# Population assessment of the endemic angelfish *Holacanthus limbaughi* from Île de La Passion-Clipperton Atoll (Tropical Eastern Pacific)

**Eric Clua\*, Sandra Bessudo, Jennifer E. Caselle, Claude Chauvet, Christian Jost, Alan M. Friedlander**

*Corresponding author: eric.clua@univ-perp.fr

**Supplement.**   Methodology for assessing the fish densities

The densities and sizes of the Clipperton angelfish (*Holocanthus limbaughi*) were assessed during two different field missions to Clipperton atoll that took place in February and May 2016, respectively.

During the first mission, six SCUBA dives were completed in four different stations on the 3rd and 4th of February. On the first day, two dives were implemented in the southwest area while a third dive took place in the west area. On the second day, one dive was implemented in the southwest, a second one in the eastern area of the atoll and the last one on the northwest area (Fig. 1B). During each dive, two divers were dedicated to counting and assessing the size of *Holacanthus limbaughi*. The first diver was performing underwater visual census (UVC) based on strip transects of 50 m in length (accounted by deploying a pentadecameter) and 2.5 m of width on each side, representing a surface of 250 m$^2$. The transect location was chosen along isobaths with homogeneous habitat and each transect was separated by 10 m. The transects were implemented both in shallow water (between 10 and 20 m) and deep water (between 20 and 30 m). Fish total length (TL) was estimated to the nearest cm and the fish classified in four different size classes: < or equal to 10 cm, from 11

to 15 cm, from 16 to 20 cm and > 20 cm. The second diver was performing video with a

CANON C500 (1920x1080) in a GATES waterproof housing with two lights (9,000 lumen),

along other 50-m transects following isobaths in homogeneous habitat. Two transects were

implemented in deep waters (between 20 and 30 m) and then two others in shallow water

(between 10 and 20 m). The width of the strip band covered by the images was

approximately 5-m, representing a total area of 1,000 $m^2$ per dive. Regarding the video, the

number and sizing of the angelfishes was performed after the dive by the two divers through

watching the footage on a screen. The expertise of both divers in terms of fish counting and

reef fish size assessment was considered sufficient for the reliable classification of

angelfishes in the suitable class of size. Combining underwater visual census and video

transects, we conducted a total of 27 transects at 6 sites around the atoll (Fig. 1B).

During the second mission in May 2016, one diver was dedicated to UVC of reef fishes along

three transects per dive in shallow water (10 m) and while a second diver conducted three

transects in deep water (20 m). At each depth of the two depth strata within a site, the

SCUBA diver tallied the *Holacanthus limbaughi* encountered within fixed-length (25-m) belt

transects whose widths differs depending on direction of swim. Transect bearings was

assigned along isobaths with homogeneous habitat and each transect was separated by at least

5 m. All fish ≥ 20 cm total length (TL) were tallied within a 4-m wide strip surveyed on an

initial "swim-out" as the transect line was laid (transect area = 100 $m^2$). All fishes < 20 cm

TL were tallied within a 2-m wide strip surveyed on the return swim back along the laid

transect line (transect area = 50 $m^2$). Fish total (TL) length was estimated to the nearest cm.

Quantitative surveys were conducted at 14 sites around the entire atoll, representing a total of

28 transects (Fig. 1B). At each depth strata at each site, counts were summed over the three

transects. Numerical density (abundance) were expressed as number of individuals per $m^2$.

**Table S1**

Left: Densities (ind.m$^{-2}$) of *H. limbaughi* assessed in February 2016 through Underwater

Visual Censuses (UVC) and video counting in shallow water (between 10 and 20 m) and

deep water (between 20 and 30 m). Right: Densities (ind.m$^{-2}$) of *H. limbaughi* assessed in

May 2016 through UVC implemented in shallow (10 m) and deep (20 m) waters.

| February 2016 | | | | May 2016 | | |
|---|---|---|---|---|---|---|
| STATION | Type | DEPTH_STRATA | Fish density | STATION | DEPTH_STRATA | Fish density |
| 1 | UVC | Shallow | 0,016 | 1 | Deep | 0,067 |
| | UVC | Deep | 0,008 | | Shallow | 0,007 |
| | UVC | Shallow | 0.028 | 2 | Deep | 0.020 |
| | Video | Shallow/Deep | 0.011 | | Shallow | 0.013 |
| | UVC | Deep | 0.016 | 3 | Deep | 0.060 |
| | UVC | Shallow | 0.008 | | Shallow | 0.043 |
| | UVC | Shallow | 0.004 | 4 | Deep | 0.020 |
| | Video | Shallow/Deep | 0.026 | | Shallow | 0.027 |
| 2 | UVC | Deep | 0.012 | 5 | Deep | 0.047 |
| | UVC | Shallow | 0.012 | | Shallow | 0.007 |
| | UVC | Deep | 0.016 | 6 | Deep | 0.040 |
| | Video | Shallow/Deep | 0.055 | | Shallow | 0.020 |
| 3 | UVC | Deep | 0.008 | 7 | Deep | 0.040 |
| | UVC | Shallow | 0.012 | | Shallow | 0.023 |
| | UVC | Deep | 0.016 | 8 | Deep | 0.003 |
| | Video | Shallow/Deep | 0.015 | | Shallow | 0.007 |
| | UVC | Shallow | 0.016 | 9 | Deep | 0.020 |
| | UVC | Deep | 0.020 | | Shallow | 0.007 |
| | UVC | Deep | 0.016 | 10 | Deep | 0.013 |
| | UVC | Shallow | 0.008 | | Shallow | 0.000 |
| | UVC | Deep | 0.012 | 11 | Deep | 0.000 |
| | UVC | Shallow | 0.024 | | Shallow | 0.000 |
| | Video | Shallow/Deep | 0.013 | 12 | Deep | 0.013 |
| 4 | UVC | Deep | 0.008 | | Shallow | 0.007 |
| | UVC | Shallow | 0.024 | 13 | Deep | 0.087 |
| | UVC | Deep | 0.012 | | Shallow | 0.027 |
| | Video | Shallow/Deep | 0.016 | 14 | Deep | 0.013 |
| | | | | | Shallow | 0.033 |
| **Mean** | | | **0.016** | | | **0.024** |
| **SD** | | | **0.010** | | | **0.022** |