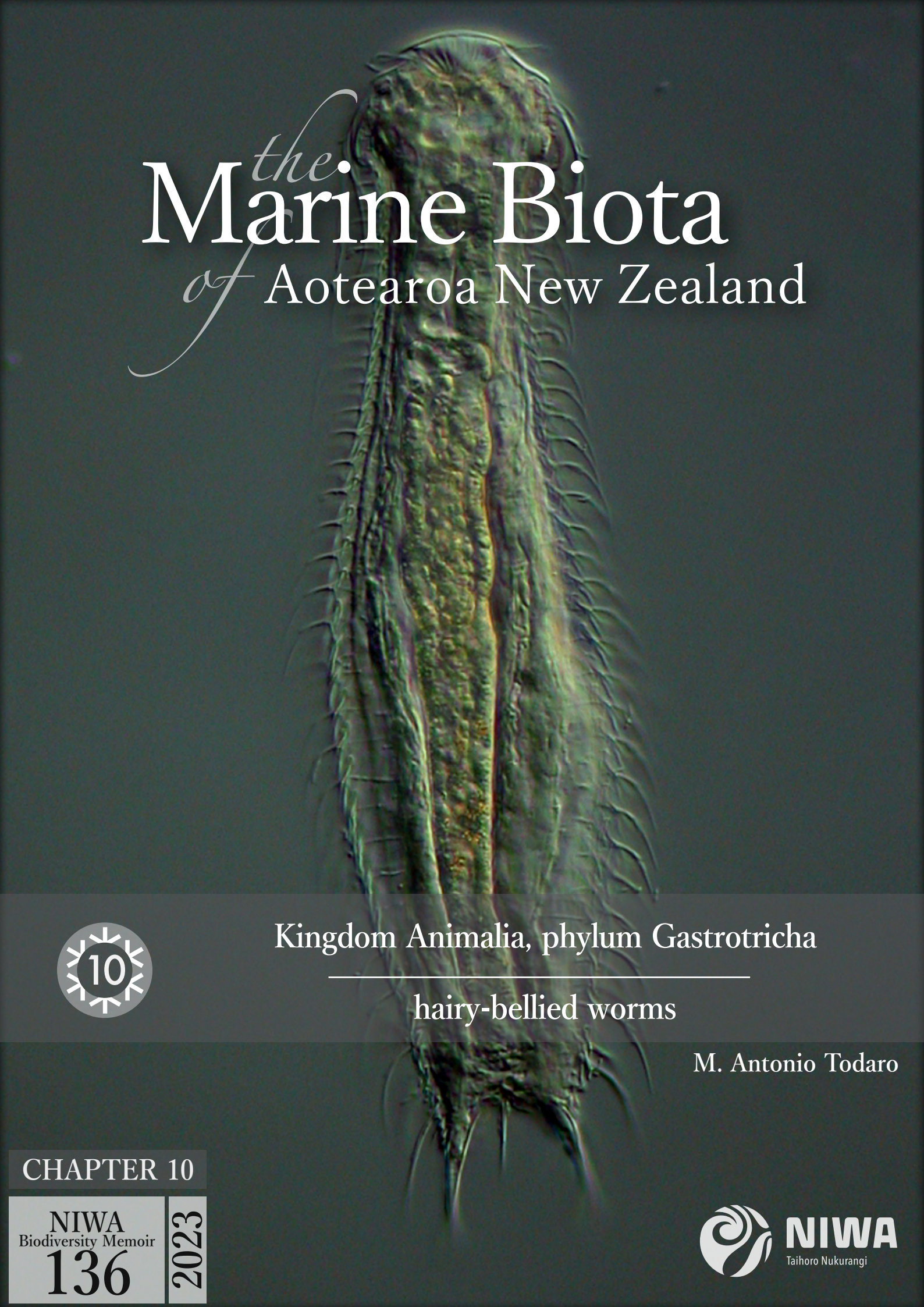

the Marine Biota of Aotearoa New Zealand

10

Kingdom Animalia, phylum Gastrotricha

hairy-bellied worms

M. Antonio Todaro

CHAPTER 10

NIWA Biodiversity Memoir 136 2023

NIWA Taihoro Nukurangi

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10 Kingdom Animalia, phylum Gastrotricha (hairy-bellied worms)

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Summary

The New Zealand Gastrotricha fauna is effectively unknown (Table 10.1; Fig. 10.1). The total number of recorded taxa from the Aotearoa New Zealand region is four genera and four undescribed species from the order Macrodasyida, and one undescribed specimen from the order Chaetonotida (fam., genus et sp. indet.; Table 10.1). In addition, there are over 330 specimens of unidentified Gastrotricha collected from New Zealand. The discovery rate, rate of description, and increase in our knowledge of gastrotrich diversity for New Zealand waters has remained unchanged during the last two decades (since Sterrer 2009). A checklist of New Zealand Gastrotricha is provided.

Introduction

The phylum Gastrotricha includes microscopic (0.08–3.5 mm body length), free-living, aquatic worms, characterised by a meiobenthic life style. The name Gastrotricha, effectively meaning 'hairy stomach,' refers to the dense ciliation that covers the ventral surface of these worms, and which they use to glide on the substrate. In marine habitats, gastrotrichs are mainly interstitial, whereas in fresh waters they are a common component of benthos, periphyton, and also of the plankton. The ecological role of the gastrotrichs is important within the microphagous, detritivorous, benthic community. Gastrotrichs ingest microalgae, bacteria and small protists by aspiration, with their potent, triradiated, myoepithelial pharynx, and in turn, they are preyed upon by small macrofauna, carnivorous ciliates, and free-living flatworms (Balsamo & Todaro 2002; Kieneke & Schmidt-Rhaesa 2015).

These tiny worms have an acoelomate body organisation and are considered to be phylogenetically closely allied to the Platyhelminthes, with which they form the clade Rouphozoa, within the protostome lineage Spiralia (e.g. Struck *et al*. 2014; Egger *et al.* 2015).

Gastrotrichs are unique among metazoans in their possession of a cuticle that envelopes the entire body, cilia included. The cuticle is composed of two layers and gives rise to external ornamentations such as plates, scales or spines, mostly seen in chetonotidans and in members of some macrodasyidan families (e.g., Thaumastodermatidae and Lepidodasyidae) (e.g. Ruppert 1991).

The body of a gastrotrich is generally elongated, dorsoventrally flattened, transparent and colourless, though the ingested food may colour the digestive tract. Gastrotrichs are characterised by an anterior mouth, a long muscular pharynx, a straight gut, a ventral anus, and adhesive tubes by which they attach to sand grains or debris (Todaro *et al*. 2019; Balsamo *et al*. 2020). Excretion and osmoregulation are performed by protonephridia. Sensorial organs are in the form of tactile cilia and bristles, eye spots, and flap-like or piston-pit chemoreceptors. Marine gastrotrichs are primarily hermaphroditic, with paired gonads, and in many species, glandular or muscular reproductive organs; most such species engage in mutual cross-fertilisation, though traumatic insemination is also possible. Most freshwater species reproduce by thelytokous parthenogenesis. In the latter case, two egg types are produced: thin-walled eggs, which hatch one to two days after deposition, and thick-walled resting eggs (e.g. Kieneke & Schmidt-Rhaesa 2015).

The phylum is global in distribution and currently counts approximately 860 accepted species distributed in two orders: Macrodasyida (377 species almost all

Table 10.1. Summary of gastrotrich diversity in the Aotearoa New Zealand region expressed as total numbers and percentage change. Data for 2009 are derived from Sterrer *et al.* (2009: p. 136). OTU = Operational Taxonomic Unit.

	Chaetonotida		Macrodasyida		Total		% change
	2009	2023	2009	2023	2009	2023	
Total species diversity	1	1	4	4	5	5	0
Described extant species	0	0	0	0	0	0	0
Undescribed extant species (OTU)	1	1	4	4	5	5	0

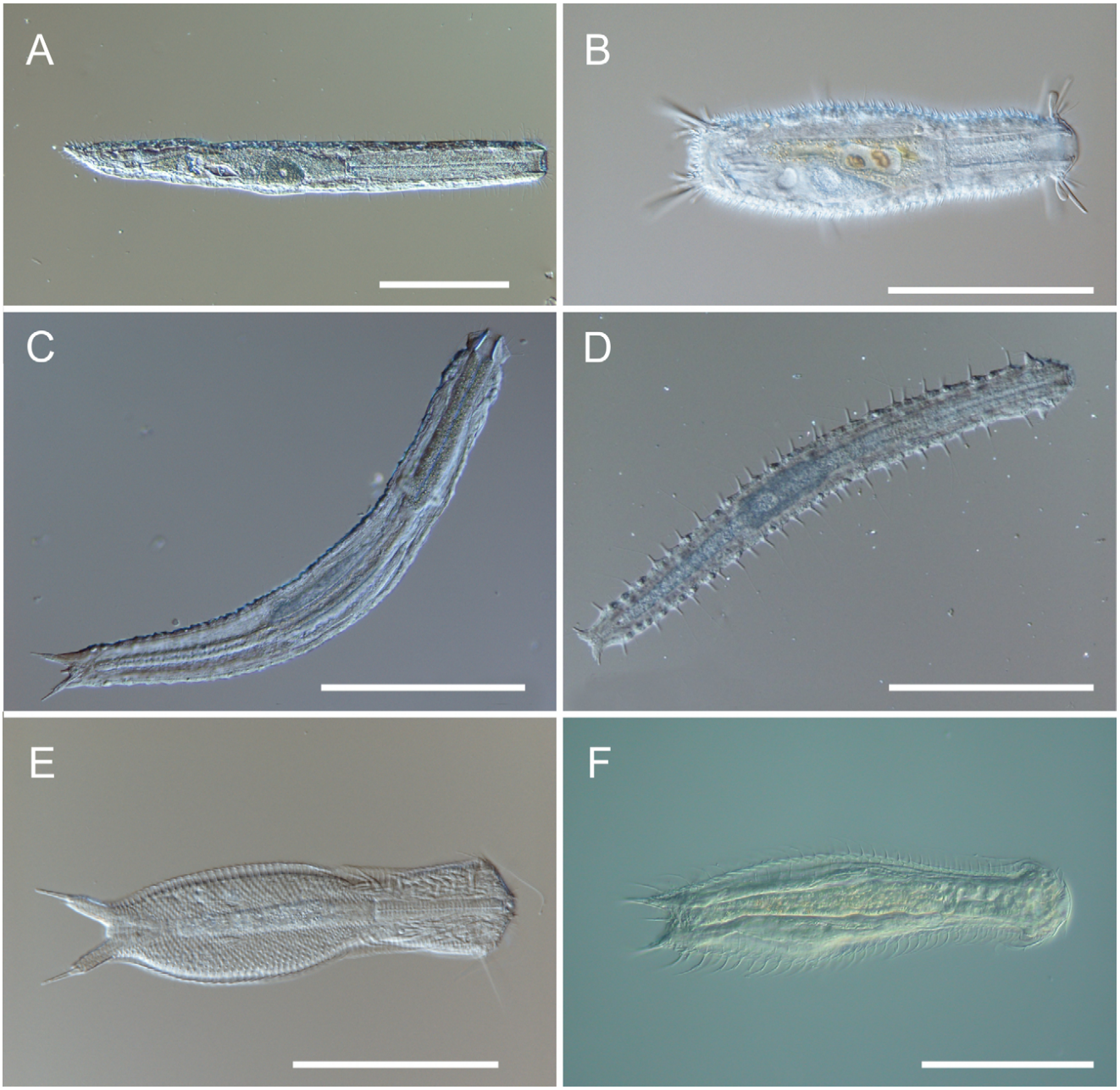

Figure 10.1. Gastrotrich species in orders Macrodasyida and Chaetonotida similar to taxa recorded from New Zealand to date: **Order Macrodasyida. A.** *Macrodasys* sp. (family Macrodasyidae), scale = 200 µm; **B.** *Thaumastoderma* sp. (family Thaumastodermatidae), scale = 100 µm; **C.** *Paraturbanella* sp. (family Turbanellidae), scale = 200 µm; **D.** *Turbanella* sp. (family Turbanellidae), scale = 200 µm. **Order Chaetonotida. E.** *Xenotrichula* sp. (family Xenotrichulidae), scale = 100 µm; **F.** *Chaetonotus* sp. (family Chaetonotidae), scale = 100 µm.

marine, distributed across 10 families and 37 genera) and Chaetonotida (132 marine and 353 freshwater species, distributed across eight families and 32 genera) (Todaro *et al*., 2021; Kieneke & Todaro 2021). Most macrodasyidan gastrotrichs lack a distinctive head, though sensorial organs can be well-defined; the sides of the body are parallel and bear from few to numerous adhesive tubes; the body ranges from short and broad to long and strap-like; the posterior body end is forked, rounded, or drawn out into a tail. In contrast, the body of most chaetonotidans includes a well-defined head lobe, a neck constriction, a slightly swollen trunk, and a forked posterior end at whose apexes are the only two, rarely four, adhesive tubes (Todaro *et al*. 2019).

The New Zealand gastrotrich fauna is, to all intents and purposes, still unknown. Sterrer (2009) highlighted this, stating: "*Gastrotricha have never been studied in this country and despite the fact that these worms are ubiquitous components of marine and freshwater meiofaunal systems, not a single species has ever been named*". Twelve years later, the situation remains unchanged, with only five putative taxa known for the New Zealand Exclusive Economic Zone. Records of marine gastrotrich taxa from New Zealand include: Riser (1984), who found *Turbanella* sp. (Macrodasyida: Turbanellidae) (see Fig. 10.1D), along with specimens of the family Thaumastodermatidae, in almost all the sampled beaches of the east coast of New Zealand,

between Paihia in the North Island and Nugget Point, Southland, South Island; yet, chaetonotid gastrotrichs (Order Chaetonotida) were found only at Taylor's Mistake and Okains Bay on Banks Peninsula in the South Island. Sterrer (2009) refers to *Macrodasys* sp. (family Macrodasyidae) (see Fig. 10.1A) and *Paraturbanella* sp. (family Turbanellidae) (see Fig. 10.1C) from the intertidal sand at Porirua Inlet in the North Island, and *Thaumastoderma* sp. (Macrodasyida: Thaumastodermatidae) (see Fig. 10.1B) from subtidal sand in Dunedin Harbour (= Otago Harbour) in the South Island. Finally, Kamenev *et al.* (1993) reported about 330 gastrotrich specimens per square metre in waters 4–12 m deep at Whale Island in the Bay of Plenty.

Provided one has a good, high-power microscope (differential interference contrast optics are recommended), most gastrotrichs are readily identifiable to genus, even by inexperienced observers, using several published dichotomous or pictorial keys (e.g., Kieneke & Schmidt-Rhaesa 2015; Todaro *et al*. 2019). For anyone who wishes to find and identify gastrotrichs, Todaro *et al*. (2019) is a primary text, providing a dichotomous and pictorial key to the genera of the phylum along with details of all the suitable techniques in the supplementary material. For the benefit of researchers working in the same areas of New Zealand that the available gastrotrich records come from, photomicrographs of non-New Zealand species belonging to the equivalent taxa reported for New Zealand are provided in Fig. 10.1. Finally, an updated list of accepted gastrotrich species/taxa may found in WoRMS (https://www.marinespecies.org/) and the Gastrotricha World Portal (https://www.gastrotricha.unimore.it), a free-access site entirely dedicated to these fascinating creatures.

Knowledge gaps, research progress and future priorities

Currently, there are over 500 marine gastrotrich species known from the world over, but none have been formally described from New Zealand. Consequently, local research on these animals cannot depart from an initial assessment of the alpha-diversity. Taxonomy should be based on an integrative approach (morphology coupled with molecular data) to avoid misidentification and unveil possible cases of cryptic speciation. New Zealand is rich in sandy beaches, the preferred habitat of these creatures, and a good start would be to focus the study on the gastrotrich fauna of the littoral and sublittoral sand of four to six beaches characterised by different exposure. Geographic distance from other localities and the amenity of the sampling locations may grant exciting future scientific discoveries.

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References to the taxonomic authorities and dates for gastrotrich taxa in this chapter and the associated checklist can be located in WoRMS (https://www.marinespecies.org/) and the Gastrotricha World Portal (https://www.gastrotricha.unimore.it).

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Checklist of extant Gastrotricha known from the New Zealand EEZ

The checklist is arranged according to the currently accepted systematics and classificatory scheme employed by the World Register of Marine Species, Gastrotricha (https://www.marinespecies.org/aphia.php?p=taxdetails&id=2078). Endemic taxa are indicated by 'E'. Non-indigenous species are indicated by 'NI'. All other taxa are considered native by default, i.e. naturally occurring in New Zealand and elsewhere.

Phylum GASTROTRICHA
Order CHAETONOTIDA
Chaetonotida sp. indet. Riser, 1984

Order MACRODASYIDA
Family MACRODASYIDAE
Macrodasys sp. indet. Sterrer, 2009
Family THAUMASTODERMATIDAE
Thaumastoderma sp. indet. Sterrer, 2009
Family TURBANELLIDAE
Paraturbanella sp. indet. Sterrer, 2009
Turbanella sp. indet. Riser, 1984

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