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Underwater Volunteers NSW

A Standardised Protocol for Assessing Targeted Fish Species in NSW Waters

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Fish Survey Protocol

Introduction

Tropical and temperate fishes are key indicators of climate change effects on shallow temperate seas. Changes in winds, rainfall, extreme weather conditions, sea level, ocean currents, temperature and ocean chemistry and are key variables expected to drive climate change impacts on fish assemblages along the NSW coast.

Predictions for climate-induced change in fish communities include the likelihood of significant range shifts by 2030. On a statewide scale tropical species will become resident throughout the year in southern NSW waters, with present resident southern species shifting southwards, driven by sea surface temperature warming, change or strengthening of boundary currents, habitat losses and gains. Thus, species distributions will shift south to match preferred temperature ranges with the southern range limits of low-latitude tropical species expanding.

The Roving Diver Technique

The roving diver technique (*RDT*) has demonstrated that experienced volunteer divers are able to generate representative fish species lists and provide frequency of occurrence as well as relative abundance data. It is the basis of the Project AWARE Fish Surveys that have been conducted by volunteer Scuba divers in not only NSW, but other states in Australia, as well as overseas. The technique is used by volunteer divers working under a program developed by the Reef Environmental Education Foundation in areas as diverse as the Western Atlantic/Northeast US & Canada, including Newfoundland, the southern Atlantic states in the US, the West Coast of the US and Canada, as well as tropical Eastern Pacific regions and the Galapagos and Hawaiian Islands.

Patterns of occurrence and relative abundance observed by trained volunteer divers are generally consistent with studies conducted by marine scientists. Because of its wide potential geographic and seasonal coverage in addition to the large number of samples that only volunteers can provide, this method can be used to collect useful ancillary data to supplement more rigorous studies. Other benefits include the fact that it is relatively inexpensive and non-destructive; it involves, educates and builds capacity to undertake scientific monitoring programs in the community and, from a volunteers viewpoint involves them making observations on what for most people is an interesting marine taxa that are good indicators of ecological integrity, thus keeping the interest and enthusiasm of volunteers at high levels.

As with any visual method, several variables can affect species observations, including underwater visibility, topography, current, size of area searched, experience of the observers, familiarity with the dive site, depth and water temperature.

With multiple divers, this technique can rapidly and thoroughly record data concerning species presence and abundance at a given reef site. It is useful for documenting threatened

or protected species under NSW Fisheries regulations, such as Black Cod, over relatively large geographic regions.

The technique lends itself to longitudinal studies in which sites, once sampled, can be re-surveyed annually. With climate change a given, and consequent changes occurring in the physico-chemical component of marine systems, scientists are already observing changes in the distribution of fish species along Australia's east coast. The data collected from the use of this technique has the potential to support the outcomes of such research.

Data generated can also alert scientists to problems or generate questions that require more detailed scientific studies. For example, differences in the fish fauna between regions in NSW coastal waters in terms of species distribution, abundance, and frequency of occurrence can be identified from which other studies would be necessary to determine the causes for these specific differences.

There is a land-based component to the technique. To take part in the surveys, each diver undergoes several hours of shore-based training and two training dives supervised by a trainer. Training of each diver to certification level helps ensure conformity to the survey methodology and scientifically credible results.

Conducting Fish Surveys

Materials Required

- Slate
- Underwater 'Paper'
- Pencil
- Compass
- Colour Fish ID Card
- Timer (watch or computer)

The slate is not a slate in the true sense of the term in that it not designed to 'write' upon, but rather, it acts as a clipboard. Before you take your slate into the water there are a few things you can do to make it easier to use, and to ensure that you don't lose any of its parts! There are a number of variations to just how a slate can be constructed. The image below shows one example.

It is constructed of polycarbonate and uses stainless steel bolts and wing nuts to make a 'clamp' at the top edge of the slate. The clamp is designed to hold the underwater 'paper' upon which records are made in place, along with a piece of taut shock cord located towards the bottom of the slate. Importantly there is a compass bolted to the slate. This is particularly useful for following compass bearings that may delineate a roving transect. Silicon tubing allows a pencil to be tethered to the slate - this is a better arrangement than using twine as the silicon tubing and pencil tend to have neutral buoyancy and are less likely to become entangled on consoles or benthos. If required an additional hole can be drilled in the top corner of the slate and a clip attached – the clip can then be attached to a D-ring on a



buoyancy vest thus leaving the hands free. If there is little current slates can be left on the substrate whilst an observer uses their hands for other purposes.

Even though volunteers will have received training in identifying targeted fish species, there may be occasions when a closely related, but non target, species is observed. In the first instance a volunteer may confer with their 'buddy' or with experienced members of the group during a surface interval, or during a debriefing session at the conclusion of the day's activities. If questions still arise as to the identification then having access to resource material will often lead to a positive identification. Fish identification reference books or an Internet connection to access fish ID websites should be available. If you are not 100% certain of a sighting, DO NOT RECORD IT.

Conducting the *RDT* survey

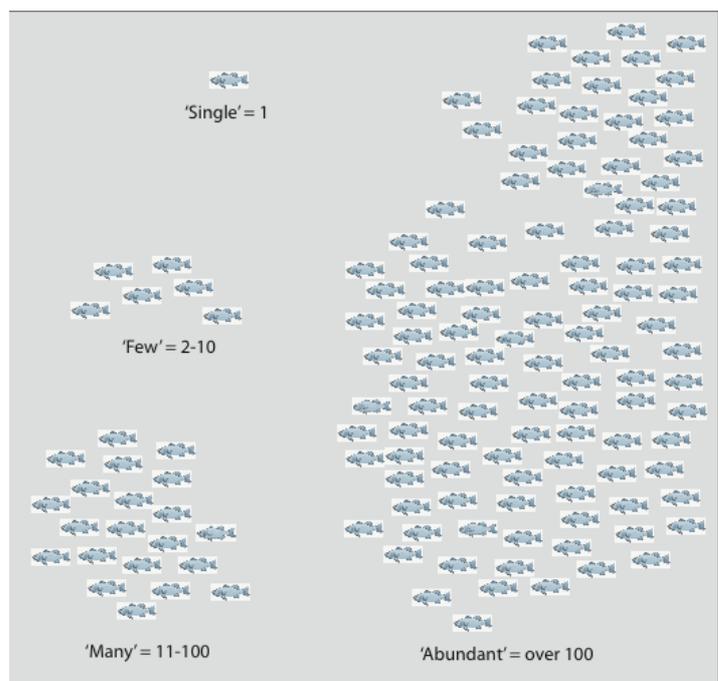
The *RDT* is simple: buddy pairs swim freely around the dive site and record those fish species that are the targeted species for the region you are surveying and which you can positively identify. The survey commences on entering the water and as an observer is descending to the seafloor. It can be conducted as a snorkeller or scuba diver.

The *RDT* is a species and abundance survey and provides data by assigning a relative abundance category to each species sighted. Many people mistakenly think they need to count every individual fish of a targeted species that is sighted...that is not the case!

The *technique* involves divers, in 'buddy pairs', "roving" around a dive site observing and recording observations related to a targeted suite of fish species during a dive. The estimated abundances of each species are recorded in categories as *Single* (1), *Few* (2-10), *Many* (11-100), and *Abundant* (> 100) occurrences.

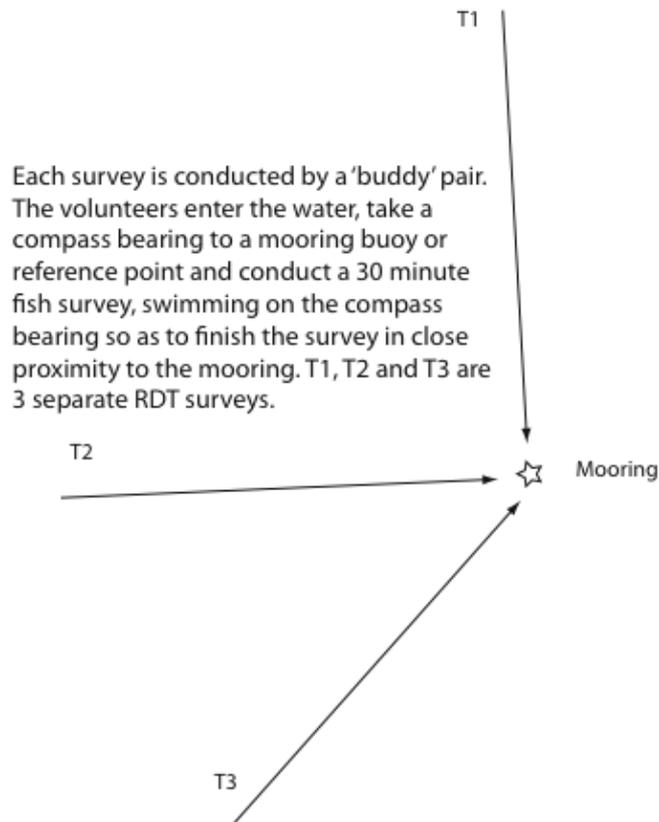
A roving diver survey is timed at 30 minutes and limited only by safe diving considerations, usually determined by depth. For example, a newly trained *Open Water* diver would be limited to 18 m in depth, but a volunteer accredited as a *Deep Diver* would be limited to depths down to 40 m.

Throughout the dive, divers estimate how many individual fish they observe of each species. If a large school is encountered determine if the school contains more or less than 100 fish. One way to do this is to count a smaller group within the school, and see how many times you could count another group of the same size within the entire school. If it adds up to over 100, assign that species to the "*Abundant*" category.

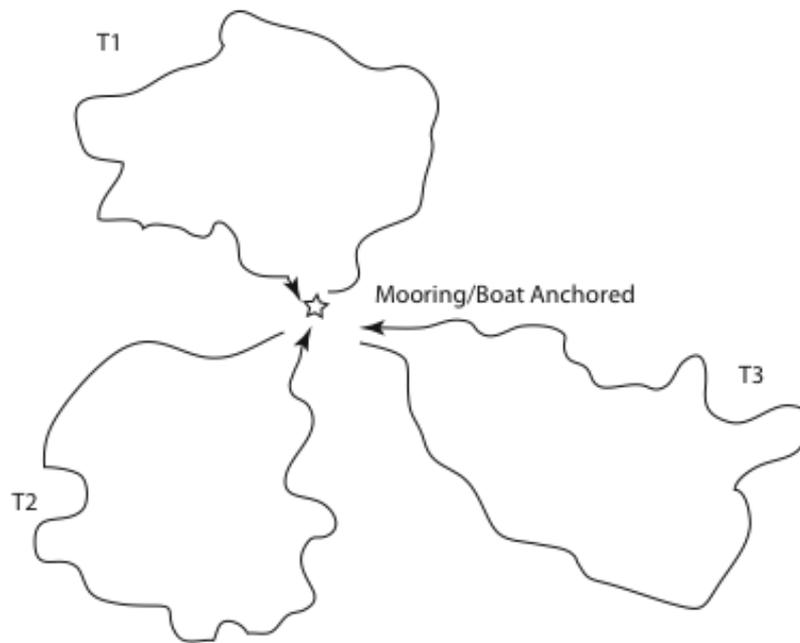


At the end of the survey dive, each observer, or a designated group member, transfers data from standard field sheets into a database.

In the example below three buddy pairs of divers have entered the water at three separate locations, taken a compass bearing to a mooring buoy or feature they have identified on the adjacent land, and swum on that compass bearing for 30 minutes whilst conducting the RDT. It's important that buddy pairs do not cover the same 'ground' to ensure that the same individual fish are not counted twice.



An alternative method enables divers follow a circuitous survey route starting from a mooring; it may be where a boat is anchored rather than a formal mooring site. Buddy pairs head in different directions. The figure below gives an example how this variant may be visualised.



Three transects, T1, T2 and T3, conducted about a mooring. Wherever appropriate divers should ensure that the deeper part of the survey is conducted first. Each transect is carried out by buddy pairs.

Completing the Standard Recording Sheet

Observers Names

Record the names of each member of the buddy pair.

Date of Survey

Self-explanatory. Record as 00/00/0000.

Location/Site

Record the name of the location. In some instances it may include a named reef/island and also a dive 'site' on that reef, e.g. Split Solitary Island – Turtle Cove. If there is only one location/site record the name under location.

GPS Coordinates

Latitude and longitude should be recorded in decimal format, i.e. 00 .0000°.

Water Temperature

Record to the nearest degree Celsius.

Start Time

Round to the nearest hour...for example, if you started your survey at 0840 hours, record as 0900 hours, but if you started it at 0828 hours, record as 0800 hours.

Visibility

Try to estimate the average visibility in metres throughout the dive taking into account where you spent the most time surveying.

Average Depth

Many dive computers will calculate the exact average depth, but make sure it accurately represents the depth where you spent the most time surveying.

State of the Tide

Record whether the tide is rising or falling.

Current

A 'strong' current is difficult to swim against and a 'weak' current is noticeable but does not affect the dive. 'None' means slight or no current.

Habitat

The type of habitat the majority of the survey was conducted over is recorded. Habitat types will vary by survey region.

Data Analysis

The protocol can be described as a Species and Abundance survey, i.e. it records the species seen and an abundance category for each species. The categories are order of magnitude estimates of the number of individuals sighted during the survey: **Single** = 1, **Few** = 2-10, **Many** = 11-100, and **Abundant** = over 100.

Density Index (Den)

This is a measure of how many individuals of a species are observed based on a scale of 1-4. It is representative of the abundance category (1-4) that was most frequently recorded for the species when it was observed. Abundance category weights are **Single**=1, **Few**=2, **Many**=3, and **Abundant**=4.

This weighted density average is calculated as:

$$Den = \frac{(S * 1) + (F * 2) + (M * 3) + (A * 4)}{\text{Number of surveys in which species was observed}}$$

The index indicates which abundance category the species was most often recorded in when it was recorded. For example, Den=2.2 would be reflective of a species that was most often recorded in category 2 (Few) but because the density index is greater than 2, there were some abundances recorded for this species in the other, larger abundance categories (either category 3 or 4).

The density index should be used as an abundance guide because area is not rigorously controlled in the RDT method. It should also be kept in mind that the density (Den) parameter is reflective of sighting distributions in the four different abundance categories (S, F, M, and A) and different distributions of sightings in each abundance category could potentially give similar values of Den (in other words, it does not account for non-sightings).

Sighting Frequency (%SF)

This is a measure of how often the species was observed. It indicates the percentage of times out of all surveys that the species was recorded.

The %SF parameter is calculated as:

$$\%SF = 100 \times \left(\frac{S + F + M + A(\text{for each species})}{\text{Number of Surveys}} \right)$$

By simultaneously examining the sighting frequency (%SF) and density index (Den), data summaries can be interpreted for fish species. The Den and %SF scores could be multiplied to provide a measure of species abundance that includes zero observations.

The following table shows examples of how the summary information can be interpreted at the species level.

Example of Data Interpretation

<i>Den</i>	<i>%SF</i>	<i>Explanation</i>
HIGH Den >3.0	HIGH %SF >50	Species is often observed and observed at high densities. Species is seen > 50% of the time and when it is seen the abundance category most often recorded is M or A. Species examples: Yellowtail Scad, Silver Sweep, Girdled parma
HIGH Den >3.0	LOW %SF <50	Species is not often seen, but when it is seen, it is observed at high densities. Species is seen < 50% of the time and when it is seen the abundance category most often recorded is M or A. Species examples: Luderick, Snapper
LOW Den <3.0	HIGH %SF >50	Species is often observed, but always at low densities. Species is seen > 50% of the time and when it is seen the abundance category most often recorded is F or S. Species examples: Greynurse shark, Sydney Cardinal fish, Blue Groper
LOW Den <3.0	LOW %SF <50	Species is not often observed and when it is observed, it is at very low densities. Species is seen < 50% of the time and when it is seen the abundance category most often recorded is S or F. Species examples: Green Moray, Red Rock Cod, Lionfish

Analysis Example

In the example discussed below a group of eight divers working in buddy pairs conduct four surveys at one site on the same day. The surveys are planned to preclude any chance of counting the same individual fish during the conduct of the surveys. Each survey is designated Transect 1, 2, 3 and 4.

The raw data for each transect is:

Transect 1

Categories				Species Name	Tally
S	F	M	A		
		X		Yellowtail Scad	85
		X		Silver Sweep	40
X				Grey Nurse Shark	1
	X			Lionfish	2

Transect 2

Categories				Species Name	Tally
S	F	M	A		
		X		Yellowtail Scad	30
		X		Silver Sweep	15
				Grey Nurse Shark	0
	X			Lionfish	3

Transect 3

Categories				Species Name	Tally
S	F	M	A		
		X		Yellowtail Scad	25
	X			Silver Sweep	10
	X			Grey Nurse Shark	5
	X			Lionfish	2

Transect 4

Categories				Species Name	Tally
S	F	M	A		
			X	Yellowtail Scad	120
	X			Silver Sweep	4
				Grey Nurse Shark	0
X				Lionfish	1

The density index is calculated as:

$$Den = \frac{(S * 1) + (F * 2) + (M * 3) + (A * 4)}{\text{Number of surveys in which species was observed}}$$

Thus for:

Eastern Hulafish	$Den = \frac{(0 \times 1) + (0 \times 2) + (3 \times 3) + (1 \times 4)}{4} = 3.25$
Silver Sweep	$Den = \frac{(0 \times 1) + (2 \times 2) + (2 \times 3) + (0 \times 4)}{4} = 2.5$
Grey Nurse Shark	$Den = \frac{(1 \times 1) + (1 \times 2) + (0 \times 3) + (0 \times 4)}{2} = 1.5$
Lionfish	$Den = \frac{(1 \times 1) + (3 \times 2) + (0 \times 3) + (0 \times 4)}{4} = 1.75$

The Percent Sighting Frequency is calculated as:

$$\%SF = 100 \times \left(\frac{S + F + M + A(\text{for each species})}{\text{Number of Surveys}} \right)$$

Thus for:

Eastern Hulafish	$\%SF = 100 \times \left(\frac{0 + 0 + 3 + 1}{4} \right) = 100$
Silver Sweep	$\%SF = 100 \times \left(\frac{0 + 2 + 2 + 0}{4} \right) = 100$
Grey Nurse Shark	$\%SF = 100 \times \left(\frac{1 + 1 + 0 + 0}{4} \right) = 50$
Lionfish	$\%SF = 100 \times \left(\frac{1 + 3 + 0 + 0}{4} \right) = 100$

Resources

- Australian Museum <http://australianmuseum.net.au/Fishes>
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- Reef Environmental Education Foundation <http://www.reef.org/>
- Solitary Islands Underwater Research Group http://www.surg.org.au/show_family.php
- The Underwater Photo Gallery <http://www.daveharasti.com/>
- DiveAround <http://www.divearound.com.au/index.html>
- Julian Rocks <http://julianrocks.net/>
- Diving the Gold Coast <http://www.divingthegoldcoast.com.au/>



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