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Tagging and sampling protocol for deepwater sharks

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Abstract

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A tagging and sampling protocol has been developed to accomplish the requirements of the EU funded project "Improving Scientific Advice on deep-water sharks in the SIOFA Area" aiming to improve the knowledge of several species caught in SIOFA fisheries, mainly deep-water sharks.
The Spanish longline fishery in SIOFA targets mainly benthopelagic and demersal species such as toothfish (*Dissostichus spp.*) and wreckfish (*Polyprion americanus*), however, deep-water sharks are frequently caught as bycatch, namely Portuguese dogfish (*Centroscymnus coelolepis*), birdbeak dogfish (*Deania calcea*), Kitefin sharks (*Dalatias licha)* and gulper sharks (*Centrophorus spp*), among others. Due to the fact that most of these species are included in the SIOFA Conservation and Management Measure 2022/12 for sharks (CMM 2022/12) as at "high risk" and "of concern" it has been deemed necessary to obtain all available information for the provision of robust scientific advice. As such, this paper provides a clear and simple protocol to help collect data from these species.

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Tagging and sampling protocol for deepwater sharks

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TAGGING AND SAMPLING PROTOCOL FOR DEEPWATER SHARKS

NOTE: This tagging protocol has been designed for application by observers on board Spanish longline vessels operating in the South Indian Ocean (SIOFA) targeting different species. The objectives are to collect information on the fishing operations and species caught (retained and discarded) during the fishing trips, as well as collect biological data (length, sex, maturity, etc.). In addition, tagging procedures will be carried out focusing on deep-water sharks whenever possible.

1. Modus Operandi

1) All sharks caught should be brought on board (to the rail, see Annex 2). If the shark is very large, it is recommended to use handling aids such as a stretcher to avoid damaging the fish (breaking the mouth and losing it). Fishermen or the observer should try to remove carefully the hook from the shark (unless it is dead).

2) Once on board, the vitality of the specimen should be checked and recorded according to the following criteria:

Table 1. Criteria used to assess at-vessel mortality.

SCORE	Vitality	Description
1	STRONG	Shark shows vigor or energical movements
2	WEAK	Shark is not dead but severy injured or weak with low probabilioties of survival
3	DEAD	Shark Is dead

If score is 2 (weak) or 3 (dead), the shark should be retained on board and the observer should proceed with sampling, as per instructions below (Biological sampling protocol). If the shark is in good condition and showing strong vitality, it should be considered for tagging.

3) The estimated tagging rate is 5 sharks per ton fished.

2. Tagging operations

The priority should be to minimise the handling of the fish and the time it spends out of water. Tags and the tagging gun should be prepared in advance to reduce the handling time. A tag release data sheet to record data should be used.

The shark should be placed on the table, measured to the lowest centimetre, sex recorded and maturity estimated for males according to the size and shape of claspers (1. Immature, 2. Developing, 3. Mature, 4. Active). For females, palpation to check for uterus expansion and the presence of eggs/pups should also be carried out and recorded.

Conventional Tags:

Several types of plastic tags can be used, in this study, we will opt for T-bar tags. These are widely used tags, which are suitable for use on a wide range of species (i.e., teleost fish such as hake, wreck, toothfish, as well as elasmobranchs) and are relatively easy to apply.

- T-bar tags should be placed onto the body musculature below the dorsal fin using the applicator Mark-II regular tagging gun. Each tag should have a code number that must be carefully recorded each tagged fish, along with the biological data recorded (i.e., species name, length, sex, maturity stage, etc.) and the information of the fishing operation (i.e., haul number, location (latitude and longitude) of fish release).

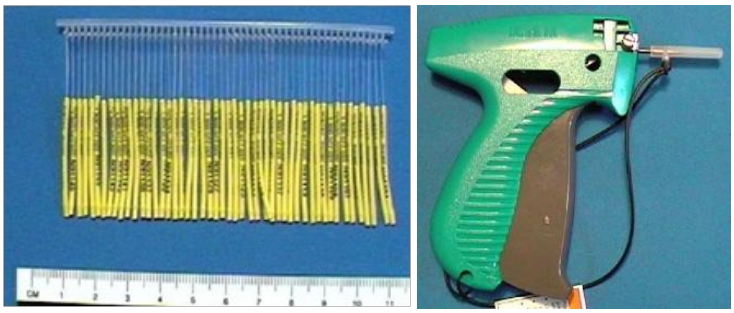

Figure 1.T-bar Tags and applicator

Electronic tags:

- Electronic tags (sPAT and or Mini PAT) should be placed in front of the first dorsal fin with the help of suitable pliers (Figure 2). Tags will need to be programmed prior to deployment and prepared to start automatically once the shark is released into the water.

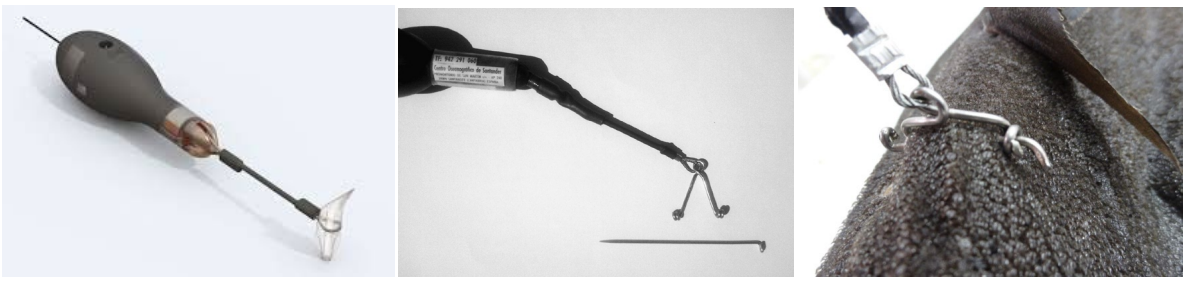

Figure 2. From left to right: a) Electronic satellite tag (PAT) b) Anchor used in this study c) Example of a tag placed onto a shark (Rodriguez-Cabello and Sánchez, 2014).

Where possible, it is recommended to record any known injuries to the shark before release. These could, for example, include: hook damage to the mouth, significant tearing of tissue around the jaw, non-removal of the hook, any visible wounds, bleeding from the gills, etc. Once released, information on the shark's vitality should be recorded, as per Table 2.

Table 2. Criteria used to assess release condition.

SCORE	Health	Description
1	GOOD	Strong and lively. Swims down quickly and with energy
2	MODERATE	Lively. Swims on the surface trying to go down but not immediately going deep

3	POOR	Lively but weaker movement. Floats on the surface. Slight movements of fins

3. Biological sampling

In cases where a shark is either dead or in very poor condition (i.e., not suitable for tagging purposes), data should still be collected. Record should be made of the species, total length (cm), weight (g), sex, and maturity stage, as described for oviparous and viviparous species, following the Maturity Guide in Annex 1, adapted from Stehmann (2002). Figure 3 shows different maturity stages during biological sampling of Portuguese dogfish.

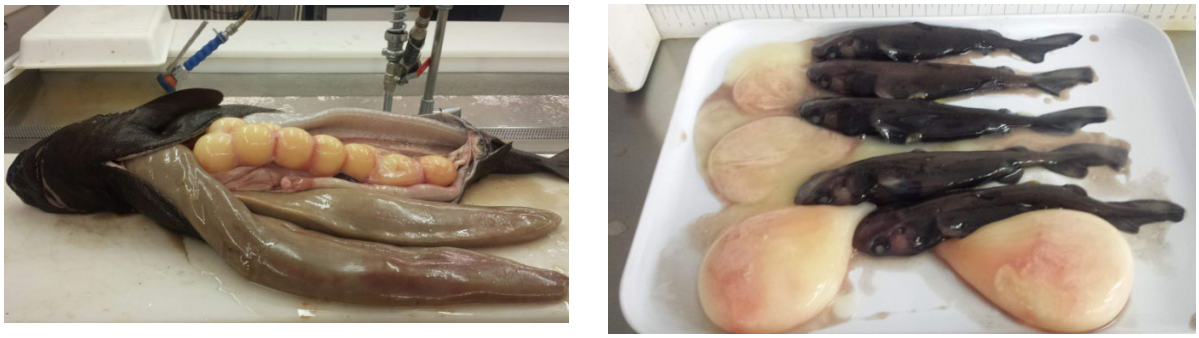

Figure 3. Biological sampling. Different maturity stages recorded in *Centroscymnus coelolepis*.

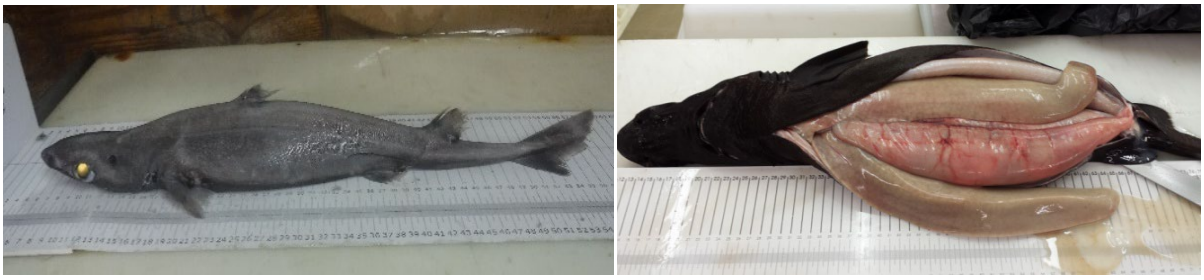

Figure 4. Biological sampling, measuring and recording maturity stage on *Etmopterus* spp (left) and *Centroselachus crepidater* (right).

For certain species, like gulper sharks (*Centrophorus* spp) and Portuguese dogfish (*C. coelolepis*), a minimum of 10 samples per SIOFA area and species will be collected for genetic analysis. A small muscle sample should be taken and placed into a vial with 99% alcohol (Figure 5). In cases where a specimen could not be identified (Annex 3), a photograph and tissue sample should be collected for DNA barcoding.

Figure 5. Sampling for molecular analysis.

4. References

Rodriguez-Cabello, C., Sánchez, F. (2014) Is *Centrophorus squamosus* a highly migratory deep-water shark? Deep-Sea Research I, 92: 1–10.

Stehmann, M.F.W. (2002) Proposal of a maturity stages scale for oviparous and viviparous cartilaginous fishes (Pisces, Chondrichthyes). Arch. Fish. Mar. Res. 50 (1): 23-48.

ANNEXES

Annex 1: MATURITY SCALE FOR VIVIPAROUS SHARKS (adapted from Stehmann)

MALES

Stage 1 - Immature (juvenile)

Claspers small and flexible, shorter than the extreme tip of the posterior pelvic fin lobes. Gonads small, whitish and thread-like.

Stage 2 - Developing (subadult)

Claspers becoming extended, of equal size or longer than tips of posterior pelvic fin lobes, with their skeleton still soft and flexible. Gonads enlarged, sperm ducts beginning to meander.

Stage 3 - Mature (adult)

Claspers fully formed and stiff, presenting cartilaginous hooks, claws or spines of glands free and sharp. Gonads enlarged, well rounded, filled with flowing sperm and often reddish. Sperm ducts are highly coiled and well filled with sperm.

Stage 4 - Active

Clasper glands often dilated and swollen, with free cartilaginous spines mostly erect; sperm flowing from cloaca under pressure on seminal vesicle and/or present in clasper groove.

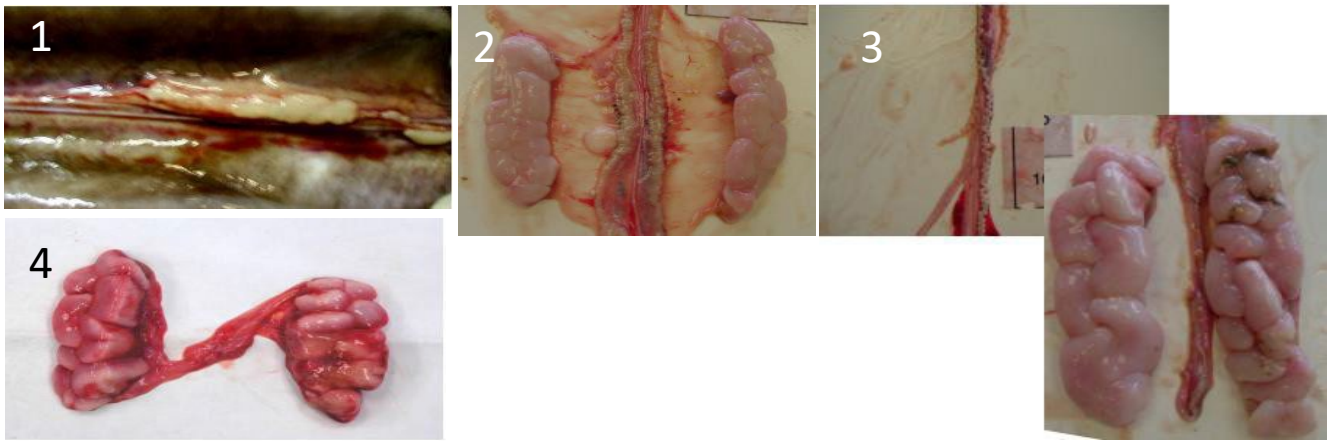

Figure 1 Annex1. Illustration of the different maturity stages of males

FEMALES

FEMALES - ovarian stages

Stage 1 – Immature (juvenile)

Ovaries are small, with a granulated aspect. Oocytes are small (up to 1 cm in diameter). Uteri narrow and thread-like (usually between 2 and 5 mm wide). The oviducal gland is not differentiated.

Stage 2 – Maturing (Subadult)

Ovaries somewhat larger than stage 1. Oocytes starting to differentiate into different stages, with the largest ones reaching 3 cm in diameter. No atretic oocytes in the ovaries. Uteri larger than stage 1 but still narrow.

Stage 3 – Mature (Adult)

Ovaries are large with oocytes; vitellus can reach up to 9 cm in diameter. Oocytes can be counted and measured easily. Count and measurement of the diameter of the eggs in each uterus must be done before collecting the entire reproductive system.

FEMALES - uterine stages

Stage 4 – Developing

Uteri wide with yolk (eggs) inside. Embryos not yet distinguishable. Uteri presenting unsegmented aspect.

Stage 5 – Differentiation

The uteri are segmented and small embryos can be differentiated; unpigmented and with large yolk sacs.

Stage 6 – Extrusion

The embryos are well formed and pigmented. The yolk sacs are visibly smaller.

Stage 7 - Post-natal

Uteri are empty but widened considerably over their full length (in contrast to stages 2), they are highly irrigated. The ovary shows many atretic oocytes (strong yellow color or brown) of large dimensions.

Stage 8 – Beginning of development

This stage is similar to stage 2, but it can be distinguished due to the presence of many atretic oocytes in the ovaries. The uteri are larger and irrigated, indicating that embryos were previously formed and released.

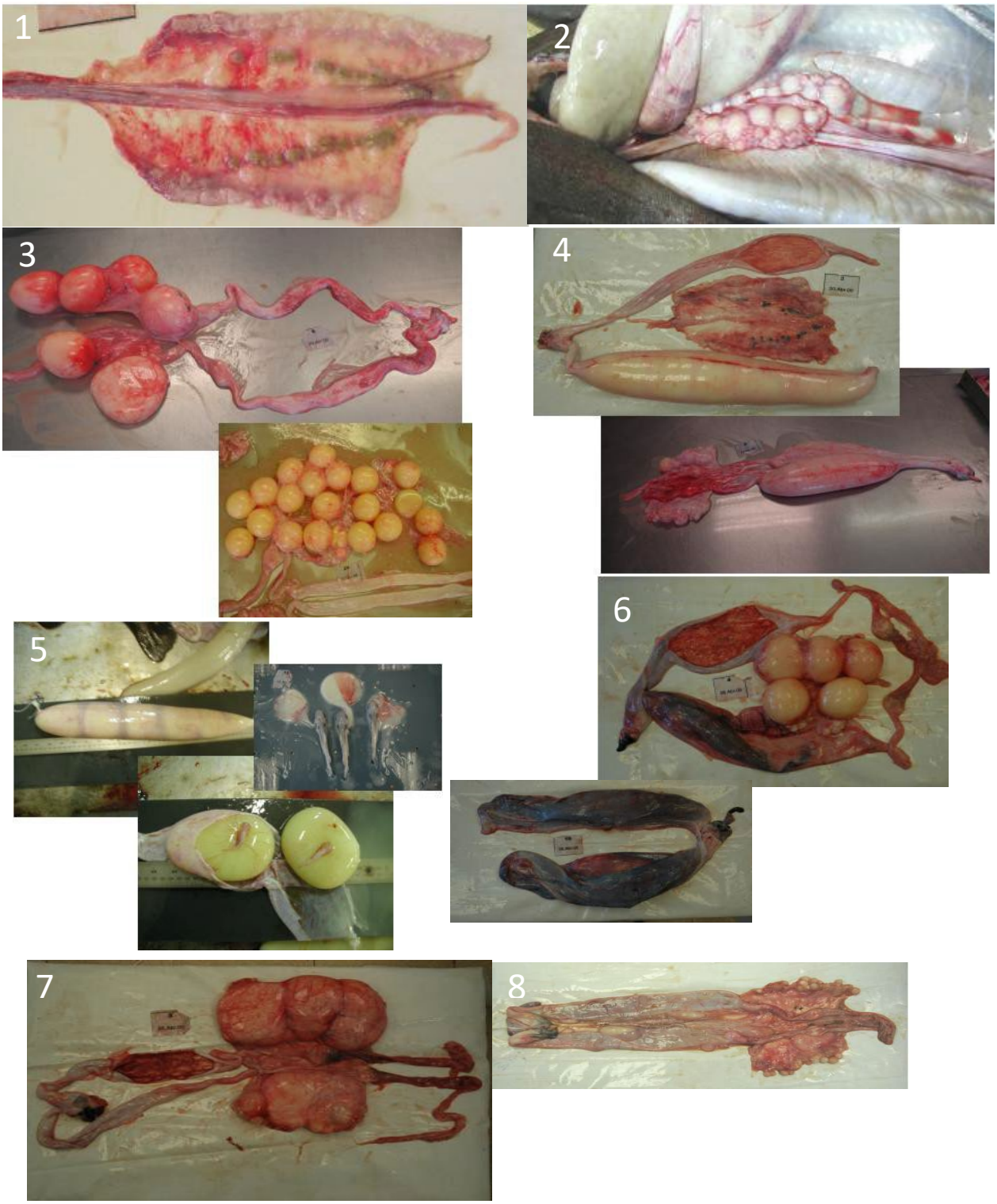

Figure 2 Annex1. Illustration of the different maturity stages of viviparous females

Annex 2: LESSONS LEARNED FOR CATCH AND RELEASE OF DEEP-WATER SHARKS ON BOARD THE SPANISH F/V IBSA QUINTO

In order to find the most suitable procedure for lifting, sampling, tagging and subsequently releasing the sharks in the bottom longline fishery within the SIOFA CA, tests were carried out during a 2022 trip.

As shown on Figure 1, the observer was located on the hauling deck, the area considered most suitable to speed up the tagging procedure. The observer was located next to the sailor, who was working on the hauling deck, in order to observe the arrival of the catch from the front line.

In cases where the catch was identified as a specimen belonging to the species of interest, a first inspection was carried out to check whether any important wounds were visible and whether it had been nailed to the hook by a clean bite. If this was the case, the haul stop button was pressed and the line was cut. The shark was then placed onto the band of the boat to remove the hook and was then measured, sexed and released. The distance to the water surface was less than half a meter.

It should be noted that these sharks, although they can be lively, are not as voracious as pelagic sharks, and are quite easy to handle. It is therefore possible to achieve the sampling and tagging objectives without exerting too much force, as long as the skill to carry out the tasks are well understood.

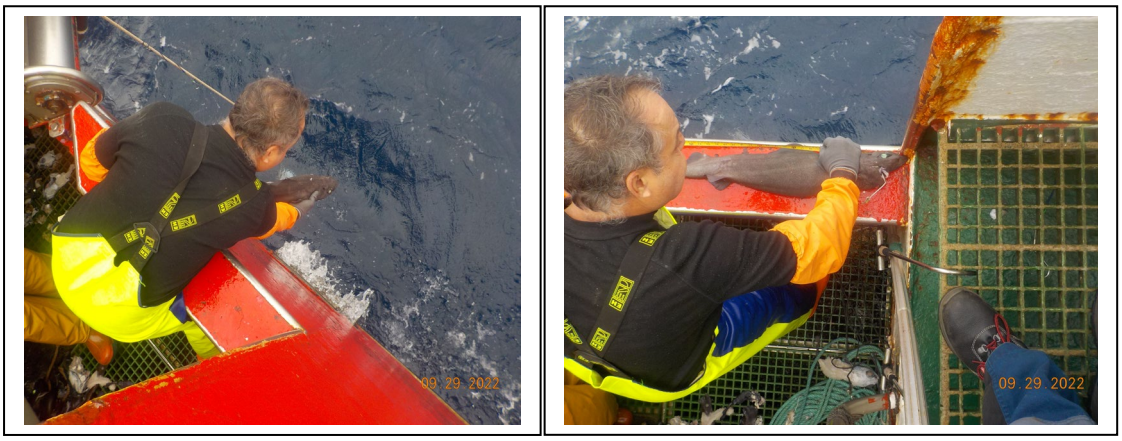

Figure 1 Annex 2. Illustration of sampling during fishing operations. Catch and release of deep-water sharks.

Potential problems:

Days with good weather need to be selected to carry out the work, as carrying out the tasks in poor weather could be dangerous. Additionally, it would not be possible for two people to fit in the hauling deck, as they would have to be harnessed for safety.

Moreover, only sets with a short soak time should be selected to try to ensure a higher percentage of specimens that can be caught and released.

The work area on the side of the hauling deck, where the specimen is measured, is only 120 cm long, so selected individuals cannot be much longer than this length.

Annex 3: QUICK SHARK IDENTIFICATION GUIDE

Observers are trained before getting on board to identify the most frequent species caught in the fishing area (SIOFA) during the fishing operations carried out by the longline fishing vessel. Nevertheless, some deep-water sharks are rather difficult to identify at the species level and some

taxa are still under revision. A quick identification guide has therefore been developed to help observers in this task.