USE OF SATELLITE TAGS TO REVEAL THE MOVEMENTS AND INTERACTIONS OF SHARKS WITHIN THE NEUM BAY AND THE REST OF ADRIATIC SEA

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Abstract: The Neum Bay presents the largest section of the marine part of Bosnia and Herzegovina; which present the most unexplored area in the entire Adriatic sea. According to the actual checklist, there are seven registered species of sharks in Bosnia and Herzegovina [2], with no data about movements and populations. In this paper authors present methods that can bring scientific data about movements of the sharks through the Neum Bay and their interactions with Malostonski Bay and the rest of the Adriatic Sea. This will help to discover the actual state of sharks in Bosnia and Herzegovina.

Key words: Shark, Tagging, Neum, Migrations, Biodiversity.

1 Introduction

Historical date shows that Neum Bay has been researched only twice in last two centuries. The first major research was held in the late 1970's by Dr. Tonko Šoljan and his team from Institute of Oceanography and Fisheries from Split (former republic of Yugoslavia, today republic Croatia). The second research was held in September 2011 by Andrej Gajić and his team from Sharklab (Hamrun, Malta) and Society for animal protection and inventory (Sarajevo, Bosnia and Herzegovina). Both researches had inventory caught and have not dealt with any detail about population of sharks; and

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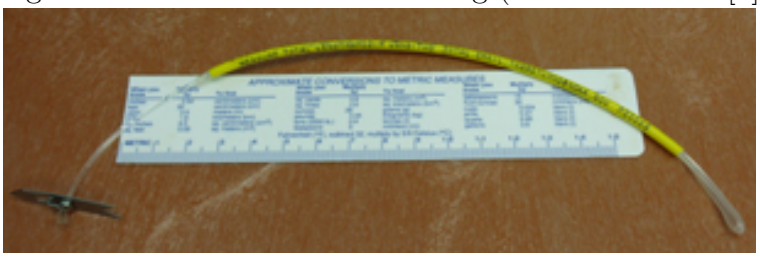
did not explain whether sharks occur in Neum Bay or whether there is a stable population of sharks smooth-hound inhabit in marine part of Bosnia and Herzegovina. There have not been any satellite tagging projects in the Adriatic Sea thus far.

Tagging species is an extremely efficient way of collecting vast amounts of data, both over a large period of time and short period of time. There are many different tagging methods, all depending on the source of data desired as well as the specie's environment and size. M-tags (Figure 1 & 2), Spaghetti tags and Roto-tags (Figure 3 & 4) are an efficient way of collecting continuous data for a long period of time. Most of these tags are composed of plastic, and positioned at the base of the dorsal fin of a shark. These conventional tags display an ID number as well as a contact number.

Figure 1: M-tag, used predominately in larger shark species. (Source: Swisher, A.)

Figure 2: Detail of the newer M-tag (Source: NOAA [2])



Various data is recorded at the time of attachment including measurements, location, sex, identifying marks, etc... Therefore, when a tagged shark is recovered, one can refer back to its original data and detect a pattern as well as learn the growth and its straight-line movement patterns.

Unfortunately, this method of tagging only provides the net distance travelled and time elapsed between the tagging and the recatch site, and it does not provide any temperature, depth or actual path. These plastic tag devices are good for a majority of shark species and very reliable and require easy attachment for low amounts of stress. These conventional tags also give way to a continuous amount of data collecting.

Figure 3: Attaching the Roto-tag on large tiger shark. (Source: Geary, D.)

To attain a large amount of precise data over a short period of time, it is best to use a satellite tag. There is a large assortment of satellite tags including SPLAH tags, Pop-up tags, SPOT tags, and TDR tags. Each one measures a precise objective and is fit to suit the size of the species. Furthermore, satellite tags eliminate the need for physical recovery. Recently, there have been developments of small pop-up satellite tags, which are very effective in tagging species that were previously too small to have been fixed with a satellite tag.

2 Material and Methods

This paper is based on personal experience of the Authors in different types of shark tagging programs in the Gulf of Mexico with blacktip sharks

Figure 4: Roto-tag is beeing attached on large black tip shark. (Source: Swisher, A.)

(*Carcharhinus limbatus* (J. P. Mŭller & Henle, 1839)) and the Bahamas, with several shark species including tiger sharks (*Galeocerdo cuvier* Péron & Lesueur, 1822), nurse sharks (*Ginglymostoma cirratum* (Bonnaterre, 1788)), lemon sharks (*Negaprion brevirostris* (Poey, 1868)), and some other species; and personal experience of Gajić in researching of biodiversity and ecology of Neum Bay, in September 2011 and different series of studying biology and ecology on sharks, some of which occurs in the Adriatic Sea, and marine part of Bosnia and Herzegovina, which include Neum Bay.

With personal experience in different types of shark biology of authors and after consulting available literature, we are suggesting a best method of shark tagging for Neum Bay.

3 Results ans Discussion

According to actual check-list, there are seven registered and eleven possible, shark species in the waters of Bosnia and Herzegovina [2].

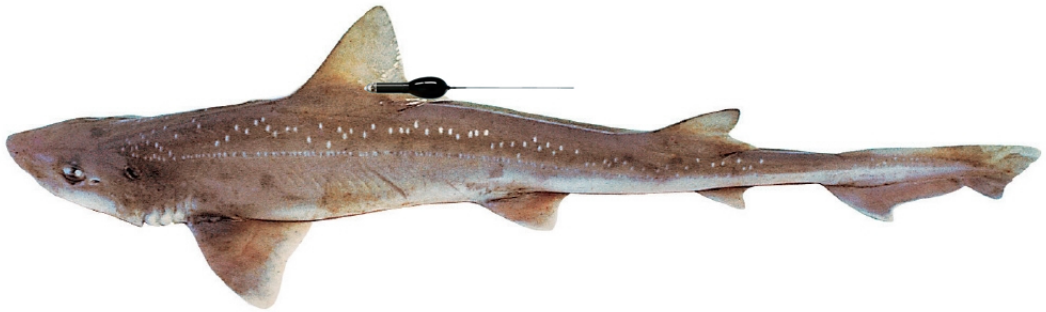
To this date, there have been no records of shark tagging in the Adriatic Sea, and therefore there is very little information about the sharks that inhabit these waters. With such a huge lack of data we are not able to understand the sharks movements inside the Neum Bay, and their interactions with other parts of Adriatic and Mediterranean Sea. The two most prevalent species of shark that reside in the Adriatic Sea, and can be particularly found off the coastal waters of Bosnia and Herzegovina, are the leser-spotted cat shark (*Scyliorhinus canicula* (L.)) and common smooth-hound (*Mustelus mustelus* (L.)) These are generally a small species only reaching on average approximately 45-200 cm in total length. In order to understand these species, including the subpopulations, distribution, and migration patterns, it is important to implement a plan on gaining this knowledge. The most appropriate tag for either *S. canicula* or *M. mustelus*, would be a popup satellite archival transmitting tag (PSAT), specifically a MiniPAT or X-tag (Figure 5).

Figure 5: MiniPAT, pop-up Archival Transmittig Tags which are best to use for small species that are most common in the Neum Bay (Source: Wildlife Computers)

The size of these tags are considerably smaller than other commercially available satellite tags, thus permitting the use of advanced tagging technology to track the movements of these relatively small species. Attached tags on small-spotted cat shark and common smooth-hound can be seen at Figures 4 and 5. The MiniPAT records depth, temperature, and light-level data while being towed by the animal. At a user-specified date and time, the MiniPAT actively corrodes the pin to which the tether is attached, thus releasing the MiniPAT from the animal. The MiniPAT then floats to the surface and transmits summarized information via the Argos system (Wildlife Computer 2011). Argos also uses the transmitted messages to provide the

position of the tag at the time of release. The transmitted data are sent to the researcher by Service Argos.

Figure 6: PTT-100 X Pop-up Tag on the first dorsal fin of the smooth-hound shark (*Mustelus mustelus*). (Source: NFRDI, adapted by: Gajić, A.)



The data can be analyzed further by the researcher using Wildlife Computers PC-based WC-DAP software. The results provide the migration path taken by the study animal, depth and temperature preferences of the study animal, as well as oceanographic data in the form of depth-temperature profiles (Wildlife Computers 2011). The X-tag works generally the same. The generated data collected may provide sufficient information to present an overall and consistent trend in the horizontal movement patterns of this species. The information will then give way to possible distribution of these species as well as detailed migratory patterns. Along with the satellite tag, it would be necessary to create an ongoing data base with data collected from plastic tags, particularly M-tags and Roto-tags. These will be fixed onto both the primary species of study, and any by-catch of other shark species in order to gain a broad knowledge of these fish, and determine distribution, sub populations, and growth patterns. This will also allow for a continuous recovery of field data.

4 Conclusion

Historical date shows that Neum Bay has been researched only twice in last two centuries. According to actual check-list, there are seven registered and eleven possible, shark species in the waters of Bosnia and Herzegovina [2].

Tagging species is an extremely efficient way of collecting vast amounts of data, both over a large period of time and short period of time. There are several methods used in shark tagging program, which mostly depends of the size and environment of the species that you want to track. M-tags, Roto-tags and Spaghetti tags are an efficient way of collecting continuous data for a long period of time.

To this date, there have been no records of shark tagging in the Adriatic Sea, and therefore there is very little information about the sharks that inhabit these waters. With such a huge lack of data we are not able to understand the sharks movements inside the Neum Bay, and their interactions with other parts of Adriatic and Mediterranean Sea. The two most prevalent species of shark that reside in the Adriatic Sea, and can be particularly found off the coastal waters of Bosnia and Herzegovina, are the leser-spotted cat shark (*Scyliorhinus canicula* (L.)) and common smooth-hound (*Mustelus mustelus* (L.)) These are generally a small species only reaching on average approximately 45-200 cm in total length. In order to understand these species, including the subpopulations, distribution, and migration patterns, it is important to implement a plan on gaining this knowledge. It is recommended to use a popup satellite archival transmitting tag (PSAT), specifically a MiniPAT or X-tag; which are the most appropriate tag for either *S. canicula* or *M. mustelus*.

The MiniPAT records depth, temperature, and light-level data while being towed by the animal. Along with the satellite tag, it would be necessary to create an ongoing data base with data collected from plastic tags, particularly M-tags and Roto-tags. These will be fixed onto both the primary species of study, and any by-catch of other shark species in order to gain a broad knowledge of these fish, and determine distribution, sub populations, and growth patterns. This will also allow for a continuous recovery of field data. Various data is recorded at the time of attachment including measurements, location, sex, identifying marks, etcetera.

References

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