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Peter J. Smith
Dirk Steinke
Peter J. McMillan
S. Margaret McVeagh
Carl D. Struthers

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Peter J. Smith[1]
Dirk Steinke[2]
Peter J. McMillan[1]
S. Margaret McVeagh[1]
Carl D. Struthers[3]

[1]NIWA
Private Bag 14901
Wellington

[2]Canadian Center for DNA Barcoding
Biodiversity Institute of Ontario
University of Guelph
Guelph, Ontario, Canada N1G2W1

[3]Museum of New Zealand Te Papa Tongarewa
P O Box 467
Wellington

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EXECUTIVE SUMMARY

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Specimens of commercially important marine fishes were collected through *Kaharoa* and *Tangaroa* voyages and the MFish Scientific Observer Programme in the New Zealand EEZ. Muscle tissue samples taken were for DNA barcoding. The coastal fishes included some species which are not included in the Quota Management System, but for which there may be fillet identification problems among phenotypically similar or taxonomically closely related species. A regular tissue sampling protocol was set up with the Fish Team at Te Papa to ensure that tissue samples are taken from new specimens registered into the National Fish Collection. DNA extraction, amplification, and sequencing followed standard procedures for the cytochrome *c* oxidase I gene, the COI barcode region. For species tested with multiple specimens there was a low sequence divergence within species (average 0.6%) and greater divergence among species within the same genus (average 6.3%), validating the barcode method for the identification of New Zealand fish specimens and products. Preliminary analyses of the COI sequences revealed several taxonomic and identification issues. For example, there appears to be confusion and mislabelling of specimens of ghost sharks, *Hydrolagus* and *Chimaera*, and for the deep-sea finless flounders *Mancopsetta* and *Achiropsetta*. Specimens of southern bream (*Brama australis*) and Ray's bream (*Brama brama*) are frequently misidentified at sea. Better field guides for these species will overcome some of the identification problems. In response to requests from MFish staff, the barcode method was applied to the identification of smoked eel product, coastal shark fillets, and paua swab samples. A preliminary comparison of the New Zealand and Australian marine fishes in the Barcode Of Life Database (BOLD) has revealed some potentially cryptic sister species on either side of the Tasman Sea.

1. INTRODUCTION

A global DNA-based barcode identification system is being developed for all animal species, and when coupled with high throughput sequencing methods will provide a simple, universal tool for the identification of most animal species. The barcode system is based on DNA diversity in a single gene region, a section of the mitochondrial DNA cytochrome *c* oxidase I gene (COI). Specimens and products are identified by comparing their DNA barcode sequences against a DNA database of COI sequences derived from reference specimens. Hebert and coworkers (Hebert et al. 2003a, 2003b) have demonstrated that the COI region is appropriate for discriminating between closely related species across diverse animal phyla, and this has been verified in marine fishes (Steinke et al. 2005, Ward et al. 2005).

DNA barcodes are being collected for a wide range of animals from insects to mammals and COI sequences deposited in the Barcode of Life Database (BOLD) –www.barcodinglife.org/views/login.php. The Fish Barcode of Life Initiative (FISH-BOL) – www.fishbol.org/ – is a global effort to coordinate the assembly of a standardised reference DNA sequence library for all fish species. FISH-BOL provides a publicly available electronic database containing not only DNA barcodes, but complementary images of fish specimens, and geospatial coordinates of test specimens. The DNA reference sequences are based on voucher specimens identified by authoritative taxonomists. The benefits of barcoding fishes include facilitating species identification for all potential users (especially non-taxonomists); flagging previously unrecognised species; and most importantly, enabling identifications where conventional methods are not applicable, e.g., fillet and product identification.

1.1 Objectives

Overall objective

To create a DNA database for identification of commercially important marine species in New Zealand waters.

Specific objectives

1. To collect DNA sequences for vouchered specimens of commercially important marine fishes and submit the DNA data to the international Barcode of Life Database (BOLD).
2. To collect DNA sequences for vouchered specimens of commercially important marine invertebrates and submit the DNA data to the international Barcode of Life Database (BOLD).

Note: Because funding was limited for this Objective, MFish agreed to omit the invertebrate species (Objective 2) from this project and reduce the number of fish species sequenced from 100 to 80 (up to 5 specimens per species). During the course of the project MFish staff asked NIWA to identify smoked eel product, suspect shark fillets, and possible paua slime with DNA markers, and consequently the project was modified to accommodate these requests.

2. METHODS

2.1 Specimen selection and collection

Up to five specimens of the commercially important species were collected through *Kaharoa* and *Tangaroa* voyages in the New Zealand EEZ. Specimens were provisionally identified at sea, frozen whole, and returned to NIWA, Greta Point, for storage and processing. The aim was to collect specimens of the elasmobranch and teleost species in the Quota Management System, and some of the key bycatch species. Samples of coastal fishes included some species which are not included in the Quota Management System, but for which there may be fillet identification problems among phenotypically similar or taxonomically closely related species (e.g., Cheilodactylidae and Latridae). Specimens of Antarctic skates and toothfish collected by MFish Observers on New Zealand vessels fishing in the Ross Sea were included.

For several years NIWA and Te Papa have collected specimens of species identified as problematic for joint molecular and taxonomic studies (e.g. Smith et al. 1996, 2003, 2006). Some of these existing specimens and corresponding tissue samples were used for the DNA barcoding project.

2.2 Taxonomic identification, tissue sampling, and vouchering of specimens

In the laboratory, whole specimens were thawed and identified by a recognised fish taxonomist and the specimen labelled with a unique voucher label. Small, duplicate pieces of muscle tissue were removed from each specimen, labelled to correspond to the specimen voucher label, and stored in ethanol for DNA analyses. Some large specimens (over 50 cm) were photographed either at sea or in the laboratory and the digital images stored as e-vouchers. All fish specimens were offered to the National Fish Collection at Te Papa for vouchering.

2.3 DNA extraction, amplification, and sequencing

DNA was extracted from muscle tissues using an automated Glass Fiber protocol (Ivanova et al. 2006). The 650 bp barcode region of COI was amplified using standard primers (Ivanova et al. 2007) under the following thermal conditions: 2 min at 95 °C; 35 cycles of 0.5 min at 94 °C, 0.5 min at 52 °C, and 1 min at 72 °C; 10 min at 72 °C; held at 4 °C. The 12.5 µl PCR reaction mixes included 6.25 µl of 10% trehalose, 2.00 µl of ultrapure water, 1.25 µl 10X PCR buffer [200 mM Tris-HCl (pH 8.4), 500 mM KCl], 0.625 µl MgCl2 (50 mM), 0.125 µl of each primer cocktail (0.01 mM), 0.062 µl of each dNTP (10 mM), 0.060 µl of Platinum® Taq Polymerase (Invitrogen), and 2.0µl of DNA template. DNA products were labelled using the BigDye® Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems, Inc.) and sequenced bidirectionally using ABI 3730 or ABI 3100 capillary sequencers following manufacturer's instructions.

2.4 DNA data editing and collation, DNA and biological data entry

Sequences were aligned manually with SeqScape v2.5 software (Applied Biosystems, Inc.) and pairwise nucleotide divergences for both conspecific and congeneric pairs were calculated using the Kimura two parameter (K2P) distance model (Kimura 1981). Relationships among individuals and species were visualised with a NJ tree based on K2P distances; bootstrapping was

performed in MEGA v.3 (Kumar et al. 2004) with 1000 replications. COI sequences, specimen voucher numbers, and associated biological data have been deposited in BOLD.

3. RESULTS

3.1 Specimen selection and collection

Specimens of common marine fishes were collected during 2006–07 *Tangaroa* and *Kaharoa* voyages. The New Zealand Chondrichthyes (the Holocephali, ghost sharks and the Elasmobranchii,sharks, rays and skates) that were barcoded are listed in Appendix 1, and the teleosts in Appendix 2. A full list of the New Zealand teleosts and sharks/rays barcoded to October 2007 is given in Appendices 3 and 4 and includes meso-pelagic fishes barcoded under another project (for identification of gut contents of fishes and seabirds), and Ross Sea fishes taken aboard New Zealand commercial vessels fishing in the Ross Sea (skates: *Amblyraja* and *Bathyraja*; teleosts: *Dissostichus* spp., *Macrourus holotrachys*, and Channichthyidae).

Specimens of large pelagic species were not retained due to the costs and logistics of vouchering specimens. However, several of the Indo-Pacific tunas and swordfishes have been barcoded by research groups in other countries and the COI sequences deposited in BOLD. These sequences are available for New Zealand researchers and fisheries managers wishing to identify specimens/product of tunas and swordfish, and have been used by NIWA staff to identify bluefin tuna caught in the New Zealand EEZ for both MFish and for recreational anglers (Smith et al. 2001, Smith & McVeagh 2006).

Tissue samples were not available from reference specimens of kingfish *Seriola lalandi*, scad *Decapterus muroadsi*, koheru (*Decapterus koheru*), Kermadec kahawai (*Arripis xylabion*), the butterfish (*Odax pullus* and *O. cyanoallix)*, the soles (*Peltorhamphus latus* and *P. tenuis*), the black flounder (*Rhombosolea retiaria*), the mullets (*Aldrichetta forsteri* and *Mugil cephalus*), golden snapper (*Centroberyx affinis*), longfinned beryx (*Beryx decadactylus*), and John dory (*Zeus faber*) (these species are marked in bold in Appendix 3). COI sequences for Australian specimens of kingfish (*Seriola lalandi*) have been deposited in BOLD and are identical to COI sequences of New Zealand kingfish taken from non-reference specimens (Smith, unpublished sequences).

Reference specimens of two less common species for which there have been fillet identification problems in the past were also not obtained: escolar (*Lepidocybium flavobrunneum*) and oilfish (*Ruvettus pretiosus*).

3.2 Taxonomic identification, tissue sampling, and vouchering of specimens

Tissue samples were available from several species of large shark, and these were barcoded due to the need to identify shark fins. The large shark specimens were identified by Malcolm Francis (NIWA) and Clinton Duffy (DoC) but the specimens were not retained. Reference specimens and tissue samples were retained for several smaller species of sharks and rays (both quota and non-quota species) and the tissue samples barcoded. The specimens were identified by Peter McMillan (NIWA) and Andrew Stewart (Te Papa). The New Zealand sharks and rays that were

barcoded for this project are listed in Appendix 2, and the total list barcoded to Ocober 2007 is given in Appendix 4.

Specimens of key teleosts were returned to NIWA, Greta Point, after *Tangaroa* and *Kaharoa* voyages, and identifications confirmed by Peter McMillan, Carl Struthers, and Andrew Stewart following provisional identifications made at sea. Tissue samples were removed and, where feasible, specimens were deposited into the National Fish Collection. Tissue samples were also available from several species of coastal teleosts for which reference specimens had previously been deposited into the National Fish Collection. A regular tissue sampling protocol was set up with the Fish Team at Te Papa to ensure that tissue samples were taken from new specimens registered into the National Fish Collection, before the specimens were fixed in formalin. Subject to resourcing, the tissue sampling protocol will continue after the completion of this project to ensure that there is a tissue sample bank for vouchered fish specimens.

A few rare and unusual fishes were supplied to NIWA though MFish Observers and fishing companies. Notable examples were the first New Zealand record of the knifejaw, *Oplegnathus woodwardi* (Waite, 1900), distributed from Western Australia to New South Wales and Tasmania, and caught off the west coast South Island (identification confirmed by Peter McMillan), and the giant barracudina, *Magnisudis prionosa* (Rofen, 1963), also caught off the west coast South Island (identification confirmed by Malcolm Francis). Ross Sea skates and selected teleosts were collected by MFish Observers on commercial vessels longlining for toothfish, and identifications made by Carl Struthers, and Andrew Stewart.

The fish collection storage area of the National Fish Collection was being refurbished during 2006–07 and access to the collection, including deposition of new specimens, was restricted. Unfortunately, most fish specimens stored in the Te Papa collection have been fixed in formalin, and are not suitable for tissue sampling for routine DNA barcoding. Therefore for species that were not accepted by Te Papa, small specimens (under about 30 cm) were fixed in formalin and/or ethanol following tissue sampling at NIWA and stored at NIWA, Greta Point. Some larger specimens (about 50 cm) were frozen and stored at NIWA, after tissue sampling and DNA extractions.

3.3 DNA extraction, amplification, and sequencing

Tissues were processed following the standard protocols. The fish primer pair FishF2 and FishR2 (Ward et al. 2005) provided amplification of COI from all fishes except skates, for which the *Raja* specific COI primers (Spies et al. 2006) were used.

3.4 DNA data editing and collation, DNA and biological data entry

For most species with multiple specimens there was a low sequence divergence within species and greater divergence among species within the same genus, validating the barcode method for the identification of fish specimens and products; average within-species and within-genus K2P distances were 0.6% and 6.3% respectively. For example, COI divergences within and among the New Zealand Cheilodactylidae (porae, king tarakihi, and tarakihi) and Latridae (moki, trumpeter, silver trumpeter, and telescope fish) were 0.1–0.5% within species, 1–8% within genera, and 13–15 % between genera (Figure 1).

Peter McMillan (NIWA) identified specimens of rattails and grenadiers (Macrouridae) caught in deepwater trawl fisheries around New Zealand, enabling the establishment of the largest COI database for this large group of fishes. For the genus *Coryphaenoides* (grenadiers) sequence divergences were 0.1–4% within species and 8–21% among species (Figure 2), and 23% within the family (Macrouridae: 27 species).

As might be expected in building a DNA database of New Zealand marine fishes, a few problems were encountered. For example, preliminary analyses of the COI sequences revealed several mis-identifications of reference specimens held in the National Fish Collection at Te Papa. This was not surprising given the large number of specimens that have been catalogued from a diverse fish fauna. Potential specimen misidentifications were highlighted in the COI data sets when an unexpected species name appeared within a clade (see, for example, Figures 2 and 3). This type of observation was produced by either tissue mislabelling or specimen mislabelling. Reference specimens providing the tissue samples (and sequences) enable the identifications to be checked, and sequences re-evaluated.

Key examples of mislabelled specimens in the National Fish Collection were: jack mackerel *Trachurus novaezelandiae* mislabelled as *Trachurus declivis*; congrid eel (*Bassanago* sp.) mislabelled as *Conger* sp., *Macrourus whitsoni* and *M. holotrachys* mislabelled as *M. carinatus*; orange perch *Lepidoperca aurantia* mislabelled as *Lepidoperca magna* (see Figure 2). The macrourid *Coryphaenoides ferrieri* may be a misidentification or a shared haplotype (see Figure 3). Specimens referred to as the giant skate (*Zearaja nasutus*) aligned with the skate *Dipturus inominatus* and not *Zearaja nasutus*.

There has been some confusion and mislabelling of specimens of ghost sharks, *Chimaera* and *Hydrolagus*, both in the laboratory and in specimens identified at sea. Barcode sequences highlighted misidentified specimens. The two genera can be distinguished by the presence/absence of the anal fin (present in *Chimaera*), and re- examination of specimens placed them in the correct genus. Within the genus *Hydrolagus*, specimens identified as *Hydrolagus trolli* and *Hydrolagus* sp. D shared sequences (Figure 4).

Likewise there appears to be confusion over identification of the deep-sea finless flounders, *Mancopsetta* and *Achiropsetta*. Specimens of southern bream *Brama australis* and Ray's bream *Brama brama* were frequently mis-identified at sea. Better descriptions of these species will overcome some of these identification problems. In this respect NIWA has been funded by the Ministry of Fisheries to produce a guide to the commercial fishes of New Zealand.

A preliminary comparison of the New Zealand and Australian marine fishes in BOLD revealed potentially cryptic sister species on either side of the Tasman Sea. For example the common red cod (*Pseudophycis bachus*) shows low sequence divergence among specimens within Australia (0.002) and New Zealand (0.000), but high sequence divergence in the pooled data (0.086), typical of species pairs in the Moridae (see Figure 5). Specimens of the two species of bastard red cod (*Pseudophycis barbata* Günther, 1863 southern bastard red cod, and *Pseudophycis breviuscula* (Richardson, 1846), northern bastard red cod) will need to be collected in New Zealand to address sequence divergence within and among species of *Pseudophycis*. The sequence data for the *Pseudophycis* species will not be released until the species identification issue has been resolved under another project.

Other species showing low sequence divergence within New Zealand and within Australia, but high sequence divergence in the pooled Australasian specimens, were rubyfish (*Plagiogeneion*

rubiginosum), slender cod (*Halargyreus johnsonii*), and deepsea ghostflathead (*Hoplichthys haswelli*). The sequence data for these species will not be released until the species identification issue has been resolved under another project.

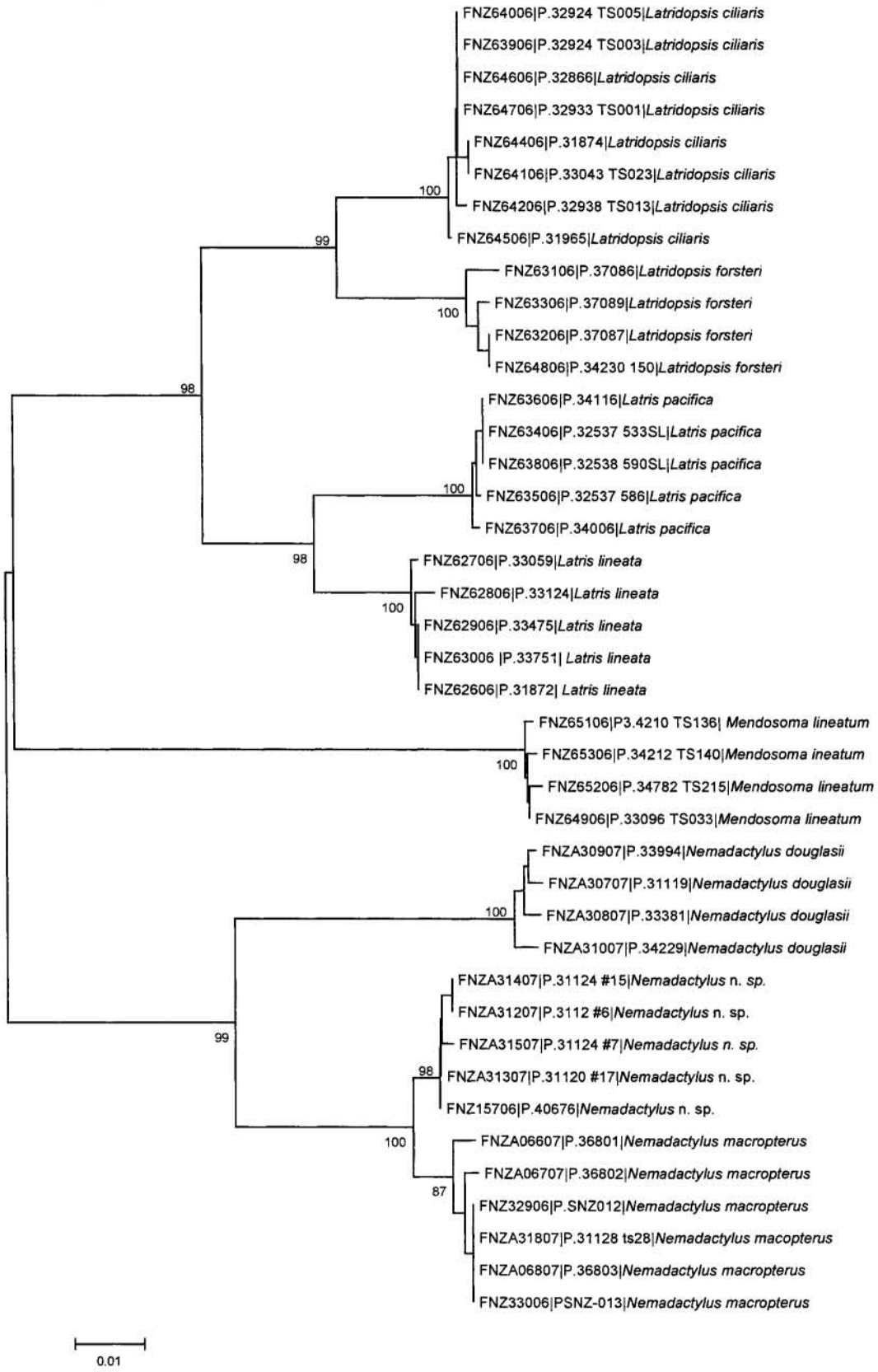
FNZ64006|P.32924 TS005|Latridopsis ciliaris
FNZ63906|P.32924 TS003|Latridopsis ciliaris
FNZ64606|P.32866|Latridopsis ciliaris
FNZ64706|P.32933 TS001|Latridopsis ciliaris
FNZ64406|P.31874|Latridopsis ciliaris
FNZ64106|P.33043 TS023|Latridopsis ciliaris
FNZ64206|P.32938 TS013|Latridopsis ciliaris
FNZ64506|P.31965|Latridopsis ciliaris
FNZ63106|P.37086|Latridopsis forsteri
FNZ63306|P.37089|Latridopsis forsteri
FNZ63206|P.37087|Latridopsis forsteri
FNZ64806|P.34230 150|Latridopsis forsteri
FNZ63606|P.34116|Latris pacifica
FNZ63406|P.32537 533SL|Latris pacifica
FNZ63806|P.32538 590SL|Latris pacifica
FNZ63506|P.32537 586|Latris pacifica
FNZ63706|P.34006|Latris pacifica
FNZ62706|P.33059|Latris lineata
FNZ62806|P.33124|Latris lineata
FNZ62906|P.33475|Latris lineata
FNZ63006 |P.33751| Latris lineata
FNZ62606|P.31872| Latris lineata
FNZ65106|P3.4210 TS136| Mendosoma lineatum
FNZ65306|P.34212 TS140|Mendosoma ineatum
FNZ65206|P.34782 TS215|Mendosoma lineatum
FNZ64906|P.33096 TS033|Mendosoma lineatum
FNZA30907|P.33994|Nemadactylus douglasii
FNZA30707|P.31119|Nemadactylus douglasii
FNZA30807|P.33381|Nemadactylus douglasii
FNZA31007|P.34229|Nemadactylus douglasii
FNZA31407|P.31124 #15|Nemadactylus n. sp.
FNZA31207|P.3112 #6|Nemadactylus n. sp.
FNZA31507|P.31124 #7|Nemadactylus n. sp.
FNZA31307|P.31120 #17|Nemadactylus n. sp.
FNZ15706|P.40676|Nemadactylus n. sp.
FNZA06607|P.36801|Nemadactylus macropterus
FNZA06707|P.36802|Nemadactylus macropterus
FNZ32906|P.SNZ012|Nemadactylus macropterus
FNZA31807|P.31128 ts28|Nemadactylus macopterus
FNZA06807|P.36803|Nemadactylus macropterus
FNZ33006|PSNZ-013|Nemadactylus macropterus
100
99
100
98
100
98
100
100
99
98
100
87
0.01

Figure 1 (opposite): Relationships among the New Zealand Cheilodactylidae (porae, tarakihi and king tarakihi) and Latridae (copper moki, blue moki, trumpeter, silver trumpeter, and telescope fish), based on COI sequence data (unrooted tree). Numbers before the species names are the BOLD process ID numbers followed by the Te Papa specimen reference number. The scale bar represents an interval of the K2P model. Numbers at nodes are bootstrap percentages (>85%), based on distance (after 1000 replicates).

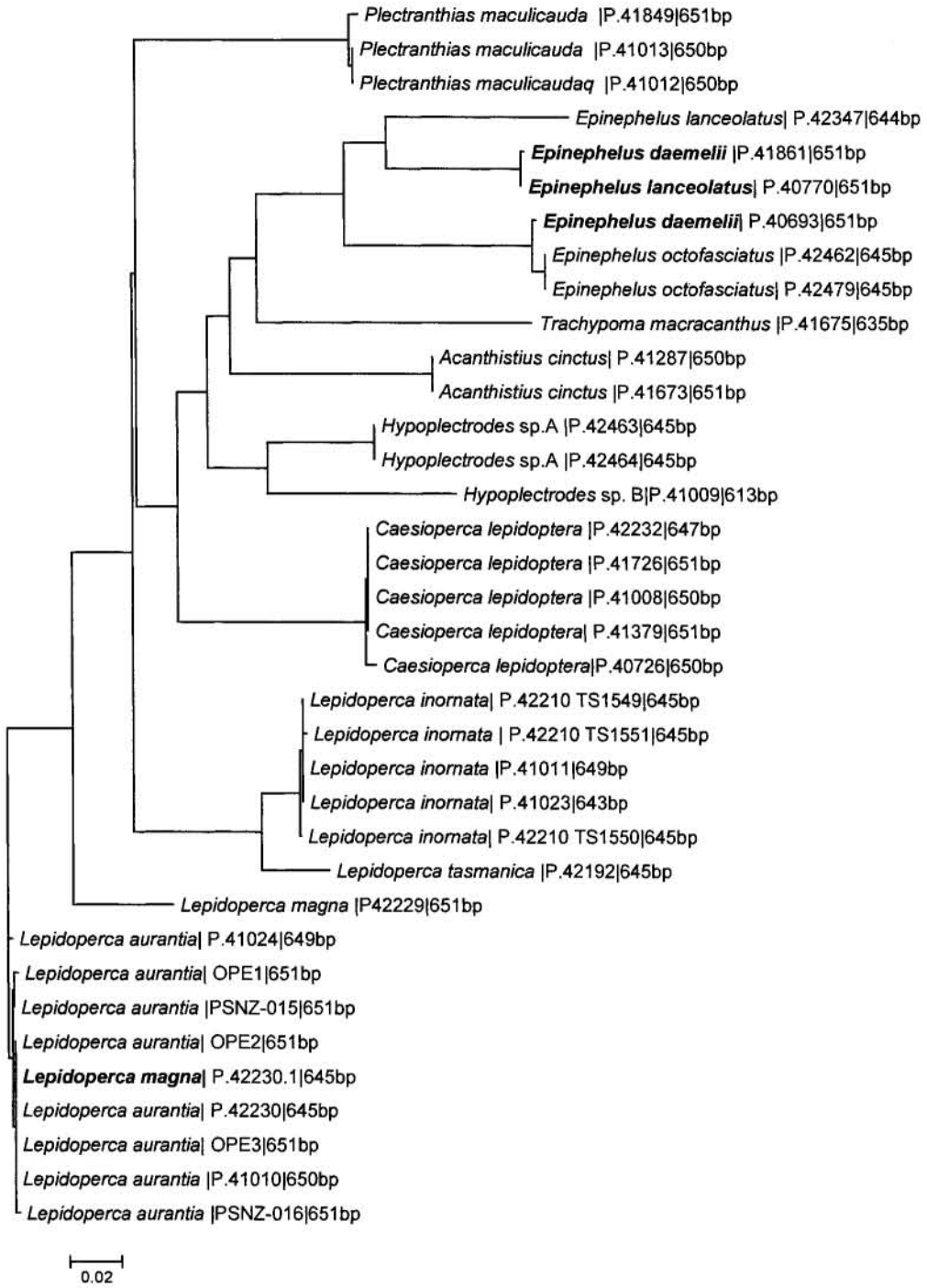

Figure 2: Relationships among the New Zealand Serranidae based on COI sequence data (unrooted tree). The reference specimen numbers are shown after the species name, followed by the sequence length in base pairs (bp). Note possible misidentification of specimens shown in bold. The scale bar represents an interval of the K2P model.

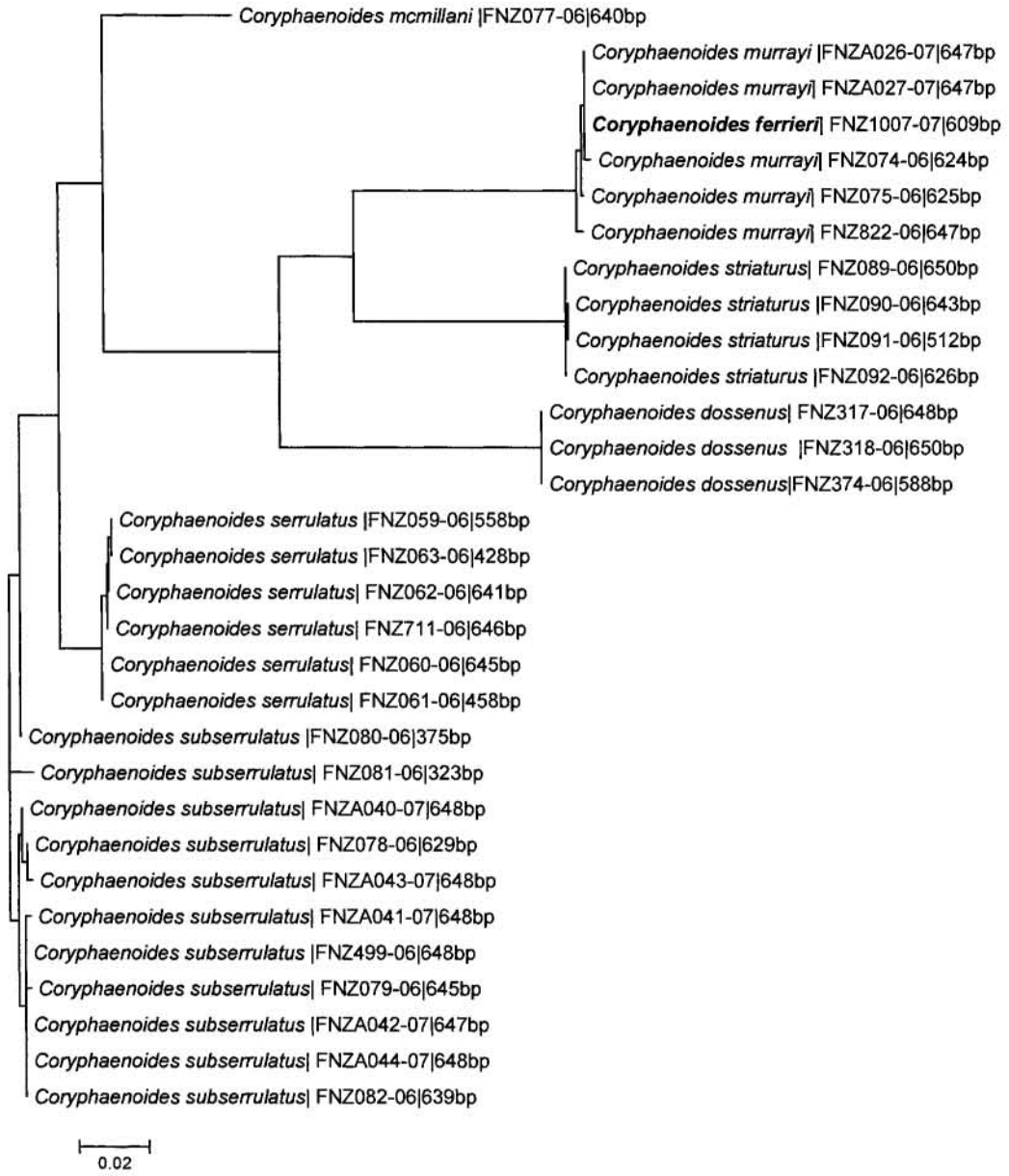

Figure 3: Relationships among the New Zealand *Coryphaenoides* based on COI sequence data (unrooted tree). The BOLD process ID numbers are shown after the species name, followed by the sequence length in base pairs (bp). Note possible misidentification or shared haplotype of the *Coryphaenoides ferrieri* specimen shown in bold. The scale bar represents an interval of the K2P model.

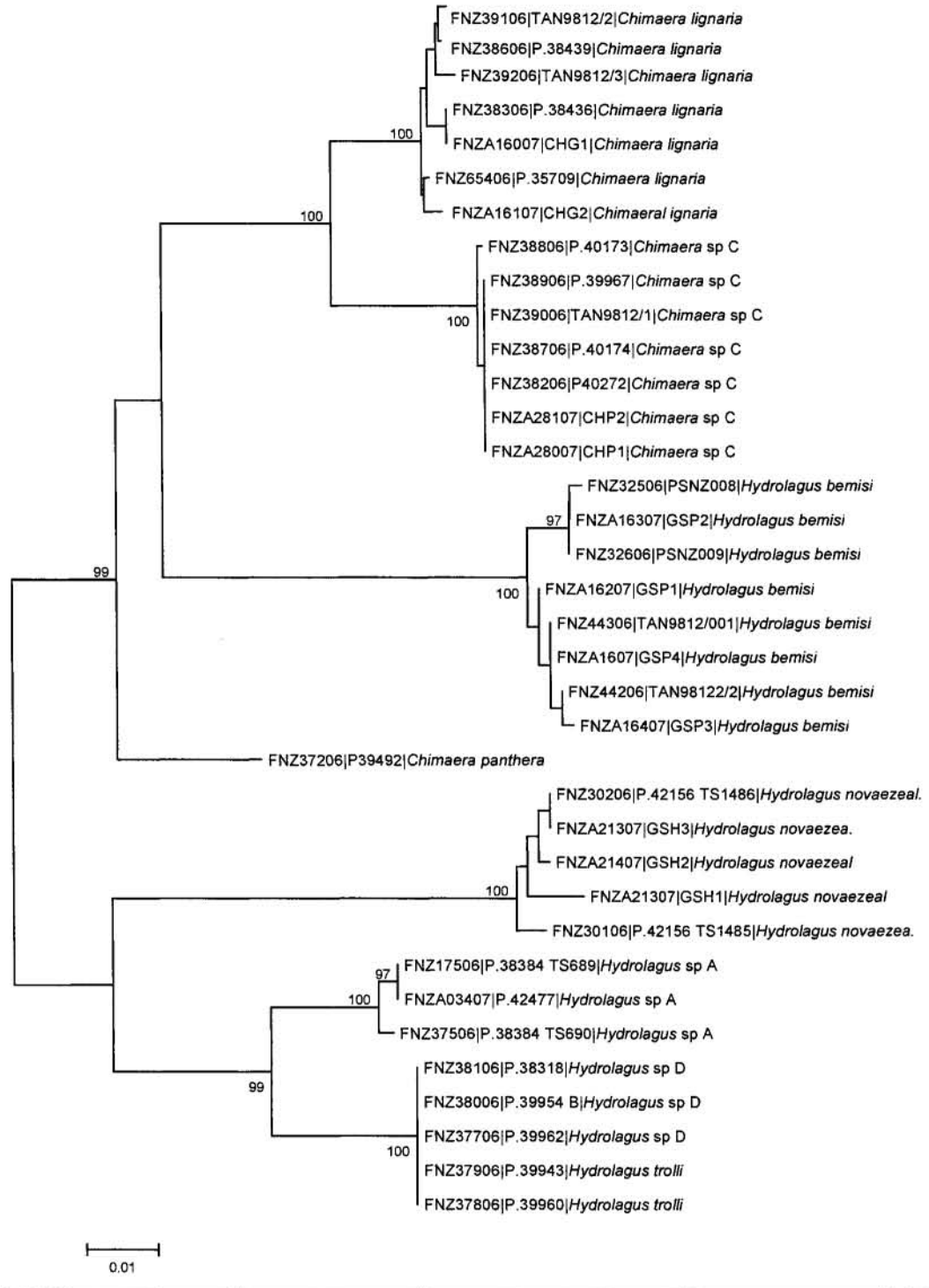

Figure 4: Relationships among the New Zealand Chimaeridae based on COI sequence data (unrooted tree). Numbers before the species names are the BOLD process ID number followed by the Te Papa or NIWA reference specimen number. The scale bar represents an interval of the K2P model.

Figure 5: Relationships among the New Zealand and Australian specimens of red cod (*Pseudophycis bachus*) and the southern bastard red cod (*P. barbata*), based on COI sequence data (unrooted tree). Numbers before the species names are the BOLD process ID number for the New Zealand (FNZ) and Australian (FOAD) sequences, followed by the specimen reference number. The scale bar represents an interval of the K2P model.

3.5 DNA identifications of smoked eel product

3.5.1 Smoked eel product

Smoked eel product supplied to NIWA in February 2007 was identified as the longfin eel, *Anguilla dieffenbachii* (Figure 6). All of the DNA sequences from the six New Zealand smoked eel products matched with the DNA COI sequences for the longfin eel with 99–100% identities, and not shortfin (94% identity) or speckled longfin eels (93%), *A. australis* and *A. reinhardtii*, respectively. Much lower identities were found between the smoked eel product and the marine *Conger* and *Bassanago* eels (81–85% identities).

This was the first example of the use of DNA barcoding for the identification of smoked fish product and the results have been published (Smith et al. 2008). Previous attempts to identify smoked fish using isoelectric focusing of muscle proteins had not been successful, because the proteins are denatured during the smoking process. In order to test the general applicability of

DNA barcoding for identification of smoked fish product, smoked fillets of blue cod, groper, hoki, kahawai, kingfish, mackerel, salmon, snapper, trevally, tuna, and warehou were purchased in retail outlets, and subsamples sequenced for COI. The COI sequences were then matched against sequences held in BOLD and GenBank (Smith et al. 2008). All the smoked fish products purchased in retail outlets were labelled with the correct common name, but smoked product labelled as mackerel *Trachurus novaezelandiae* was mackerel *T. declivis*. The two species of *Trachurus* are difficult to discriminate, the key morphological character being the relative length of the dorsal accessory lateral line (Paulin et al. 2001). Specimens of *T. novaezelandiae* and *T. declivis* are only readily distinguished by fisheries biologists and taxonomists.

DNA COI sequences for the specimens of *Trachurus*, *Conger*, and *Bassanago* used in the identification of the smoked fish products have been released in GenBank EU182959-78 (Smith et al. 2008).

3.5.2 Suspect shark fillets

COI sequences from the New Zealand suspect shark fillets matched with the DNA COI sequences from coastal sharks with 99–100% identities. Eighteen fillets had an identical match to reference sequences from rig, *Mustelus lenticulatus*, while one fillet had a 99.6% identity to rig. Two additional fillets had an identical match to school shark, *Galeorhinus galeus*, from both New Zealand and Australia (Figure 7). The undescribed "northern rig" (FNZ27-607, Figure 7) from northern New Zealand had a different COI sequence from *M. lenticulatus*, with shallow sequence divergence (less than 1%), and this sequence will not be released until additional specimens of "northern rig" have been sampled and sequenced in conjunction with CSIRO scientists. New Zealand *Squalus* COI sequences have been released (Ward et al. 2007).

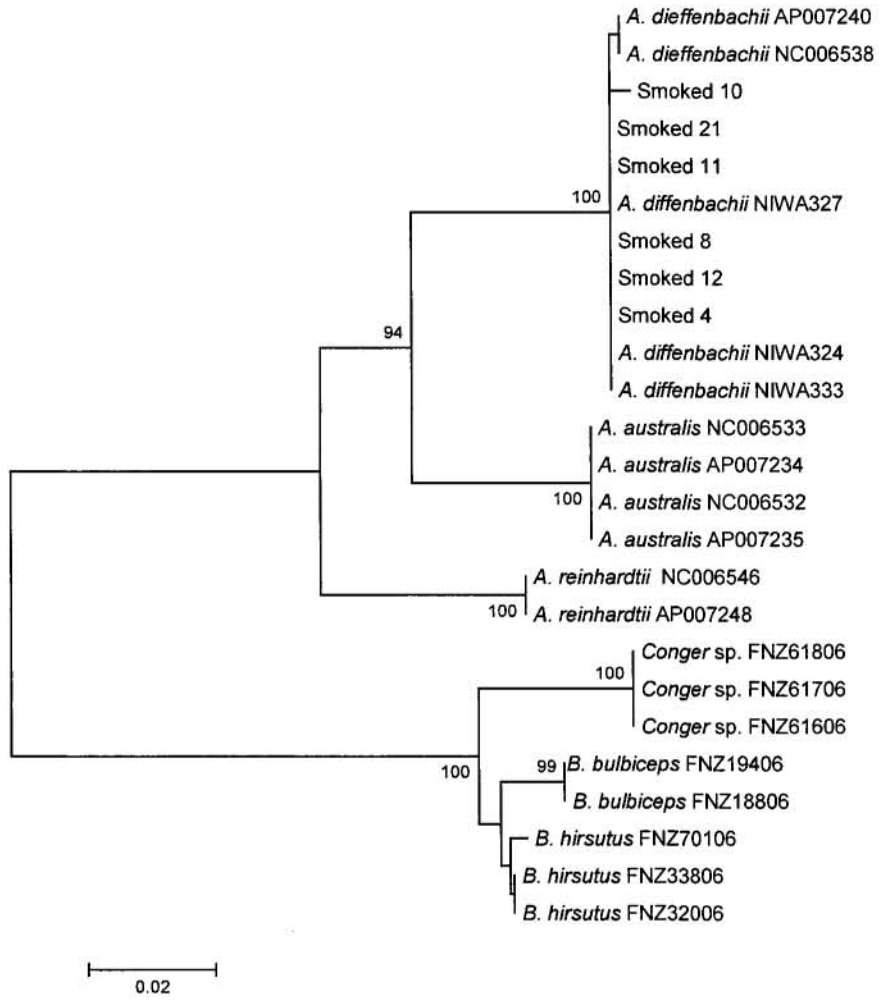

Figure 6: Relationships of eel COI sequences and smoked eel product. Codes after the species names are NIWA IDs, GenBank (AP, NC) Accession Nos. and BOLD (FNZ) process IDs. Numbers at nodes are bootstrap percentages (>80%) after 1000 replicates, based on distance; the scale bar represents an interval of the K2P model.

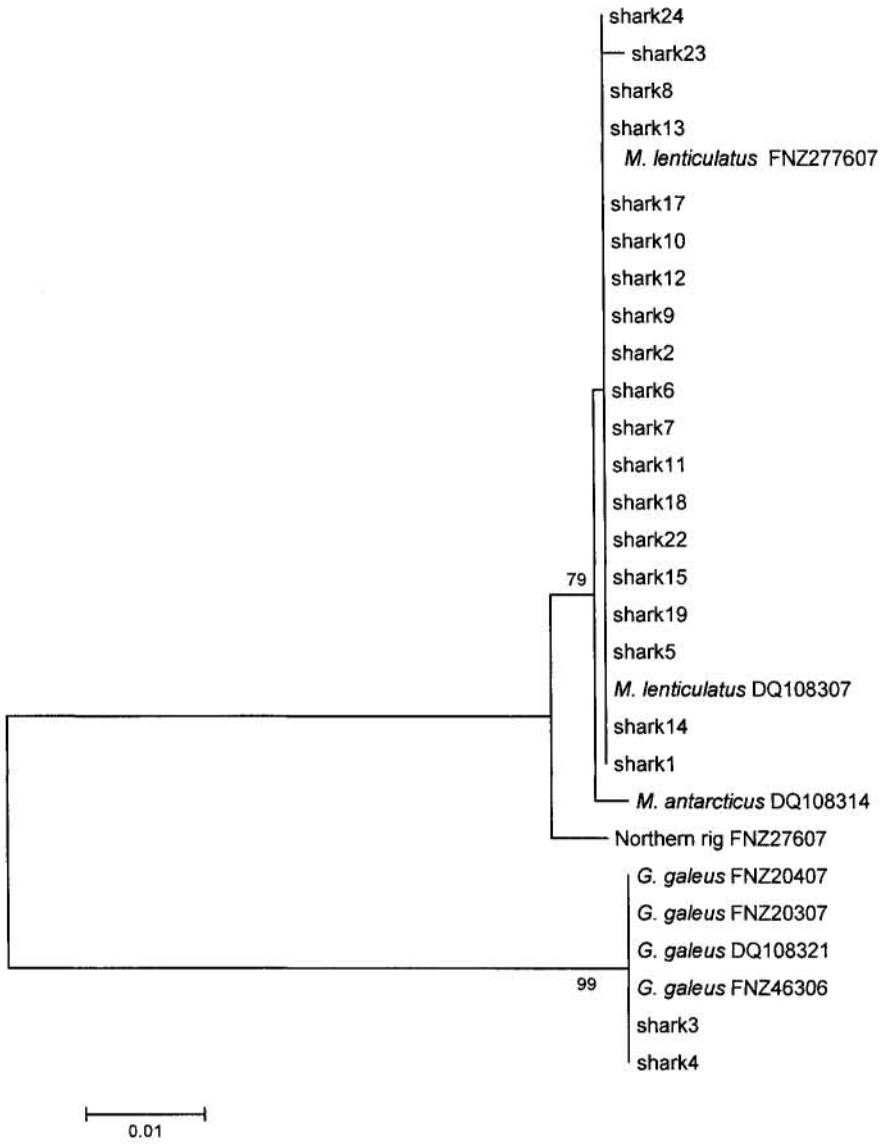

Figure 7: Relationships between COI sequences from suspect shark fillets and references sequences from school shark (*Galeorhinus galeus*) rig (*Mustelus lenticulatus*) northern rig (an undescribed species *Mustelus* sp.) and gummy shark (*Mustelus antarcticus*) from Australia. Code numbers after the species names are BOLD (FNZ) process ID numbers and GenBank (DQ) Accession Nos. Numbers at nodes are bootstrap percentages (>75%) after 1000 replicates, based on distance; scale bar represents an interval of the K2P model.

3.5.3 Suspect paua swab samples

NIWA were asked to identify three swab samples taken from a commercial property. The swab samples were suspected of being blackfoot paua, *Haliotis iris*. COI sequences for two of the swab samples matched with the DNA COI sequences for blackfoot paua with a 99–100% identity (Figure 8). The sequences for these two swab samples showed lower identities with other paua species from New Zealand: 94% identity with yellowfoot paua (*H. australis*) and 87% identity with whitefoot paua (*H. virginea*), and even lower identities with abalone species from other regions of the world.

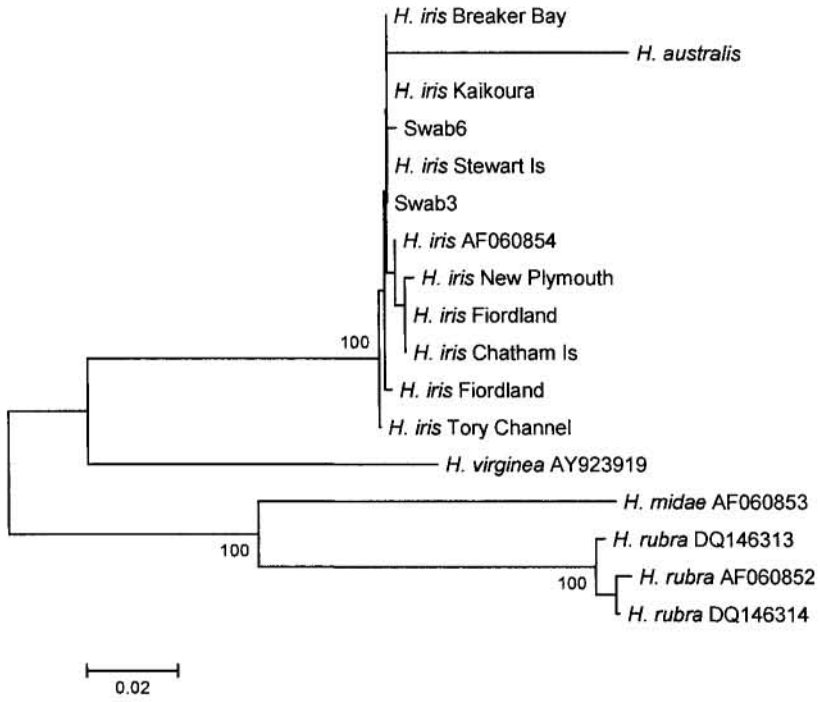

Figure 8: Relationships of *Haliotis* COI sequences and swab samples. COI sequence data for *H. iris* and *H. australis* are unpublished sequence data held by NIWA, other *Haliotis* sequences are taken from GenBank (and shown with Accession Nos.). Numbers at nodes are bootstrap percentages (>90%) after 1000 replicates, based on distance; scale bar represents an interval of the K2P model.

4. CONCLUSIONS

1. There was a low sequence divergence within species and higher divergence among species within the same genus, validating the barcode method for the identification of fish specimens and products in New Zealand waters; average within-species and within-genus K2P distances were 0.6% and 6.3% respectively. However, sequence divergences were low in some genera (e.g., *Bathyraja* skates 1–3%) and high in others (e.g., *Coryphaenoides*, grenadiers 8–21%), so that sequence divergences need to be validated for each family in order to use barcoding for species recognition and identification.

2. Specimens of ghost sharks, *Chimaera* and *Hydrolagus*; deep-sea finless flounders, *Mancopsetta* and *Achiropsetta*; and southern bream (*Brama australis*) and Ray's bream (*B. brama*) were frequently mis-identified at sea. The fish guide being developed by NIWA staff will help to resolve identification problems at sea.

3. Specimens of New Zealand hoki (*Macruronus novaezelandiae*) had identical COI sequences to specimens of Patagonian grenadier (*Macruronus magellanicus*) from Argentina. A similar result was found with partial sequences of the mtDNA cytochrome *b* gene (Olavarría et al. 2006). It is possible that these currently recognised species are disjunct populations of one Southern Ocean species, and should be tested with additional DNA markers and specimens of the Cape grenadier (*Macruronus capensis*) from South Africa and *Macruronus maderensis* from the eastern central South Atlantic Ocean.

4. Four New Zealand species exhibited high sequence divergences with Australian specimens, and possibly represent sister trans-Tasman species: rubyfish, *Plagiogeneion rubiginosum* (Hutton, 1875), slender cod, *Halargyreus johnsonii* Günther, 1862, deepsea ghostflathead, *Hoplichthys haswelli* McCulloch, 1907, and red cod, *Pseudophycis bachus* (Forster, 1801). These potentially cryptic species need to be verified by testing additional specimens and DNA markers. Consequently the COI sequence data sets will not be released until the identification issues have been resolved, in conjunction with CSIRO scientists.

5. The barcode method was successfully applied to the identification of smoked eel product, shark fillets, and paua slime. The method is also in routine use for identification of bluefin tuna specimens caught in the New Zealand EEZ. As the barcode database is developed it will be increasingly used for identification of suspect product and specimens – COI sequences from any suspect specimens or fish products can be matched against those held in BOLD (http://www.boldsystems.org/views/login.php), and, using the identification engine to submit and identify the sequence, obtain a specimen similarity (% value), not just for New Zealand entries but all fish.

6. DNA sequences for the specimens (*Trachurus*, *Conger*, and *Bassanago*) used in the identification of the smoked fish products have been released in GenBank EU182959-78 (see Smith et al. 2008), and for skates (*Bathyraja*) EU119792-863 (Smith et al. in press). A shark barcode workshop held in Manila in May 2008 highlighted some inconsistencies among the Australian and New Zealand sequence data sets with different names applied to specimens with identical sequences. These shark barcode-taxonomic issues will be resolved in a joint manuscript. A similar process is underway for the telesot COI data for Australian and New Zealand marine fishes in conjunction with Dirk Steinke (Canadian Barcoding centre), Bob Ward (CSIRO), and Peter Smith (NIWA) before release of the COI sequences into GenBank.

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Appendix 1A. BOLD reference numbers and specimen numbers for New Zealand teleosts barcoded under this project.

FISH-BOL Ref. No	Specimen Code	Species
		Anguilliformes
FNZA363-07	P.42700	*Bassanago bulbiceps*
FNZ943-07	HCO1	*Bassanago hirsutus*
FNZ339-06	PSNZ-019	*Bassanago hirsutus*
FNZ338-06	PSNZ-018	*Bassanago hirsutus*
FNZ702-06	Bh3	*Bassanago hirsutus*
FNZA382-08	P.42376	*Bassanago hirsutus*
FNZ701-06	Bh2	*Bassanago hirsutus*
FNZ700-06	Bh1	*Bassanago hirsutus*
FNZ620-06	P.33131 TS57	*Bassanago nielseni*
FNZ194-06	P.41325	*Bassanago bulbiceps*
FNZ320-06	P.42167	*Bassanago hirsutus*
FNZ188-06	P.41326	*Bassanago bulbiceps*
FNZ109-06	P.41987 TS1141	*Bassanago sp.*
FNZ618-06	P.33130 TS53	*Conger sp.*
FNZ617-06	P.33130 TS51	*Conger sp.*
FNZ616-06	P.33130 TS49	*Conger sp.*
		Argentiniformes
FNZA039-07	SSM5	*Alepocephalus antipodianus*
FNZA038-07	SSM4	*Alepocephalus antipodianus*
FNZA037-07	SSM3	*Alepocephalus antipodianus*
FNZA035-07	SSM1	*Alepocephalus antipodianus*
FNZA029-07	Ao2.1	*Alepocephalus antipodianus*
FNZA028-07	Ao1.1	*Alepocephalus antipodianus*
		Aulopiformes
FNZA362-07	P.42697	*Macroparalepis macrogeneion*
FNZA062-07	P.42561	*Macroparalepis macrogeneion*
FNZA061-07	P.42560	*Macroparalepis macrogeneion*
		Ophidiiformes
FNZ912-07	CAN1	*Cataetyx niki*
FNZ880-07	ECH2	*Echiodon cryomargarites*
FNZ879-07	ECH1.1	*Echiodon cryomargarites*
FNZA093-07	LIN4	*Genypterus blacodes*
FNZA092-07	LIN3	*Genypterus blacodes*
FNZA091-07	LIN2	*Genypterus blacodes*
FNZA090-07	LIN1	*Genypterus blacodes*

FNZ948-07	LIN6	*Genypterus blacodes*
FNZ947-07	LIN5	*Genypterus blacodes*
		Gadiformes
FNZA017-07	VCO1	*Antimora rostrata*
FNZA018-07	VCO2	*Antimora rostrata*
FNZA019-07	VCO3	*Antimora rostrata*
FNZA020-07	VCO4	*Antimora rostrata*
FNZA333-07	PCO1	*Auchenoceros punctatus*
FNZA334-07	PCO2	*Auchenoceros punctatus*
FNZA176-07	CAS2	*Coelorinchus aspercephalus*
FNZ1020-07	CB1	*Coelorinchus biclinozonalis*
FNZ1021-07	CB2	*Coelorinchus biclinozonalis*
FNZA030-07	F135.1	*Coelorinchus biclinozonalis*
FNZ1022-07	CB3	*Coelorinchus biclinozonalis*
FNZA180-07	CBO1	*Coelorinchus bollonsi*
FNZA181-07	CBO2	*Coelorinchus bollonsi*
FNZA178-07	CFA2	*Coelorinchus fasciatus*
FNZA054-07	Fe188	*Coelorinchus fasciatus*
FNZA053-07	Fe187	*Coelorinchus fasciatus*
FNZA051-07	Fe185	*Coelorinchus fasciatus*
FNZA052-07	Fe186	*Coelorinchus fasciatus*
FNZA050-07	Fe184	*Coelorinchus fasciatus*
FNZA177-07	CFA1	*Coelorinchus fasciatus*
FNZA024-07	CIN1	*Coelorinchus innotabilis*
FNZA021-07	CKA1	*Coelorinchus kaiyomaru*
FNZA023-07	CKA3	*Coelorinchus kaiyomaru*
FNZA022-07	CKA2	*Coelorinchus kaiyomaru*
FNZA179-07	COL	*Coelorinchus oliverianus*
FNZA027-07	CMU2	*Coryphaenoides murrayi*
FNZA026-07	CMU1	*Coryphaenoides murrayi*
FNZA040-07	CSU1.1	*Coryphaenoides subserrulatus*
FNZA041-07	CSU2	*Coryphaenoides subserrulatus*
FNZA042-07	CSU3	*Coryphaenoides subserrulatus*
FNZA043-07	CSU4	*Coryphaenoides subserrulatus*
FNZA044-07	CSU5	*Coryphaenoides subserrulatus*
FNZ1047-07	P.42570, TS1789	*Euclichthys polynemus*
FNZA357-07	P.42690	*Guttigadus sp.*
FNZA124-07	HJO1	*Halargyreus johnsonii*
FNZ1029-07	P.42521	*Lepidion microcephalus*
FNZA183-07	VNI2	*Lucigadus nigromaculatus*

FNZA182-07	VNI3	*Lucigadus nigromaculatus*
FNZA045-07	MCA1	*Macrourus carinatus*
FNZA047-07	MCA3	*Macrourus carinatus*
FNZA046-07	MCA2	*Macrourus carinatus*
FNZA048-07	MCA4	*Macrourus carinatus*
FNZA049-07	MCA5	*Macrourus carinatus*
FNZA107-07	HOK4	*Macruronus novaezelandiae*
FNZ916-07	HAK1	*Merluccius australis*
FNZ917-07	HAK2	*Merluccius australis*
FNZA347-07	HAK3	*Merluccius australis*
FNZA348-07	HAK4	*Merluccius australis*
FNZ854-07	SBW5	*Micromesistius australis*
FNZ853-07	SBW4	*Micromesistius australis*
FNZ852-07	SBW3	*Micromesistius australis*
FNZ916-07	HAK1	*Merluccius australis*
FNZA349-07	HAK5	*Merluccius australis*
FNZA348-07	HAK4	*Merluccius australis*
FNZA347-07	HAK3	*Merluccius australis*
FNZ854-07	SBW5	*Micromesistius australis*
FNZ853-07	SBW4	*Micromesistius australis*
FNZ852-07	SBW3	*Micromesistius australis*
FNZA119-07	RIB1	*Mora moro*
FNZA120-07	RIB2	*Mora moro*
FNZA121-07	RIB3	*Mora moro*
FNZA025-07	Neznam1	*Nezumia namatahi*
FNZA117-07	NES1	*Nezumia namatahi*
FNZA126-07	DCO2	*Notophycis marginata*
FNZ950-07	RCO4	*Pseudophycis bachus*
FNZ949-07	RCO1	*Pseudophycis bachus*
FNZA351-07	RCO5	*Pseudophycis bachus*
FNZ883-07	WHX1	*Trachyrincus aphyodes*
FNZ885-07	WHX3	*Trachyrincus aphyodes*
FNZ884-07	WHX2	*Trachyrincus aphyodes*
FNZ886-07	WHX4	*Trachyrincus aphyodes*
FNZ887-07	WHX5	*Trachyrincus aphyodes*
FNZ999-07	P.42613	*Trachonurus gagates*
FNZA143-07	GRC2	*Tripterophycis gilchristi*
FNZA142-07	GRC1	*Tripterophycis gilchristi*
		Beryciformes
FNZA151-07	SFM1	*Diretmichthys parini*
FNZA109-07	Dirarg	*Diretmus argenteus*

		Zeiformes
FNZ851-07	BOE2	*Allocyttus niger*
FNZ850-07	BOE1	*Allocyttus niger*
FNZA375-07	BOE3	*Allocyttus niger*
FNZ873-07	MD03	*Zenopsis nebulosa*
FNZ875-07	MD05	*Zenopsis nebulosa*
FNZ874-07	MD04	*Zenopsis nebulosa*
FNZ847-07	LDO4	*Cyttus traversi*
FNZ846-07	LDO3	*Cyttus traversi*
FNZ845-07	LDO2	*Cyttus traversi*
FNZ844-07	LDO1	*Cyttus traversi*
		Scorpaeniformes
FNZ926-07	API4	*Alertichthys blacki*
FNZ925-07	API3	*Alertichthys blacki*
FNZ923-07	API1	*Alertichthys blacki*
FNZA377-07	P.42732	*Alertichthys blacki*
FNZ924-07	API2	*Alertichthys blacki*
FNZ858-07	TOP1	*Ambophthalmos angustus*
FNZA356-07	TOP7	*Ambophthalmos angustus*
FNZ860-07	TOP3	*Ambophthalmos angustus*
FNZ867-07	TOP4	*Ambophthalmos angustus*
FNZ942-07	TOP1.1	*Ambophthalmos angustus*
FNZA071-07	369-03	*Chelidonichthys kumu*
FNZA070-07	369-02	*Chelidonichthys kumu*
FNZA069-07	369-01	*Chelidonichthys kumu*
FNZ928-07	DSP1	*Congiopodus coriaceus*
FNZ929-07	DSP2	*Congiopodus coriaceus*
FNZ931-07	DSP4	*Congiopodus coriaceus*
FNZ932-07	DSP5	*Congiopodus coriaceus*
FNZA006-07	P.42476	*Congiopodus leucopaecilus*
FNZA346-07	PIG2	*Congiopodus leucopaecilus*
FNZA345-07	PIG1	*Congiopodus leucopaecilus*
FNZ1033-07	P.42542	*Ebinania* sp.
FNZ1019-07	P.42614	*Hoplichthys haswelli*
FNZA136-07	FDH3	*Hoplichthys haswelli*
FNZ922-07	SCG5	*Lepidotrigla brachyoptera*
FNZ921-07	SCG4	*Lepidotrigla brachyoptera*
FNZ920-07	SCG3	*Lepidotrigla brachyoptera*
FNZ919-07	SCG2	*Lepidotrigla brachyoptera*
FNZ918-07	SCG1	*Lepidotrigla brachyoptera*
FNZ1028-07	P.42616	*Neophrynichthys heterospilos*

FNZ1027-07	P.42615	*Neophrynichthys heterospilos*
FNZ941-07	TOD1	*Neophrynichthys latus*
		Perciformes
FNZA306-07	P.34421	*Bodianus flavifrons*
FNZA305-07	P.34420	*Bodianus flavifrons*
FNZA304-07	P.34416	*Bodianus flavifrons*
FNZA380-07	P.34413	*Bodianus flavifrons*
FNZ935-07	SRB3	*Brama australis*
FNZ856-07	SRB4	*Brama australis*
FNZ934-07	SRB2	*Brama australis*
FNZ933-07	SRB1	*Brama australis*
FNZA364-07	P.42701	*Brama brama*
FNZ861-07	RBM3	*Brama brama*
FNZ162-06	P.40726	*Caesioperca lepidoptera*
FNZA320-07	I.43522-002	*Caprodon longimanus*
FNZA056-07	P.41021	*Caprodon longimanus*
FNZA324-07	I.36638	*Caprodon longimanus*
FNZA323-07	P.41022	*Caprodon longimanus*
FNZA322-07	P.41016	*Caprodon longimanus*
FNZA321-07	P.41015	*Caprodon longimanus*
FNZA325-07	P.39085	*Caprodon* sp. *A*
FNZA055-07	P.41018	*Caprodon* sp. BD
FNZA058-07	P.39831	*Caprodon* sp. *C*
FNZA057-07	P.39830	*Caprodon* sp. C
FNZA123-07	CCA2	*Cubiceps caeruleus*
FNZA122-07	CCA1	*Cubiceps caeruleus*
FNZA378-07	CCA3	*Cubiceps caeruleus*
FNZ869-07	RBT4	*Emmelichthys nitidus*
FNZ868-07	RBT3	*Emmelichthys nitidus*
FNZ915-07	RBT2	*Emmelichthys nitidus*
FNZ914-07	RBT1	*Emmelichthys nitidus*
FNZ952-07	EPT7	*Epigonus telescopus*
FNZ951-07	EPT6	*Epigonus telescopus*
FNZA129-07	EPT3	*Epigonus telescopus*
FNZA128-07	EPT2	*Epigonus telescopus*
FNZA059-07	P.42347	*Epinephelus lanceolatus*
FNZA008-07	P.42479	*Epinephelus octofasciatus*
FNZ997-07	P.42608	*Hemerocoetes artus*
FNZ940-07	OPA3	*Hemerocoetes artus*
FNZ939-07	OPA2	*Hemerocoetes artus*
FNZ938-07	OPA1	*Hemerocoetes artus*

FNZ911-07	BNS1	*Hyperoglyphe Antarctica*
FNZ609-06	TS012	*Hyperoglyphe antarctica*
FNZA060-07	P.42230.1	*Lepidoperca aurantia*
FNZ946-07	OPE3	*Lepidoperca aurantia*
FNZ945-07	OPE2	*Lepidoperca aurantia*
FNZ944-07	OPE1	*Lepidoperca aurantia*
FNZA140-07	FRO4	*Lepidopus caudatus*
FNZA139-07	FRO3	*Lepidopus caudatus*
FNZA138-07	FRO2	*Lepidopus caudatus*
FNZA137-07	FRO1	*Lepidopus caudatus*
FNZA010-07	P.42428	*Matanui bathytaton*
FNZA315-07	P.31124 #17	*Nemadactylus*
FNZA314-07	P31124 #15	*Nemadactylus*
FNZA313-07	P.31120 #17	*Nemadactylus*
FNZA312-07	P.31120 #6	*Nemadactylus*
FNZA310-07	P.34229	*Nemadactylus douglasii*
FNZA309-07	P.33994	*Nemadactylus douglasii*
FNZA308-07	P.33381	*Nemadactylus douglasii*
FNZA307-07	P.31119	*Nemadactylus douglasii*
FNZA318-07	P.31128 28	*Nemadactylus macropterus*
FNZA068-07	368-03	*Nemadactylus macropterus*
FNZA067-07	368-02	*Nemadactylus macropterus*
FNZA066-07	368-01	*Nemadactylus macropterus*
FNZA188-07	SCD5	*Notothenia microlepidota*
FNZA187-07	SCD4	*Notothenia microlepidota*
FNZA186-07	SCD3	*Notothenia microlepidota*
FNZA185-07	SCD2	*Notothenia microlepidota*
FNZA184-07	SCD1	*Notothenia microlepidota*
FNZA332-07	Op18	*Omobranchus punctatus*
FNZA330-07	Op16	*Omobranchus punctatus*
FNZ862-07	YCO1	*Parapercis gilliesii*
FNZA009-07	P.42480	*Paristiopterus labiosus*
FNZA002-07	P.42471	*Paristiopterus labiosus*
FNZ892-07	RBY1	*Plagiogeneion rubiginosum*
FNZ1032-07	P.42539	*Platyberyx* sp.
FNZ849-07	HAP1	*Polyprion oxygeneios*
FNZ913-07	HAP2	*Polyprion oxygeneios*
FNZA072-07	370-01	*Pseudocaranx dentex*
FNZA133-07	SUM1	*Schedophilus maculatus*
FNZ1015-07	P.42594	*Seriolella caerulea*
FNZ909-07	WWA6	*Seriolella caerulea*

FNZ908-07	WWA5	*Seriolella caerulea*
FNZ906-07	WWA3	*Seriolella caerulea*
FNZ907-07	WWA4	*Seriolella caerulea*
FNZA108-07	WWA2	*Seriolella caerulea*
FNZA003-07	P.42472	*Seriolella caerulea*
FNZ1016-07	P.42595	*Seriolella labyrinthica*
FNZ910-07	SWA4	*Seriolella punctata*
FNZA094-07	BAR1	*Thyrsites atun*
FNZ1018-07	BAR5	*Thyrsites atun*
FNZ1017-07	BAR4	*Thyrsites atun*
FNZA095-07	Tdec1	*Trachurus declivis*
FNZA096-07	Tdec2	*Trachurus declivis*
FNZA097-07	Tdec3	*Trachurus declivis*
FNZA098-07	Tdec4	*Trachurus declivis*
FNZA007-07	P.42487	*Trachurus declivis*
FNZA102-07	Tmur4	*Trachurus murphyi*
FNZA100-07	Tmur2	*Trachurus murphyi*
FNZA106-07	Tnov4	*Trachurus novaezelandiae*
FNZA105-07	Tnov3	*Trachurus novaezelandiae*
FNZA104-07	Tnov2	*Trachurus novaezelandiae*
FNZA103-07	Tnov1	*Trachurus novaezelandiae*
FNZ964-07	P.42666	*Trematomus lepidorhinus*
FNZA005-07	P.42474	*Xenobrama microlepis*
FNZA359-07	P.42694	*Zanclistius elevatus*
FNZA358-07	P.42693	*Zanclistius elevatus*
FNZA001-07	P.42470	*Zanclistius elevatus*
		Pleuronectiformes
FNZ1046-07	P.42568	*Achiropsetta tricholepis*
FNZ878-07	WIT5	*Arnoglossus scapha*
FNZ877-07	WIT4	*Arnoglossus scapha*
FNZA169-07	WIT2	*Arnoglossus scapha*
FNZ876-07	WIT3	*Arnoglossus scapha*
FNZA168-07	WIT1	*Arnoglossus scapha*
FNZA011-07	P.42401	*Azygopus pinnifasciatus*
FNZA170-07	SDF5	*Azygopus pinnifasciatus*
FNZA131-07	SDF2	*Azygopus pinnifasciatus*
FNZA335-07	BRI1	*Colistium guntheri*
FNZ937-07	LSO1	*Pelotretis flavilatus*
FNZA337-07	LSO2	*Pelotretis flavilatus*
FNZA336-07	ESO1	*Peltorhamphus novaezeelandiae*
FNZA338-07	YBF1	*Rhombosolea leporina*

FNZA172-07	MAN3	*Neoachiropsetta milfordi*
FNZA173-07	MAN4	*Neoachiropsetta milfordi*
FNZA174-07	MAN6	*Neoachiropsetta milfordi*
FNZ864-07	MAN7	*Neoachiropsetta milfordi*
FNZ865-07	MAN8	*Neoachiropsetta milfordi*
FNZ866-07	MAN9	*Neoachiropsetta milfordi*

Appendix 1 B. BOLD reference numbers and specimen numbers for Southern Ocean teleosts barcoded under this project.

FISH-BOL Ref. No	Specimen Code	Species
		Gadiformes
FNZ986-07	P.42593	*Antimora rostrata*
FNZ985-07	P.42592	*Antimora rostrata*
FNZ992-07	P.42601	*Antimora rostrata*
FNZ991-07	P.42600	*Antimora rostrata*
FNZ990-07	P.42599	*Antimora rostrata*
FNZ1007-07	P.42626	*Coryphaenoides ferrieri*
FNZ984-07	P.42591	*Macrourus holotrachys*
FNZ983-07	P.42590	*Macrourus holotrachys*
FNZ982-07	P.42589	*Macrourus holotrachys*
FNZ981-07	P.42588	*Macrourus holotrachys*
FNZ980-07	P.42587	*Macrourus holotrachys*
FNZ979-07	P.42586	*Macrourus holotrachys*
FNZ953-07	P.42655	*Macrourus carinatus*
FNZ978-07	P.42585	*Macrourus holotrachys*
FNZ972-07	P.42575	*Macrourus holotrachys*
FNZ971-07	P.42574	*Macrourus holotrachys*
FNZ970-07	P.42573	*Macrourus holotrachys*
FNZ995-07	P42604	*Muraenolepis* sp.
		Scorpaeniformes
FNZ956-07	P.42658	*Liparidae*
FNZ1005-07	P.42623	*Liparidae*
FNZ965-07	P.42667	*Liparidae*
FNZ963-07	P.42665	*Bathydraco* sp.
FNZ962-07	P.42664	*Bathydraco* sp.
FNZ961-07	P.42663	*Bathydraco* sp.
FNZ959-07	P.42661	*Bathydraco* sp.
FNZ957-07	P.42659	*Chaenodraco wilsoni*
FNZA370-07	P.42717	*Dacodraco hunteri*
FNZ960-07	P42662	*Dacodraco hunteri*
FNZ969-07	P.42671	*Dissostichus mawsoni*
FNZA032-07	P.42330 (2)	*Lepidonotothen kempi*
FNZA031-07	P.42330 (1)	*Lepidonotothen kempi*
FNZ955-07	P.42657	*Lycenchelys* sp.

FNZA368-07	P.42715	*Pogonophryne* 'mentella' gp
FNZ1011-07	P.42635	*Pogonophryne* 'mentella' gp
FNZ1012-07	P42638	*Pogonophryne* "barsukovi" group
FNZA372-07	P.42719	*Pogonophryne* "mentella" group
FNZ1004-07	P.42622	*Pogonophryne* "mentella" group
FNZ1003-07	P.42621	*Pogonophryne* "mentella" group
FNZA373-07	P.42720	*Pogonophryne* "mentella" group
FNZ958-07	P.42660	*Pogonophryne eakini?*
FNZ1014-07	P.42640	*Pogonophryne fusca*
FNZ1009-07	P.42633	*Pogonophryne immaculata*
FNZA369-07	P.42716	*Pogonophryne orangiensis*
FNZ1002-07	P.42620	*Pogonophryne orangiensis*
FNZ1001-07	P.42619	*Pogonophryne orangiensis*
FNZ1000-07	P.42618	*Pogonophryne orangiensis*
FNZ968-07	P.42670	*Pogonophryne orangiensis*
FNZ966-07	P.42668	*Pogonophryne orangiensis*
FNZA371-07	P.42718	*Pogonophryne scotti*
FNZ1013-07	P.42639	*Pogonophryne scotti*
FNZ1010-07	P.42634	*Pogonophryne scotti*
FNZ967-07	P.42669	*Psilodraco breviceps*
FNZ977-07	P.42580	*Seleniolycus laevifasciatus*
FNZ976-07	P.42579	*Seleniolycus laevifasciatus*
FNZ975-07	P.42578	*Seleniolycus laevifasciatus*
FNZ974-07	P.42577	*Seleniolycus laevifasciatus*
FNZ973-07	P.42576	*Seleniolycus laevifasciatus*
FNZ989-07	P42598	*Trematomus eulepidotus*
FNZ988-07	P.42597	*Trematomus eulepidotus*
FNZ987-07	P.42596	*Trematomus eulepidotus*
FNZ954-07	P.42656	*Zoarcidae*
FNZA374-07	P.42723	*Zoarcidae*

Appendix 2. BOLD reference numbers and specimen numbers for New Zealand sharks and rays barcoded under this project.

BOLD Ref. No	Specimen Code	Species
		Chimaeriformes
FNZA545-08	ELE3	*Callorhinchus milii*
FNZA544-08	ELE2	*Callorhinchus milii*
FNZA281-07	CHP2	*Chimaera* sp. *C*
FNZA280-07	CHP1	*Chimaera* sp. *C*
FNZA161-07	CHG2	*Chimaera lignaria*
FNZA160-07	CHG1	*Chimaera lignaria*
FNZA167-07	LCH2	*Harriotta raleighana*
FNZA166-07	LCH1	*Harriotta raleighana*
FNZA034-07	P.42477	*Hydrolagus* sp. *A*
FNZA165-07	GSP4	*Hydrolagus bemisi*
FNZA164-07	GSP3	*Hydrolagus bemisi*
FNZA163-07	GSP2	*Hydrolagus bemisi*
FNZA162-07	GSP1	*Hydrolagus bemisi*
FNZA215-07	GSH3	*Hydrolagus novaezealandiae*
FNZA214-07	GSH2	*Hydrolagus novaezealandiae*
FNZA213-07	GSH1	*Hydrolagus novaezealandiae*
		Carcharhiniformes
FNZA286-07	CAR7	*Cephaloscyllium isabellum*
FNZA234-07	P.42519	*Apristurus exsanguis*
FNZA224-07	P.42520	*Apristurus exsanguis*
FNZA254-07	Apr-61	*Apristurus cf. exsanguis*
FNZA230-07	P.42569	*Apristurus* sp. *C*
FNZA190-07	CAR2	*Cephaloscyllium isabellum*
FNZA285-07	CAR6	*Cephaloscyllium isabellum*
FNZA284-07	CAR5	*Cephaloscyllium isabellum*
FNZA204-07	SCH4	*Galeorhinus galeus*
FNZA203-07	SCH3	*Galeorhinus galeus*
FNZA221-07	SCH2	*Galeorhinus galeus*
FNZA199-07	DCS2	*Halaelurus dawsoni*
FNZA303-07	P.42731	*Halaelurus dawsoni*
FNZA276-07	P.34395	*Mustelus* sp. *Northern rig*
FNZA277-07	P.42214	*Mustelus lenticulatus*
FNZA225-07	P.42524	*Parmaturus*
FNZA033-07	P.42517	*Parmaturus n.* sp.
FNZA237-07	BWS3	*Prionace glauca*
FNZA275-07	P.34219	*Sphyrna zygaena*

FNZA274-07	P.34214	*Sphyrna zygaena*
		Squaliformes
FNZA205-07	CYP5	*Centroscymnus crepidater*
FNZA219-07	CYP5_1306	*Centroscymnus crepidater*
FNZA229-07	P.42564	*Centroscymnus crepidater*
FNZA296-07	P.42726	*Centroscymnus crepidater*
FNZA192-07	CYP1	*Centroscymnus crepidater*
FNZA296-07	P42726	*Centroscymnus crepidater*
FNZA192-07	CYP1	*Centroscymnus crepidater*
FNZA193-07	CYP2	*Centroscymnus crepidater*
FNZA202-07	PLS1	*Centroscymnus plunketi*
FNZA299-07	CSQ4	*Centrophorus squamosus*
FNZA253-07	P.42489	*Cirrhigaleus barbifer*
FNZA247-07	BSH4	*Dalatias licha*
FNZA298-07	P.42729	*Dalatias licha*
FNZA245-07	BSH2	*Dalatias licha*
FNZA244-07	BSH1	*Dalatias licha*
FNZA250-07	DEQ1	*Deania quadrispinosum*
FNZA228-07	P.42554	*Etmopterus* sp. *B*
FNZA295-07	P.42725	*Etmopterus* sp. *B*
FNZA294-07	P.42724	*Etmopterus* sp. *B*
FNZA114-07	ETB5	*Etmopterus baxteri*
FNZA206-07	ETB6	*Etmopterus baxteri*
FNZA302-07	ETB7	*Etmopterus baxteri*
FNZA113-07	ETB4	*Etmopterus baxteri*
FNZA112-07	ETB3	*Etmopterus baxteri*
FNZA110-07	ETB1	*Etmopterus baxteri*
FNZA297-07	P.42728	*Oxynotus bruniensis*
FNZA218-07	PDG2	*Oxynotus bruniensis*
FNZA217-07	PDG1	*Oxynotus bruniensis*
FNZA226-07	P.42526	*Somniosus pacificus*
FNZA231-07	P.42571	*Squalus acanthias*
		Rajiformes
FNZA227-07	P.42535	*Amblyraja cf. hyperborea*
FNZA222-07	BTH1	*Brochiraja spinifera*
FNZC022-07	Bi2KNIWA	*Bathyraja irrasa*
FNZC021-07	Bi1KNIWA	*Bathyraja irrasa*
FNZC070-07	P.39877	*Bathyraja richardsoni*
FNZC069-07	P.39878	*Bathyraja shuntovi*
FNZC068-07	P.39854	*Bathyraja shuntovi*
FNZA291-07	P.42691	*Brochiraja albilabiata*

FNZA290-07	BTH6	*Brochiraja asperula*
FNZA289-07	BTS2	*Brochiraja spinifera*
FNZA210-07	BTH3	*Brochiraja asperula*
FNZA288-07	BTS1	*Brochiraja spinifera*
FNZA279-07	EGR1_1307	*Myliobatis tenuicaudatus*
FNZA233-07	P.42606	*Zearaja nasutus*

Appendix 3. New Zealand teleosts barcoded as at 1 October 2007. Identification numbers: P = specimen registration number in the National Fish Collection (NFC) at the Museum of New Zealand Te Papa Tongarewa; other codes = specimen number held in frozen (F), in ethanol (E) or formalin (fr) at NIWA or as an e-voucher (photograph only). Reference specimens of species shown in bold were not collected.

New Zealand teleosts barcode includes Ross Sea species	Tissue code number		
Class ACTINOPTERYGII			
Division TELEOSTEI			
Order ALBULIFORMES			
Notacanthus chemnitzii Bloch, 1788 Giant spineback	P41695		
Notacanthus sexspinis Richardson, 1846 Spineback	Fe094-98	P42185.2	P42185.3
Order ANGUILLIFORMES			
Anguillidae Freshwater eels			
Anguilla australis Richardson, 1841 Shortfin eel	NIWA320	NIWA323	
Anguilla dieffenbachii Gray, 1842 Longfin eel	NIWA333	NIWA324	
Muraenidae Moray eels			
Enchelycore ramosa (Griffin, 1926) Mosaic moray	P41273		
Gymnothorax nubilus (Richardson, 1848) Grey moray	P41745		
Gymnothorax prasinus (Richardson, 1848) Yellow moray	P41295	P41744	
*Gymnothorax porphyreis (*Guichenot, 1848) Lowfin moray	P41275		
Synaphobranchidae Cutthroat eels			
Diastobranchus capensis Barnard, 1923 Basketwork eel	BEE1- 5		
Ophichthidae Snake eels			
Ophisurus serpens (Linnaeus, 1758) Snake eel	P41294	P41293	P42407

Derichthyidae Longnecked eels						
Nessorhamphus ingolfianus (Schmidt, 1912) Duckbill eel	P37730-35					
Nemichthyidae Snipe eels						
Nemichthys curvirostris (Strömman, 1896) Blackspot snipe eel	F026E	F027E				
Avocettina sp.	P42546	P42553				
Congridae Conger eels						
Bassanago bulbiceps (Whitley, 1948) Swollen headed conger	P41325	P41326	SCO1-6	P42376		
Bassanago hirsutus Castle, 1960 Hairy conger	P42167	unreg 2	Bh1	Bh2	Bh3	HCO1
Bassanago sp.	P41987	P41987				
Bassanago nielseni (Karmovskaya 1990)	P33131					
Conger verreauxi Kaup, 1856 Southern conger	CON1					
Conger sp. Brown conger	P33130:					
Serrivomeridae Sawtooth eels						
Serrivomer sp.	P37736	P37739	SAW1 fr			
Order SACCOPHARYNGIFORMES						
Eurypharyngidae Gulpers						
Eurypharynx pelecanoides Vaillant, 1882 Gulper	P42558					
Order CLUPEIFORMES						
Engraulidae Anchovies						
Engraulis australis (White, 1790) Anchovy	Fe159 - 163					
Clupeidae Sardines						
Sprattus antipodum (Hector, 1872) Slender sprat	SPR1-3					
Sprattus muelleri (Klunzinger, 1880) Sprat	SPR4-6					
Sardinops neopilchardus (Steindachner, 1879) Pilchard	PIL1-3					

Order GONORYNCHIFORMES				
Gonorynchidae Sandfishes				
Gonorynchus forsteri Ogilby, 1911 Sandfish	P34300-06	HA2-028	P41213	P41214
Order OSMERIFORMES				
Argentinidae Silversides				
Argentina elongata Hutton, 1879 Silverside	AE1	SSI1- 2	SSI3 - SSI5	
Microstmatidae White smelts				
Nansenia sp. A	P42202.39	P42202.40		
Bathylagidae Deepsea smelts				
Bathylagichthys greyae (Cohen, 1958) Grey's smelt		F029F		
Bathylagus antarcticus Günther, 1878 Black smelt	P42198	Bathant1		
Alepocephalidae Slickheads				
Alepocephalus antipodianus (Parrott, 1948) Smallscaled	P40925	SSM1 - 5	SSM6 -7	
Alepocephalus australis Barnard, 1923 Largescaled brown	P40924			
Alepocephalus owstoni ?.	Ao1	Ao2		
Xenodermichthys copei (Gill, 1884) Cope's bluntsnout sl	Fe084-88	BSL1-2		
Platytroctidae Tubeshoulders				
Holtbyrnia sp. Barlight tubesholder	P41691	HOL1		
Persparsia kopua (Phillipps, 1942) Common tubesholder	F016-19E	F047-50F		
Order STOMIIFORMES				
Gonostomatidae Bristlemouths				
Diplophos rebainsi Krefft & Parin, 1972	F001-3F	TS1537	P42201	

Gonostoma elongatum Günther, 1878	P42469					
Sternoptychidae Marine hatchet fishes						
Argyropelecus gigas Norman, 1930 Giant hatchetfish	P42196	AGI1 -3	P42173			
Polyipnus sp.	P42447					
Sternoptyx obscura Garman, 1899	P42189					
Photichthyidae Lighthouse fishes						
Photichthys argenteus Hutton, 1872 Silver lighthouse fish	FE070-74Fr	PHO1 -2	F141F	F142F		
Vinciguerria sp.	F033-35E					
Stomiidae Dragonfishes, stareaters, loosejaws						
Borostomias antarcticus (Lönnberg, 1905) Southern snag	P42178	P42551				
Chauliodus sloani Bloch & Schneider, 1801 Viperfish	F145Fr	P42448	CHA1 - 3			
Idiacanthus atlanticus Brauer, 1906 Common dragonfish	F010E	IDI1 -2	F006-9F			
Malacosteus niger Ayres, 1848	P42547	P42556				
Malacosteus sp.	MAL1	MAL2				
Opostomias micripnus (Günther, 1878) Speckled dragonfish	P40923	F042F	P42443	OMI1-2	P42164	P42565
Stomias boa (Risso, 1810) Scaly dragonfish	F01-015Fr					
Trigonolampa ?miriceps Regan & Trewavas, 1930 Starburst drag.	P42534	P42548				
Trigonolampa sp.	MEN1					
Stomias sp.	P42166					
Order AULOPIFORMES						
Aulopodidae Sergeant Bakers						
Hime sp. Sergeant Baker	P42234					
Aulopodidae n. gen. et n. sp.	P42518					
Chlorophthalmidae Cucumberfishes						
Paraulopus nigripinnis (Günther 1878)	P42473	P42617	CUC1- 4	P42529		

Notosudidae Waryfishes				
Scopelosaurus gibbsi Bertelsen, Krefft & Marshall, 1976	F004-5F			
Scopelosaurus herwigi Bertelsen, Krefft & Marshall, 1976	SPL1-2			
Paralepididae Barracudinas				
Macroparalepis macrogeneion Post, 1973 Headband barraco	P42560	P42561	P42696	P42697
Macroparalepis sp. A Barracoudina	P42417			
Magnisudis prionosa (Rofen, 1963) Giant barracoudina	P42184			
Macroparalepis sp.	P41301			
Evermanellidae Sabretooth fishes				
Evermannella balbo (Risso, 1820) Brown sabretooth	P42191	P42197	SAB1	SAB2
Order MYCTOPHIFORMES				
Neoscopelidae Blackchins				
Neoscopelus macrolepidotus Johnson, 1863	P42372			
Myctophidae Lanternfishes				
Ceratoscopelus warmingii (Lütken, 1892)	F030E	NIWA 2		
Diaphus danae Tåning, 1932	F039Fr	P42468	TS1715-18	
Diaphus hudsoni Zurbrigg & Scott, 1976	F144Fr			
Electrona carlsbergi (Tåning, 1932)	F143Fr			
Electrona paucirastra Bolin in Andriashev, 1962	TS1499			
Metelectrona ventralis (Becker 1963)	F031F	NIWA 3		
Gymnoscopelus microlampas Hulley, 1981		P42203		
Gymnoscopelus sp.	GS1F	P42200	GYM1	GYM2-4
Hygophum sp.		P42204		
Lampanyctodes hectoris (Günther, 1876)	F020-024			
Lampanyctodes sp.	P41722			

Lampanyctus australis Tåning, 1932	Lampaus1		
Lampanyctus intricarius Tåning, 1928	Lamp1 -5		
*Lampanyctus macdonaldi (*Goode & Bean, 1896)	Lampmac1	to Lamp4	
Lampanyctus sp.	LS1	LS2	
Symbolophorus sp. B	FO32F		
Symbolophorus sp. C	F036F	Symbc1 -4	
Nannobranchium ater?	P42205		
Order LAMPRIDIFORMES			
Veliferidae Velifers			
Metavelifer multiradiatus (Regan, 1907) Velifer	P40555	P41316	
Trachipteridae Dealfishes, ribbonfishes			
Trachipterus jacksonensis (Ramsay, 1881) Jackson ribbonfish	P41970		
Trachipterus trachypterus (Gmelin, 1789) Peregrin ribbonfish	P41259		
Regalecidae Oarfishes			
Regalecus glesne Ascanius, 1772 King of the herrings	P41231	P41939	P42362
Order POLYMIXIFORMES			
Polymixiidae Beardfishes			
Polymixia sp. Beardfish	P40685		
Order OPHIDIIFORMES			
Carapidae Pearlfishes			
Echiodon cryomargarites Markle, Williams & Olney, 1983	ECH1 -2	ECH1f	
Echiodon sp.	P42429	TS1491-93	
Ophidiidae Cusk eels			
Genypterus blacodes (Forster, 1801) Ling	P38207-08	LIN1- 6	
Spectrunculus grandis (Günther, 1877) Warty cuskeel	P41204		

Bythitidae Brotulas						
Cataetyx niki Cohen, 1981 Brown brotula	P41257	CAN1				
Cataetyx sp. A White brotula	P42351					
Order GADIFORMES						
Euclichthyidae Eucla cod						
Euclichthys polynemus McCulloch, 1926 Eucla cod	P40550	P42570.89	P42570.90			
Macrouridae Rattails, grenadiers						
Coelorinchus aspercephalus Waite, 1911 Obliquebanded	CAS1 -2	CAS3 -4				
Coelorinchus biclinozonalis Arai & McMillan, 1982	F134	F135	CBI1-3			
Coelorinchus bollonsi McCann & McKnight, 1980	CBO1 -2					
Coelorinchus fasciatus (Günther, 1878) Banded rattail	F138	F139	Fe188	CFA1 -2		
Coelorinchus innotabilis McCulloch, 1907 Notable rattail	Fe0104-8	CIN1				
Coelorinchus kaiyomaru Arai & Iwamoto, 1979 Kaiyomaru r	TS1532	TS1544	CKA1-3			
Coelorinchus matamua (McCann & McKnight, 1980) Mahia r	CMA1	CMA2				
Coelorinchus oliverianus Phillipps, 1927 Shortnosed rattail	Col1	Col2	COLIV1-5	COL		
Coelorinchus parvifasciatus Smallbanded rattail	TS1515	TS1516				
Coelorinchus trachycarus Iwamoto, Rough headed rattail	CHY1-2					
Coryphaenoides dossenus McMillan, 1999 Longbarbel grenadier		CD 1	CD2			
Coryphaenoides mcmillani Iwamoto & Shcherbachev, 1991 ier	Fe078					
Coryphaenoides murrayi Günther, 1878 Abyssal grenadier	CMU1 -2	Fe075-76				
Coryphaenoides serrulatus Günther, 1878 Serrulate grenadier		Fe060-64				
Coryphaenoides striaturus Barnard, 1925 Striate grenadier		Fe090-93	P42416			
Coryphaenoides subserrulatus Makushok, 1976 Four rayed		Fe079-083	CSU1 -5			
Gadomus aoteanus McCann & McKnight, 1980 Filamentous r		Gadaot1				
Lepidorhynchus denticulatus (Richardson, 1846) Javelin fish	F132f	F131f	LEPD1-5			
Lucigadus nigromaculatus (McCulloch, 1907) Blackspot rattail	unreg 1	VNI1	VNI2 -3			
Macrourus carinatus (Günther, 1878) Ridgescaled rattail	F136	F137	MCA1 -5	P42295	P42247-8	P42323
Macrourus holotrachys Günther 1878	P425703	P425705	P42585	P4289		

Macrourus whitsoni (Regan 1913)	P42222	P42316	P41446	P42316
Mesobius antipodum Hubbs & Iwamoto, 1977 Bathypelagic r		BJA1	BJA2	
Nezumia namatahi McCann & McKnight, 1980 Squashedface r	Neznam1	NES1-2		
Nezumia coheni Iwamoto & Merrett, 1997	P42449			
Odontomacrurus murrayi Norman, 1939 Largefang rattail	P41863			
Trachonurus gagates Iwamoto & McMillan, 1997 Velvety rattail	P42409	P42613		
Trachyrincus aphyodes McMillan, 1995 Unicorn rattail	WHX1 -5			
Trachyrincus longirostris (Günther, 1878) Slender unicorn rattail	ureg 2			
Kuronezumia leonis (Barnard 1925)	Fe077			
Moridae Morid cods				
Antimora rostrata (Günther, 1878) Violet cod	VCO1- 4	F133	Ar1	
Notophycus marginata (Günther, 1878) Dwarf cod	P42157	NM1	NM2	DCO1-2
Auchenoceros punctatus (Hutton, 1873) Ahuru	PCO1-2			
Guttigadus sp. Nakedhead codling	P42690			
Halargyreus johnsonii Günther, 1862 Slender cod	P41309	Fe099-03	TS1533	HJO1
Lepidion microcephalus Cowper, 1956 Longfinned cod	Fe065-69	Lm1 f	P42521	
Lepidion schmidti Svetovidov, 1936 Schmidt's giant cod	P41305	P42216	P42713	
Mora moro (Risso, 1810) Ribaldo	RIB1 -3			
Pseudophycis bachus (Forster, 1801) Red cod	RCO1	RCO4	RCO5	RCO6
***Pseudophycis barbata* Günther, 1863 Southern bastard red cod**				
***Pseudophycis breviuscula* (Richardson, 1846) Northern bastard red cod**				
Tripterophycis gilchristi Boulenger, 1902 Grenadier cod	GRC1 GRC2			
Melanonidae Pelagic cods				
Melanonus gracilis Günther, 1878 Black pelagic cod	F044F			
MACRURONIDAE Southern hakes				
Lyconus sp. A Fangtooth hoki	LYC1	LYC2		
Macruronus novaezelandiae (Hector, 1871) Hoki	F123, 124	HOK1-4	Fe176 -79	
Lyconus sp.	P41252			

Lyconus pinnatus Gunther, 1887	P41721	TS1508			
Lyconus brachycolus Holt & Byrne 1906		TS1507			
Muraenolepididae Moray cods					
Muraenolepis n. sp. Grey moray cod	P40472-	P40518-	P40567	P40574	P40577
PHYCIDAE Phycid hakes					
Merlucciidae Hakes					
Merluccius australis (Hutton, 1872) Hake	HAK1 HAK2	HAK3-6			
Gadidae True cods					
Micromesistius australis Norman, 1937 Southern blue whiting	SB1	SB2	SBW3-SBW5		
Order LOPHIIFORMES					
Chaunacidae Seatoads					
Chaunax sp. A Greenspot frogmouth	P41711	P41743			
Chaunax sp. C Pink frogmouth	P42411	P42410	CHX1		
Ogcocephalidae Batfishes					
Halieutopsis sp.	P41210				
Melanocetidae Humpback anglerfish					
Melanocetus johnsonii Günther, 1864 Humpback anglerfish	P41314	F038F			
Himantolophidae Prickly anglerfish					
Himantolophus appelii (Clarke, 1878) Prickly anglerfish	P40998	P41680	P41686	F043F	P42396
Himantolophus sp.	P42004 X2	P42004 X1			
Oneirodidae Smooth anglerfishes					
Dolopichthys pullatus Regan & Trewavas, 1932	P41681				

Oneirodes kreffti Pietsch, 1974	P42441					
Oneirodes notius Pietsch, 1974 Smooth anglerfish	P42629					
Oneirodes sp.	F045FORM	P42442	P42440			
Ceratiidae Seadevils						
Ceratias holboelli Krøyer, 1845 Northern seadevil		P42610				
Ceratias tentaculatus (Norman, 1930) Southern seadevil	P41719	P41990 X2	P41990X1	P42443		
Cryptopsaras couesii Gill, 1883 Warty seadevil	P419889	P41989	F037E, F	Fe089	P42158	P
Ceratias sp.	P42159					
Gigantactinidae Slender anglerfishes						
Gigantactis paxtoni Bertelsen, Pietsch & Lavenberg, 1981	P42005					
Gigantactis sp.	P41724					
Linophrynidae Linophrynids						
Haplophryne mollis (Brauer, 1902) Phantom angler	P41209	P41313				

Order MUGILIFORMES

Mugilidae Mullets

***Aldrichetta forsteri* (Valenciennes, 1836) Yelloweyed mullet**

***Mugil cephalus* Linnaeus, 1758 Grey mullet**

Order BELONIFORMES

Exocoetidae Flyingfishes

Cheilopogon pinnatibarbatus (Bennett, 1831) Barbeled flyingfish	P41291

Order STEPHANOBERYCIFORMES

Melamphaidae Bigscalefishes

Poromitra capito Goode & Bean, 1883	Poromcap1

Cetomimidae Flabby whalefishes						
Ditropichthys storeri (Goode & Bean, 1895) Kermadec whalefish	P41320					
Order BERYCIFORMES						
Anoplogastridae Fangtooth						
Anoplogaster cornuta (Valenciennes, 1833) Fangtooth	P41684	P42422				
Diretmidae Discfishes						
Diretmichthys parini (Post & Quéro, 1981) Black discfish		SFN1				
Diretmus argenteus Johnson, 1864 Silver discfish	P41474.10	P42174.11	P42160			
Trachichthyidae Roughies						
Hoplostethus atlanticus Collett, 1889 Orange roughy	P34698	P34701-02	P41334			
Hoplostethus cf. *gigas* McCulloch, 1914 NZ giant sawbelly	P38325	P31100 460	P31100 490		TS003	TS004
Hoplostethus mediterraneus Cuvier, 1829 Silver roughy	P33825,87-96	P39501 X6	P39464 X12	P39188	P39159	P39213
Paratrachichthys trailli (Hutton, 1875) Common roughy	P41333	F125 -26	F127- 8			
Thalasseleotris sp.	P39807	P39407	P39221	P39573		
Berycidae Alfonsinos						
***Beryx decadactylus* Cuvier, 1829 Longfinned beryx**						
Beryx splendens Lowe, 1834 Alfonsino	BYX1-3					
***Centroberyx affinis* (Günther, 1859) Golden snapper**						
Centroberyx sp.	P39803-06	P40667				
Gephyroberyx darwini (Johnson 1866)	P37179					
Order ZEIFORMES						
Zeidae Dories						
Capromimus abbreviatus (Hector, 1875) Capro dory	P42170.06	P42170.05	unreg3			

Cyttus novaezealandiae (Arthur, 1885) Silver dory	F129f	F130f				
Cyttus traversi Hutton, 1872 Lookdown dory	LDO1 -5					
Zenopsis nebulosus (Temminck & Schlegel, 1845) Mirror dory	MDO1-5					
***Zeus faber* Linnaeus, 1758 John dory**						
Oreosomatidae Oreos						
Allocyttus niger James, Inada & Nakamura, 1988 Black oreo	Fe051-54	BOE1-2	BOE3			
Neocyttus rhomboidalis Gilchrist, 1906 Spikey oreo	TS1496	TS1497	Fe055-58			
Pseudocyttus maculatus Gilchrist, 1906 Smooth oreo		SSO1				
Order GASTEROSTEIFORMES						
Syngnathidae Seahorses, pipefishes						
Solegnathus spinosissimus (Günther, 1870) Spiny seadragon	P42450	P42695				
Macroramphosidae Snipefishes						
Centriscops humerosus (Richardson, 1846) Redbanded bellowsfish	unreg 2	BBE1 - 5				
Notopogon lilliei Regan, 1914 Crested bellowsfish	CBE1-5		CBE6			
Order SCORPAENIFORMES						
Scorpaenidae Scorpionfishes						
Helicolenus barathri (Hector, 1875) Bigeye seaperch	P35211-13					
Helicolenus percoides (Richardson, 1842) Jock stewart	P35165 X4					
Helicolenus sp. Louisville	P34801,02					
Helicolenus sp. Kermadec	P34818-20	P34828,29	P35176			
Phenacoscorpius megalops Fowler, 1938 Hookcheek scorpionfish	P41324					
Pterois volitans (Linnaeus, 1758) Red lionfish	P41672					
Scorpaena cardinalis Solander & Richardson, 1842 Red rockcod	P34412, 370, 455	P34419	P34423	P34424	P34428-29	P41667
Scorpaena cookii Günther, 1874 Kermadec scorpionfish	P41288					

Trachyscorpia eschmeyeri Whitley, 1970 Cape scorpionfish	P37015	unreg 2	P34697			
Trachyscorpia n. sp.	P38277					
Congiopodidae Pigfishes						
Alertichthys blacki Moreland, 1960 Alert pigfish	unreg 2	API1-4	P42732			
Congiopodus coriaceus Paulin & Moreland, 1979 Deepsea pigfish	DSP1-5					
Congiopodus leucopaecilus (Richardson, 1846) Southern pigfish	P42476	PIG1 PIG2				
Triglidae Gurnards						
Chelidonichthys kumu (Lesson & Cuvier, 1829) Red gurnard	369-1 369-3					
Lepidotrigla brachyoptera Hutton, 1872 Scaly gurnard	SCG1-5					
Pterygotrigla andertoni Waite, 1910 Spotted gurnard	P42233					
Hoplichthyidae Ghostflatheads						
Hoplichthys haswelli McCulloch, 1907 Deepsea ghostflathead	FHD1-FHD3	FHD4	P42614 (FHD6)	FHD1-FHD3		
Psychrolutidae Toadfishes						
Ambophthalmos angustus (Nelson, 1977) Pale toadfish	P40935	P42335	TOP1 TOP3	TOP4	TOP6	TOP7
Cottunculus nudus Nelson, 1989 Bonyskull toadfish	P41986	F140f				
Neophrynichthys latus (Hutton, 1875) Dark toadfish	P41701	TOD1				
Neophrynichthys heterospilos Southern dark toadfish	P42615	P42616				
Psychrolutes microporos Nelson, 1995 Blobfish	P40933-34	P41202	P42412	P42413	P42414	P42542
Psychrolutes sp.	P42567					
Order PERCIFORMES						
Polyprionidae Wreckfishes						
Polyprion americanus (Bloch & Schneider, 1801) Bass	P40996					

Polyprion oxygeneios (Schneider & Forster, 1801) Hapuku	P41702	Fe122	Fe148	HAP1	HAP2
Serranidae Sea perches, gropers					
Acanthistius cinctus (Günther, 1859) Yellowbanded perch	P41287	P41673			
Caesioperca lepidoptera (Forster, 1801) Butterfly perch	P40726	P41008	P41379	P41726	
Caprodon longimanus (Günther, 1859) Pink maomao	P34458	P41015	P41022	P41016	P41021
Caprodon sp. A	P39085				
Caprodon sp. BD	P39829-	P41018			
Caprodon sp. C		P39831			
Caprodon sp.C-BD		P39830			
Caprodon sp. Kermadecs	P38242				
Caprodon sp. NSW and Queensland	I36638	I43522-	I43441		
Hypoplectrodes sp. A Eyebrow seaperch	P40724		P40725		
Hypoplectrodes sp. B Halfbanded seaperch	P41009				
Epinephelus daemelii (Günther, 1876) Spotted black groper	P40693	P41861			
Epinephelus lanceolatus (Bloch, 1790) Queensland groper	P40770	P42347			
Epinephelus octofasciatus Griffin, 1926 Convict groper	P42284	P42479			
Lepidoperca aurantia Roberts, 1989 Orange perch	P41010	P41024	OPE1 -3	P42230	
Lepidoperca inornata Regan, 1914 Plain perch	P41011	P41023	P42210		
Lepidoperca magna Katayama & Fujii, 1982 Seamount perch	P42229	P42230			
Lepidoperca tasmanica Norman, 1937 Wavyline perch	P42192				
Plectranthias maculicaudus (Regan, 1914) Tailspot perchlet	P41012	P41849	P41013		
Trachypoma macracanthus Günther, 1859 Toadstool groper	P41675				
Callanthiidae Splendidperches					
Callanthias australis Ogilby, 1899 Splendid perch		P42231			
Epigonidae Deepwater cardinalfishes					
Epigonus lenimen (Whitley, 1935) Bigeye cardinalfish	EPL1	EPL2			

Epigonus robustus (Barnard, 1927) Robust cardinalfish	P42337				
Epigonus telescopus (Risso, 1810) Black cardinalfish	EPT1-3	EPT 6-7			
Echeneididae Remoras					
Remora osteochir (Cuvier, 1829) Hardfin marlinsucker	P41230				
Coryphaenidae Dolphinfishes					
Coryphaena hippurus Linnaeus, 1758 Mahimahi	P41258				
Carangidae Trevallies, jacks					
***Decapterus koheru* (Hector, 1875) Koheru**					
***Decapterus muroadsi* (Temminck & Schlegel, 1844) Scad**					
Elagatis bipinnulata (Quoy & Gaimard, 1825) Rainbow runner	P41706				
Naucrates ductor (Linnaeus, 1758) Pilotfish	P41725				
Pseudocaranx dentex (Bloch & Schneider, 1801) Trevally	Fe167-71				
***Seriola lalandi* Valenciennes, 1833 Kingfish**					
Trachurus declivis (Jenyns, 1841) Jack mackerel	P41760	P42487	Tdec1 - 4		
Trachurus novaezelandiae Richardson, 1843 Horse mackerel	Tnov1 - 4				
Trachurus murphyi Nichols, 1920	Tmur1 -4				
Bramidae Pomfrets, breams					
Brama australis Valenciennes, 1837 Southern bream	P41227	RBM1	RBM2	SRB1-3	SRB4 - 5
Brama brama (Bonnaterre, 1788) Ray's bream	P41228	RBM3 f	P42701		
Pterycombus petersii (Hilgendorf, 1878) Fanfish	P41201				
Xenobrama microlepis Yatsu & Nakamura, 1989 Bronze bream	P42474				
Taractichthys longipinnis (Lowe, 1843)	P41712	P41712			
Caristiidae Manefishes					
Platyberyx sp. Largemouth manefish	P41683	P42350	P42539		

Emmelichthyidae Bonnetmouths				
Emmelichthys nitidus Richardson, 1845 Red baitfish	RBT1	RBT2	RBT3-5	
Plagiogeneion rubiginosum (Hutton, 1875) Rubyfish	P41269	RBY1		
Sparidae Seabreams				
Pagrus auratus (Forster, 1801) Snapper	SNAP1-3			
Mullidae Goatfishes				
Parupeneus spilurus (Bleeker, 1854) Blackspot goatfish	P41289			
Pentacerotidae Boarfishes				
Paristiopterus labiosus (Günther, 1872) Sowfish	P41260	P402471	P42480	
Pentaceros decacanthus Günther, 1859 Yellow boarfish	P40670	P40680	P40680	P40680
Pseudopentaceros richardsoni (Smith, 1844) Southern boarfish	P40681			
Zanclistius elevatus (Ramsay & Ogilby, 1888) Longfin boarfish	P42470	P42693	P42694	
Kyphosidae Drummers, mados				
Girella fimbriata (McCulloch, 1920) Caramel drummer	P41277			
Kyphosus sydneyanus (Günther, 1886) Silver drummer	P41290	P42348		
Scorpis violacea (Hutton, 1873) Blue maomao	P41709			
Arripididae Kahawai				
Arripis trutta (Forster, 1801) Kahawai	KAH 1-3			
***Arripis xylabion* Paulin, 1993 Kermadec kahawai**				
Aplodactylidae Marblefishes				
Aplodactylus etheridgii (Ogilby, 1889) Notchheaded marblefish	P41279			

Cheilodactylidae Morwongs, tarakihi						
Cheilodactylus spectabilis Hutton, 1872 Red moki	P33135					
Nemadactylus douglasii (Hector, 1875) Porae	P33381	P33994	P34229	P31119		
Nemadactylus macropterus (Forster, 1801) Tarakihi	P33387	unreg 2	368-01	P31128 28		
Nemadactylus n. sp. King tarakihi	P33388	P34115	P34151	P40676	P40676	P31120
Goniistius francisi (Burridge 2004)	P41671					
Nemadactylus monodacytlus (Carmichael, 1819)	P36017					
Latrididae Moki						
Latridopsis ciliaris (Forster, 1801) Blue moki	P33043	P32924	P32924	P32938		P32943
Latridopsis forsteri (Castelnau, 1872) Copper moki (NZ)	P32933	P31965	P34230	P33925	P33926	P33976,
Latridopsis forsteri (Castelnau, 1872) Copper moki (Australia)	P37086	P37087	P37089			
Latris lineata (Forster, 1801) Trumpeter	P33042	P33059	P33124	P31872	P33474	P33475
Mendosoma lineatum Guichenot, 1848 Telescope fish	P33096	P33956	P34210	P34212	P34782	P34783
Latris pacifica Roberts 2003 Foundation seamounts		P32537	P34116	P34006	P32538	
Oplegnathus woodwardi (Waite, 1900) knifejaw		P42395				
Pomacentridae Damselfishes						
Stegastes gascoynei (Whitley, 1964) Coral Sea gregory	P41283					
Labridae Wrasses						
Anampses caeruleopunctatus Rüppell, 1829 Bluespotted wrasse	P41280	P41280,	P41280			
Bodianus unimaculatus (Günther, 1862) Red pigfish	P34417	P34434				
Bodianus flavipinnis Goman, 2001 Foxfish	P41268		P42465			
Bodianus flavifrons Goman, 2001 Masked foxfish	P34422	P34410	P34402		P34425	P34438
Bodianus sp. Kermadecs	P34413	P34420	P34416	P34421		
Notolabrus cinctus (Hutton, 1877) Girdled wrasse	GWC1					
Notolabrus inscriptus (Richardson, 1848) Green wrasse	P41281	P41666				
Pseudolabrus luculentus (Richardson, 1848) Orange w	P41276					

Odacidae Butterfishes
***Odax cyanoallix* Ayling & Paxton, 1983 Bluefinned butterfish**
***Odax pullus* (Forster & Schneider, 1801) Greenboned butterfish**

Zoarcidae Eelpouts

Melanostigma gelatinosum Günther, 1881 Limp eelpout	P42466 X5				

Nototheniidae Ice cods

Dissostichus eleginoides Smitt, 1898 Patagonian toothfish	P34795	P42249			
Notothenia microlepidota Hutton, 1875 Smallscaled cod	P41296	SCD1 5	SCD6		
Dissostichus mawsoni Norman 1937 Antarctic toothfish	P42310				

Chiasmodontidae Swallowers

Chiasmodon niger Johnson, 1864 Black swallower	F146F				
Kali sp.	P42557				
Pseudoscopelus sp. B	P37309				

Pinguipedidae Sandperches, weevers

Parapercis colias (Forster & Schneider, 1801) Blue cod	BCO1-3				
Parapercis gilliesi (Hutton, 1879) Yellow cod	YCO1 f				

Percophidae Opalfishes

Hemerocoetes artus Nelson, 1979 Narrow opalfish	HA1	HA2	HA3	OPA1 - 3	P42608
Hemerocoetes morelandi Nelson, 1979 Moreland's	P41762				
Hemerocoetes pauciradiatus Regan, 1914	OPA4	OPA5-8			

Leptoscopidae Stargazers

Crapatalus angusticeps (Hutton, 1873) Slender stargazer	KAH0705				

***Crapatalus novaezelandiae* Günther, 1861 Sand stargazer**
***Leptoscopus macropygus* (Richardson, 1846) Estuary stargazer**

Uranoscopidae Armourhead stargazers						
Genyagnus monopterygius (Forster & Schneider, 1801) Spot stargazer	KAH0705					
Kathetostoma giganteum Haast, 1873 Giant stargazer	P34888	P34884	P34886	P34890	P34907	TS621
Kathetostoma sp. Giant banded stargazer	P34913	P34885	P34887	P34912	P39337	P39337
Pleuroscopus pseudodorsalis Barnard, 1927 Scaly stargazer	P34188	P34188	P34891	P42070	P42064	P42065
Xenocephalus armatus Kaup, 1858 Brown stargazer		P40997	TS573	TS602	TS603	
Luvaridae Louvars						
Luvarus imperialis Rafinesque, 1810 Louvar	P41255	P42349				
Scombrolabracidae Black mackerel						
Scombrolabrax heterolepis Roule, 1921 Black mackerel	P40456		P40457			
Sphyraenidae Barracudas						
Sphyraena acutipinnis Day, 1876 Sharpfin barracouda	P41663					
Channichthyidae						
Chinobathyscus dewitti Andriashev & Neyelov 1978	P40919		P42223	P42294:3		
Cryodraco antarcticus Dollo 1900.	P42259	P40063	P40234	P40235		
Dacodraco hunteri Waite 1916	P42289	P42292	P42357	P42717		
Gempylidae Snake mackerels, gemfishes						
***Lepidocybium flavobrunneum* (Smith, 1843) Escolar**						
Paradiplospinus gracilis (Brauer 1906) False frostfish	P42190					
Rexea solandri (Cuvier, 1832) Gemfish	P41763	P42179.18	P42179.19			
Rexea sp.	TS970	TS969	TS968			

***Ruvettus pretiosus* Cocco, 1833 Oilfish**						
Thyrsites atun (Euphrasen, 1791) Barracouta	BAR1-5					
Trichiuridae Cutlassfishes, scabbardfishes						
Lepidopus caudatus (Euphrasen, 1788) Frostfish	FRO1-5					
Scombridae Tunas						
Acanthocybium solandri (Cuvier, 1832) Wahoo	P40534					
Gasterochisma melampus Richardson, 1845 Butterfly tuna	P42203					
Scomber australasicus Cuvier, 1832 Blue mackerel	Fe154-158					
Gymnosarda unicolor (Rüppell, 1836) Dogtooth tuna	P41707					
Centrolophidae Raftfishes, warehou						
Centrolophus niger (Gmelin, 1789) Rudderfish	CN		PSNZ-031			
Hyperoglyphe antarctica (Carmichael, 1819) Bluenose	TS013	TS007	TS011	TS014	TS012	BNS1
Icichthys australis Haedrich, 1966 Ragfish	P40939	P41996	TS1531			
Schedophilus labyrinthica (McAllister & Randall, 1975)	P33099	P34162	P38258	P38275	P33882	P31437
Schedophilus maculatus Günther, 1860 Pelagic but	P41297	P41694	SUM1			
Seriolella brama (Günther, 1860) Blue warehou	WAR1-3					
Seriolella caerulea Guichenot, 1848 White warehou	P40849	WWA1	P42472	WWA2	WWA3-6	
Seriolella punctata (Forster, 1801) Silver warehou		TS1524	SWA1	SWA4		
Nomeidae Eyebrow fishes						
Cubiceps caeruleus Regan, 1914 Blue cubehead	P41266	P41710	CCA1-2	CCA3		
Tetragonuridae Squaretails						
Tetragonurus cuvieri Risso, 1810 Squaretail	P42399					
Oplegnathidae						

Oplegnathus woodwardi (Waite, 1990) record	P42395			
Order: PLEURONECTIFORMES				
Bothidae Lefteyed flounders				
Arnoglossus scapha (Forster, 1801) Witch	WIT1-2	WIT3 – 5		
Achiropsettidae Finless flounders				
Achiropsetta tricholepis Norman, 1930 Prickly fl				
Achiropsetta sp.	P41984	P42568		
Neoachiropsetta milfordi (Penrith, 1965) Finless f				
Mancopsetta sp. Marbled flounder	MAN1	MAN3 -6	MAN7 -9	P41311
Pleuronectidae Righteyed flounders				
Azygopus flemingi Nielsen, 1961 NZ spotted flounder		SOF1		
Azygopus pinnifasciatus Norman 1926 flounder	P42401	SDF1- 3	SDF5	
Colistium guntheri (Hutton, 1873) Brill	BRI1			
Colistium nudipinnis (Waite, 1911) Turbot	KAH0705			
Pelotretis flavilatus Waite, 1911 Lemon sole	P42169.03	P42169.04	LSO1	LSO2
***Peltorhamphus latus* James, 1972 Speckled sole**				
Peltorhamphus novaezeelandiae Günther, 1862 Common sole	ESO1			
***Peltorhamphus tenuis* James, 1972 Slender sole**				
Rhombosolea leporina Günther, 1862 Yellowbelly flounder	YBF1			
Rhombosolea plebeia (Richardson, 1843) Sand flounder	KAH0705			
***Rhombosolea retiaria* Hutton, 1874 Black flounder**				
Rhombosolea tapirina Günther, 1862 Greenback	KAH0705			
Cynolossidae new sp.	FLO2519	FLO251	FLO251	
Order: TETRAODONTIFORMES				

Monacanthidae Leatherjackets		
Aluterus monoceros (Linnaeus, 1758) Smooth leatherjacket	P42352	
Parika scaber (Forster, 1801) Rough leatherjacket	LEA1-2	
Tetraodontidae Puffers		
Contusus richei (Fréminville, 1813) Globefish	GLB1	
Lagocephalus cheesemanii (Clarke, 1897)		P41628
Torquigener altipinnis (Ogilby, 1891) Highfin puffer	P41662	P41662

Appendix 4. New Zealand sharks and rays barcoded as at 1 October 2007. Identification numbers: P = specimen registration number in the National Fish Collection (NFC) at the Museum of New Zealand Te Papa Tongarewa; other codes = specimen number held in a frozen collection at NIWA or as an e-voucher (photograph only). Reference specimens were not available for species shown in bold.

New Zealand fishes barcode: sharks and rays								
Include Ross Sea skates: *Bathyraja* and *Amblyraja*								
Class CHONDRICHTHYES								
Subclass HOLOCEPHALI								
Order CHIMAERIFORMES								
Callorhinchidae Plownose chimaeras								
Callorhinchus milii Bory de St. Vincent, 1823 Elephant fish	ELE1-2	ELE1-3						
Chimaeridae Shortnose chimaeras								
Chimaera panthera Didier, 1998 Leopard chimaera	P39162	P39492						
Chimaera sp. A Black chimaera	P35709							
Chimaera lignania Didier, 2002	CHG1- 2	P38450	TAN9812/1	TAN9812/2	TAN9812/3	P384386	P38439	P35709
Chimaera sp. C	P40272	P40174	P40173	P39967	CHP1	CHP2	TAN9812/1	
Hydrolagus novaezelandiae (Fowler, 1911) Mottled ghostshark	P42156.85	P42156.86	GSH1-3					
Hydrolagus sp. A Little black ghostshark	P38384 (2)	P42477						
Hydrolagus trolli Didier & Street, 2002	P39943	P39960						
Hydrolagus sp. D Giant black ghostshark	P38318	P39954	P39662					
Hydrolagus bemisi Didier, 2002	GSP1-4	TAN98122/2	TAN9812/001	NZ008-009				
RHINOCHIMAERIDAE Longnosed chimaeras								
Harriotta haeckeli Karrer, 1972 Smallfin spookshark								
Harriotta raleighana Goode & Bean, 1895 Longnose ghostshark	P38403	TAN9812/5	TAN9812/4	TAN9812/6	LCH1-2			
Rhinochimaera pacifica (Mitsukuri, 1895) Longnosed chimaera	P35710,11							

Order CARCHARHINIFORMES

Scyliorhinidae Catsharks						
Apristurus exsanguis Sato, Nakaya & Stewart, 1999 NZ catshark	P42176.13	P42716.14	P42520	P42519	Apr-02	Apr-03
Apristurus cf. *exsanguis*	Apr-61					
Apristurus cf. *fedorovi* Dolganov, 1985 Roundfin catshark	P41994					
Apristurus sp. B Freckled catshark	P42125	P42126				
Apristurus sp. C Fleshynose catshark	P41310	P42336 (2)	P42569	P42569		
Apristurus sp. F Bulldog catshark						
Apristurus sp. G	P41688					
Apristurus sp. E	P41689					
Cephaloscyllium isabellum (Bonnaterre, 1788) Carpetshark	CAR1, 3	CAR 4 -7				
Halaelurus dawsoni Springer, 1971 Dawson's catshark	P42162.94	P42162.95	DCS1 – 2	P42731		
Parmaturus n. sp. Roughback catshark	P42517					
N.gen n. sp. Roughback	P42524					
Proscyllidae Finback catsharks						
Gollum attenuatus (Garrick, 1954) slender smoothhound	P41776	P42431				
Triakidae Smoothhounds						
Galeorhinus galeus (Linnaeus, 1758) Tope, schoolshark	Fe121	Fe164, 165	SS166	SCH2	SCH3 -4	
Mustelus lenticulatus Phillipps, 1932 Rig, Spotted smoothhound	P42214					
Mustelus sp. Northern rig undescribed (2007)	P34395					
Carcharhinidae Requiem sharks						
Carcharhinus brachyurus (Günther, 1870) Bronze whaler	P42130	BWH1				
***Prionace glauca* (Linnaeus, 1758) Blue shark**	BWS1	BWS2	BWS3			
Sphyrna zygaena (Linnaeus, 1758) Smooth hammerhead shark	P34219	P1302	P41272	P34214		

Alopiidae Thresher sharks								
***Alopias vulpinus* (Bonnaterre, 1788) Thresher shark**	THR1 THR2							
Cetorhinidae Basking sharks								
***Cetorhinus maximus* (Gunnerus, 1765) Basking shark**	BSK39	BSK15	BSK13	BSK16	BSK33	BSK20	BSK14	BSK8
Lamnidae Mackerel sharks								
***Carcharodon carcharias* (Linnaeus, 1758) Great white shark**	WPS1	WPS2	WPS3	WPS11	WPS12	WPS13		
***Isurus oxyrinchus* Rafinesque, 1810 Mako**	MAK9	MAK10	MAK14	MAK15	MAK16			
***Lamna nasus* (Bonnaterre, 1788) Porbeagle**	POS6	POS7	POS8	POS18	POS19			
Order HEXANCHIFORMES								
Chlamydoselachidae Frillsharks								
Chlamydoselachus anguineus Garman, 1884 Frillshark	P42398							
Hexanchidae Cow sharks								
***Hexanchus griseus* (Bonnaterre, 1788) Sixgill shark**	HEX1	HEX2						
Order SQUALIFORMES								
Dalatiidae Kitefin sharks								
Centroscymnus crepidater (Bocage & Capello, 1864) Longnosed velvet dogfish		P42120	CYP1- 5	P42564	P42726			
Centroscymnus owstoni Garman, 1906 Owston's dogfish	P42124	P42418						
***Centroscymnus plunketi* (Waite, 1910) Plunket shark**	PLS1	PLS2						
Dalatias licha (Bonnaterre, 1788) Seal shark	BSH1 - 5	P42729						
Etmopterus baxteri Garrick, 1957 Southern lanternshark	ETB1- 5	ETB6	ETB7					
Etmopterus lucifer Jordan & Snyder, 1902 Lucifer dogfish	F114F- 118F	P42334						
Etmopterus pusillus (Lowe, 1839) Smooth lanternshark	P41772							
Etmopterus sp. B	P42554	P41773 X1	P41773 X2	P41773 X3	P42724	P42725		

Etmopterus sp. BA	P42302					
Oxynotus bruniensis (Ogilby, 1893) Prickly dogfish	P41256	P41703	P41704	TS1526	PDG1-2	P42728
Somniosus antarcticus Whitley, 1939 Pacific sleepershark	P42526					
Centrophoridae Gulper sharks						
Centrophorus squamosus (Bonnaterre, 1788) Leafscale gulpershark	P42127	P42128	CSQ1-2	CSQ3	CSQ4	
Deania calcea (Lowe, 1839) Shovelnose dogfish	P42121	P42122	P42123	SND5 -6		
Deania quadrispinosa (McCulloch, 1915) Longsnout dogfish	DEQ1					
Squalidae Spiny dogfishes						
Cirrhigaleus barbifer Tanaka, 1912 Mandarin dogfish	P42487					
Squalus acanthias Linnaeus, 1758 Spiny dogfish	Fe119, 120	P42571				
Squalus mitsukurii Jordan & Snyder, 1903 Piked spurdog						
Squalus sp. B [*sensu* Last & Stevens, 1994]	P34396	NMV25109				
Squalus griffini Phillipps, 1931 Northern spiny dogfish	P41193	P41774/23	P41774/24	P41774/26	P41774/27	
Order RAJIFORMES						
Torpedinidae Electric rays						
Torpedo fairchildi Hutton, 1872 Electric ray	P41676	ERA1				
Narcinidae Slender electric rays						
Typhlonarke aysoni (Hamilton, 1902) Ayson's numbfish	P41329	P42187	P42402			
Rajidae Skates						
Amblyraja cf. *hyperborea* (Collett, 1879) Thorny skate	DSK1	P42535				
Amblyraja sp.	P40517	P40548	P40576	P40570		
Amblyraja Georgiana (Norman 1938) Ross Sea	P40629-30	P42636		P42722		
Arhynchobatis asperrimus Waite, 1909 Longtailed skate	P42403 ts1667	P42403 ts1668				

Bathyraja richardsoni (Garrick, 1961) Deepsea skate	P39877							
Bathyraja shuntovi Dolganov, 1985 Longnosed deepsea skate	P42419	P42423	P42426	PSK1	PSK2	P39854	P39878	
Bathyraja sp. (blond)	P39958	P39959						
Bathyraja sp. (cf *eatonii*) Ross Sea	P38826-30							
Bathyraja sp. (dwarf) Ross Sea	P42224-6	P42721						
Bathyraja maccaini Springer 1971 Ross Sea	P38832-33	P38836	P40625					
Dipturus innominatus (Garrick & Paul, 1974) Smooth skate	P38779	P38782		P40545	P40546			
Zearaja nasutus (Müller & Henle, 1841) Rough skate	P38778	P38780	P41495	P41229	P41229B	P41229C	P42606	
Notoraja asperula (Garrick & Paul, 1974) Smooth skate	P41493	P41761	P41805	P41492	P41490	P41494	P41491	P40512
Notoraja spinifera (Garrick & Paul, 1974) Prickly skate	P41753	P41752	P41751	P41748	P41749	P41321	P41754	P41750
Notoraja sp. C Velcro skate	P41322	P41873						
Notoraja sp. E Blue skate	P41985							
Brochiraja spinifera (Garrick & Paul 1974)	BTH1	BTH2	BTS1	BTS2				
Brochiraja asperula (Garrick & Paul 1974)		BTH3 - 6						
Brochiraja albilabiata Last &McEachran 2006		P42691						

Myliobatididae Eagle rays (incl. Mobulidae: manta rays)

***Myliobatis tenuicaudatus* Hector, 1877 Eagle ray**	EGR1