	1						
	0						

MAX DAY CAPTURE (Absolute): Tot Kg…………………… N.Individuals……………… Year…………………… month………………. fishing gear…………………………

SPECIES	RANK						
	5						
	4						
	3						
	2						
	1						
	0						

MAX DAY CAPTURE (Absolute): Tot Kg…………………… N.Individuals……………… Year…………………… month………………. fishing gear…………………………

SPECIES	RANK						
	5						
	4						
	3						
	2						
	1						
	0						

MAX DAY CAPTURE (Absolute): Tot Kg…………………… N.Individuals……………… Year…………………… month………………. fishing gear…………………………

SPECIES	RANK						
	5						
	4						
	3						
	2						
	1						
	0						

MAX DAY CAPTURE (Absolute): Tot Kg…………………… N.Individuals……………… Year…………………… month………………. fishing gear…………………………

PROTOCOL 3: LEK-1: exploring Local Ecological Knowledge to reconstruct historical changes

Records.pdf

2_RECORDS

Isolated/occasional observations or captures of 'new' species, never seen before should be collected here

INTERVIEW NUMBER……………..…………. COMPILER………… Location……………………………… Country………………

NAME INTERVIEWED………………………………………….… Age……………. SINCE (year)………….. PROFESSIONAL □   SPORTIVE □

Scuba diver □   Spear fishing □   Trammel net □   Purse seine □   Traps □   Longlines □   Hooks □   Trawl □   Others ………..……………………..

SPECIES *	Year	Month	N. Ind.	Depth	Exact Location (and coordinates if available)	Fishing gear	Picture?**	Notes

*If the interviewed has observed/captured something we can not identify write: **No ID** and report general description (lenght, weight, color, shape..)

**Ask if he/she took pictures of the species (in this case try to get it)

Trustworthy (quality of the interview)

LOW □ MED. □   HIGH □

Interreg Mediterranean
MPA-ADAPT
Project co-financed by the European Regional Development Fund

CSIC   ISPRA   IUCN   portofino   BRIJUNI

LEK-2: exploring Local Ecological Knowledge for periodical monitoring

PROTOCOL 4: LEK-2: exploring Local Ecological Knowledge for periodical monitoring

RATIONALE AND OBJECTIVES

Local Ecological Knowledge is the information that people have about the ecosystems where they spend most of their time. This knowledge is gained by individuals during their daily activities, like fishing. The following protocol can be used to interview experienced fishers or other sea users, to regularly (every 12 months) monitor climate-sensitive species of both native and exotic origin. To reconstruct historical changes, please see **protocol LEK-1**.

MATERIALS

☑ Printed copies of **QuestionnaireLEK2.pdf**, to carry out interviews

☑ A **field guide** or **pictures** of fish and other marine species, to assist species identification

☑ An **excel file** where to input data (see **DATA_LEK_2.xls**)

PROTOCOL 4: LEK-2: exploring Local Ecological Knowledge for periodical monitoring

INTERVIEWS

Interviewers should be practitioners skilled in species identification and with a good knowledge of local fisheries. Respondents should be selected among experienced fishermen or other sea users, like divers or recreational anglers with more than 10 years of activity in the area where the interview is performed.

APPROACHING RESPONDENTS

Fishermen can be interviewed during their land activities, while they are cleaning the nets or when they are fixing their boats. Considered that fishermen could distrust researchers and practitioners, special attention should be paid to the approach used during the interview. Remember: i) to be humble, ii) to behave like a facilitator and not an expert, iii) to show a genuine interest towards what respondents say but to follow the protocol but iv) to keep the interview on track and v) to critically review information.

SAMPLING LOCATION, MONITORING PERIOD AND SAMPLE SIZE

Interviews should be performed every 12 months. It is recommended to interview at least 5 respondents per gear, achieving a sample of 20 people, who ideally should remain the same across time. Considering the periodical use of the protocol, it will be important to maintain trustful long-lasting relationships with respondents.

MATERIALS

On the basis of previous experience gained at the Mediterranean level, the list of target species will be composed as it follows:

☑ **Med targets**
7 target species selected a priori to be used in all the Mediterranean MPAs: *Pomatomus saltatrix, Sparisoma cretense, Lagocephalus sceleratus, Pterois miles, Siganus luridus, Siganus rivulatus, Sarpa salpa*

☑ **Local targets**
Up to 5 additional species selected according to local monitoring needs and to the following criteria: i) easy to recognize, ii) interacting with fisheries, iii) emerging the most in the area, iv) impacting on environment, fisheries or human health

☑ **Fishermen's targets**
Any species perceived by the respondent as increasing or drastically decreasing can be added. Note that target species may change at each interviews, since they are spontaneously mentioned by each respondent

PROTOCOL 4: LEK-2: exploring Local Ecological Knowledge for periodical monitoring

DATA RECORDING

To carry out interviews, remember the following steps:

☑ Print **QuestionnaireLEK2.pdf** and bring with you a field guide or pictures of species to assist their identification

☑ Collect baseline information about respondents, which is reported on top of the questionnaire. The questionnaire can be used for scuba divers as well, but taking note of observations rather than captures

☑ Ask information about each target species, if clearly recognized by respondents

☑ Current trend of the species: "Do you think the species is currently Increasing(I)/Decreasing(D)/Fluctuating(F)/Stable(S)/Don't know(Nk)?"

☑ Current abundance: 0=ABSENT; 1=RARE (once in a year); 2=OCCASIONAL (sometimes in a year); 3=COMMON (regularly in a year); 4=ABUNDANT (regularly in captures and abundant); 5=DOMINANT (always in captures and with great abundances)

☑ Best day-catch over the past 12 month, the fishing gear and the fishing period

☑ If the species is perceived as something "Bad/Good/Neutral/Don't know" for fisheries

☑ If the species is perceived as something "Bad/Good/Neutral/Don't know" for the environment

ISOLATED RECORDS

Isolated captures/observations of new, unusual or exotic species can be registered on the Records page of **DATA_LEK_2.xlsx**

REPORTING AND DATA POLICY

Collected data can be used for your local monitoring needs, but they can also be shared with the LEKTeam, by sending them to: lek@isprambiente.it

PROTOCOL 4: LEK-2: exploring Local Ecological Knowledge for periodical monitoring

QuestionnaireLEK2.pdf

INTERVIEW N.....	Compiled by......................		DATE..................	LOCATION................................

HOW TO PERFORM THE INTERVIEWS:
For each geographical area **1)** identify a minimum of **5** EXPERT fishermen *per* **gear (N tot 5x4 = 20)** and EVERY 12 months: **2)** Ask relevant information related to **Med** and **local targets** - Ask for **additional species** they might perceive as new or increasing in their fishingh area (Fisherman's target); **3)** input the data to the excel file.

NAME or CODE FISHERMAN................................Sex...........   Age.........................   SINCE (year)...............

Used GEARS:

PROFESSIONAL			RECREATIONAL			DIVER
Set nets □	Trawl □	Others specify............	Angling □	Spear □	Other specify......	□

FREQUENCY OF FISHING ACTIVITIES: Once a month □   Once a week □   More days per week □   Almost every day □

FISHERMAN'S EXPERIENCE: Expert and trustworthy □   Very Expert and very trustworthy □

SPECIES	What is the current **TREND** ? **I** = Increasing **D** = Decreasing **F** = Fluctuating **S** = Stable **Nk** = Not known I/D/F/S/Nk	How **ABUNDANT** is the species in the fishing period? **0** = ABSENT **1** = RARE (once in a year) **2** = OCCASIONAL (sometimes) **3** = COMMON (regurarly captured) **4** = ABUNDANT (regular and abundant) **5** = DOMINANT (always and very abundant) 0/1/2/3/4/5	What is the **BEST day-catch** in the past 12 months? Kg N.	With **which Gear**?	What is the **fishing period**? From To	Is this species: Bad/Good /I dont know – for **FISHERY** B/G/Nk	Is this species: Bad/Good/I dont know – for the **ENVIRO NMENT** B/G/Nk	NOTES
P. saltatrix								
S. cretense								
S.salpa								
L. sceleratus								
S. luridus								
S. rivulatus								
P. miles								

Med Targets

Local Targets

....								
....								
....								
....								
....								

Fisherman's

....								
....								
....								
....								
....								

Select a priory

Fish visual census of climate change indicators

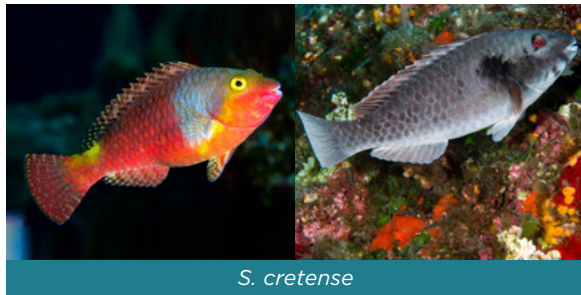## PROTOCOL 5: Fish visual census of climate change indicators

TARGET SPECIES

Based on previous scientific experiences, the following fish species (MED Targets) will be used as reliable indicators of climate change in all the Mediterranean MPAs: *Sparisoma cretense, Epinephelus marginatus, Thalassoma pavo, Sarpa salpa, Serranus scriba, Coris julis, Serranus cabrilla, Siganus spp, Fistularia commersonii.*

S. scriba

C. julis

S. cretense

E. marginatus

S. cabrilla

Siganus spp

T. pavo

S. salpa

F. commersonii

Pictures: *Giovanni Ombrello*

PROTOCOL 5: Fish visual census of climate change indicators

ADDITIONAL SPECIES

Local targets (max. 4) can be added by each MPA, according to local monitoring needs (e.g. exotic species), easiness of recognition, interaction with fisheries, increase/decrease in the area, potential impacts on the environment/fisheries/human activities.

MATERIALS

- ☑ Pre-printed **BOARD-V3.pdf** to collect data underwater
- ☑ Underwater watch to measure **5 minutes**
- ☑ **Paper sheet** or logbook where to copy the data from the plastic board
- ☑ Computer/thermometer to measure **water temperature**

FIELD WORKERS SPECIALIZATION

Scientific divers skilled to recognize and count species underwater. The protocol can also be adopted by trained recreational divers.

PERIOD OF MONITORING

Between August and October, every 12 months. For recreational divers, the censuses can be performed any time of the year.

SAMPLING LOCATION AND DEPTH

Rocky bottoms with moderate slope. Depth ranges are 1-3 m, 5-10 m, 11-20 m, 21-30 m. Censuses can be performed by snorkeling on the surface, covering the 1-3 m depth range.

SAMPLING DESIGN

Within your study area select at least 3 permanent locations separated by a minimal distance of about 0.5 Km. At each location and for each depth layer, each diver will perform 4 consecutive transects. It is suggested to work in pairs and to perform 4 transects each (8 transects in total).

The depth of 1-3 m is the most important one: you might choose to monitor only this layer by snorkelling. In this case, the total number of transects that is requested each year will be equal to: (4 transects + 4 transects) x 3 permanent locations x 1 depth layer = 24 transects.

PROTOCOL 5: Fish visual census of climate change indicators

HOW TO COUNT FISHES

☑ Swim VERY slowly underwater (speed about 10 m/minute) for 5 minutes, covering a distance of about 50 m

☑ While swimming forward, count all the species and individuals you observe within a radius of 2.5 m, because the transect is 5 m-wide. Hence, do not count fishes if they are very far from you

☑ Do not count fishes if they are smaller than 2 cm

☑ Once you have finished the first transect (after 5 minutes) you can proceed in the same direction starting a new transect
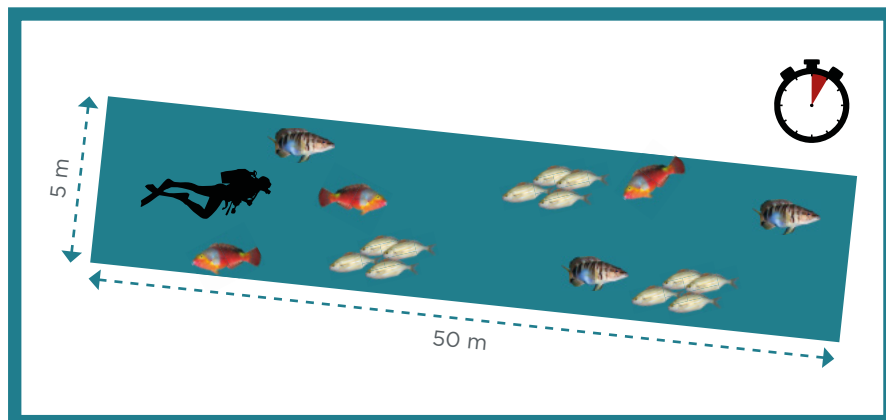
DATABASE AND REPORTING

Input your data to **DATA_Visual.xlsx**. Data can be used by each MPA, to build time series and track changes in the relative abundance of indicator species. Your data can also be shared with a large Mediterranean network of participating MPAs and other relevant stakeholders. For further information on data collection, sharing and reuse, please contact ernesto.azzurro@isprambiente.it or garrabou@icm.csic.es

PROTOCOL 5: Fish visual census of climate change indicators

UW-BOARD-V3.pdf

Credits

MASS MORTALITY ASSESSMENT AND MONITORING

The protocol has been originally developed for the project Seawatchers and adapted for the purposes of the project MPA-Adapt.

Pictures: Joaquim Garrabou, Alexis Rosenfeld and Observadores del Mar

Concepts: Joaquim Garrabou

MONITORING TEMPERATURE CONDITIONS

The protocol has been originally developed by the T-MEDNet initiative and adapted for the purpose of the project MPA-Adapt.

Pictures: Joaquim Garrabou

Concepts: Joaquim Garrabou and Nathaniel Bensoussan

LEK-1: EXPLORING LOCAL ECOLOGICAL KNOWLEDGE TO RECONSTRUCT HISTORICAL CHANGES

A first version of this protocol has been originally developed by the CIESM project Tropical Signals and adapted for the purposes of the Interreg project MPA_Adapt, with the contribution of FAO projects AdriaMed and MedSudMed.

References: https://doi.org/10.1371/journal.pone.0024885

Pictures: Gianpaolo Rampini

Concepts: Ernesto Azzurro

LEK-2: EXPLORING LOCAL ECOLOGICAL KNOWLEDGE FOR PERIODICAL MONITORING

The protocol has been conceived for the purposes of the MPA-ADAPT project and capitalizes the experience and scientific discussions made through the FAO projects AdriaMed MedSudMed projects.

Pictures: Jamila Ben Souissi

Concepts: Ernesto Azzurro

FISH VISUAL CENSUS OF CLIMATE CHANGE INDICATORS

This protocol is adapted from a previous version developed by the CIESM project Tropical Signals.

Pictures: Giovanni Ombrello

Cover image: Matteo Varenna

Graphical inputs: PADI and DAN

Concepts: Ernesto Azzurro

Cover image: Giovanni Ombrello

Graphic design & layout: Clara Comín

Graphical concepts of all the protocols: Jacopo Cerri