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ECOLOGICAL RISK ASSESSMENT FOR SPECIES CAUGHT IN WCPO TUNA FISHERIES: INHERENT RISK AS DETERMINED BY PRODUCTIVITY-SUSCEPTIBILITY ANALYSIS

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Paper prepared by

David S. Kirby

Ecological Risk Assessment for species caught in WCPO tuna fisheries: Inherent risk as determined by Productivity-Susceptibility Analysis

David S. Kirby[1]

Oceanic Fisheries Programme, Secretariat of the Pacific Communtity, Noumea.

1. INTRODUCTION

Ecological Risk Assessment is a natural resource management system that recognises, among other things, the need for methods of comparative analysis for the numerous species impacted by fisheries. The 1982 UN Convention on the Law of the Sea and the various texts that derive from that, most importantly the WCPO Convention, make little distinction in terms of the management objectives for target and non-target associated and dependent species. All must be maintained at levels above that capable of providing maximum sustainable yield (as qualified by relevant environmental or economic factors); biodiversity must be preserved and ecosystem integrity maintained. There is a general acceptance that *highly migratory species* (UNCLOS Annex 1) are the primary goup of species that the WCPO Convention and Commission have been designed to manage, yet even these constitute a long list of species, with the authority to add to this list being granted to the Commission under the Convention. Furthermore, there is an obligation to *assess the impacts of fishing, other human activities and environmental factors on target stocks, non-target species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks* (Article 5). The list of species for which the Commission has responsibility is therefore extremely long and there is a need for the SC to develop a system for comparative analysis of target and non-target associated and dependent species. Such a system would enable prioritisation of fisheries monitoring and research effort, and potential conservation and management measures. Such a system should enable the SC and members of the Commission to meet their obligations under the Convention, as briefly outlined above.

Australia has adapted its exisiting fisheries management systems to incorporate a heirarchical approach to Ecological Risk Assessment. This approach is detailed in EB WP-14. Although it may appear to be very detailed and prescriptive, the general principles are simple, sound and applicable to the WCPO. At its core (Level 2) is a method for comparing the life-history characteristics and fisheries interactions of any number of species, and calculating risk scores for each species based on the most relevant biological criteria: this has been called Productivity-Susceptibility Analysis (PSA). A PSA for WCPO tuna fisheries is presented here in the hope that (a) SC2 will endorse the approach generally, as a basis for prioritisation for fisheries monitoring and research and potential conservation and management measures; (b) that further biological, ecological, and fisheries research into the key variables used in the analysis will be encouraged; (c) there will be iterative improvement in future PSAs presented to the SC; and (d) members of the Commission might carry out similar analyses for tuna fisheries operating within their zones and that they might report the results of such analyses to the SC.

[1] With assistance/advice from Brett Molony, Peter Williams, Tim Lawson, John Hampton, Adam Langley

1.1. WCPFC-2 RESOLUTION ON NON-TARGET FISH SPECIES

In carrying out this exercise, the WCPFC-2 RESOLUTION ON NON-TARGET FISH SPECIES (see below) was kept in mind, as the Ecological Risk Assessment may provide some measure of the degree to which the two parts of the resolution are likely to be effective.

RESOLUTION ON NON-TARGET FISH SPECIES

The Commission For The Conservation And Management Of Highly Migratory Fish Stocks In The Western And Central Pacific Ocean

In accordance with the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean:

Noting the importance of many non-target fish species such as mahi mahi, rainbow runner and wahoo for sustainable livelihoods in many communities in the Convention Area;

Recognising the requirement for members of the Commission to adopt measures to minimise discards, catch of non-target fish species, and the impacts on associated or dependent species;

Resolves as follows:

1. Commission Members, Cooperating Non-members and participating Territories (CCMs) shall encourage their vessels operating in fisheries managed under the WCPFC Convention to avoid to the extent practicable, the capture of all non-target fish species that are not retained;

2. Any such non-target fish species that are not to be retained, shall, to the extent practicable, be promptly released to the water unharmed.

The effectiveness of the first part of the resolution (i.e. the degree to which bycatch has been avoided) is illustrated by the catch estimates for non-target species presented in ST IP-1. Whether they are retained and whether their condition is such that they are likely to have been unharmed by their encounter, is recorded by scientific observers and presented here. The effectiveness of the second part of the resolution can therefore also be assessed.

1.2. Species List

The list of species included in the analysis comprises all species that have been observed caught by scientific observers and are included in the SPC database covering various observer programmes of the WCPO, including Australia, New Zealand, USA (Hawaii), vessels fishing under the FSM Arrangement and US Multi-Lateral Treaty, and other SPC member country/territory national observer programmes. The list comprises 236 species and 79 species groups, the latter being classifications used by observers when identification to species level was not possible. This list therefore encompasses target species and those *associated species*[2] that *co-occur in the same fishing area* [as the target species] *and are exploited (or accidentally taken) in the same fishery or fisheries*.

[2] This definition obtained from the FAO Fisheries Glossary: http://www.fao.org/fi/glossary/

2. PRODUCTIVITY-SUSCEPTIBILITY ANALYSIS (PSA)

2.1. Introduction to Productivity-Susceptibility Analysis (PSA)

When a full stock assessment is carried out it is possible to estimate fishing mortality and its contribution to total mortality for that species. Stock assessments may present biomass depletion ratios comparing $B_{current}$ with biomass that would have existed in the absence of fishing. However, data collection for target species is presently far more complete and accurate than that for non-target species and so full stock assessments are not routinely carried out for non-target associated and dependent species. Other methods must therefore be used to assess fishing impacts for these species. The purpose of Productivity-Susceptibility Analysis (PSA) is to provide an objective biological basis for assessing the risk of adverse fisheries impacts upon species caught. Life-history characteristics and measures of fisheries interactions are scored and plotted along two respective axes: *productivity* and *susceptibility*.

Productivity[3] relates to the birth, growth and death rates of a stock. A highly productive stock is characterized by high birth, growth and mortality rates, and as a consequence, a high turn-over and production to biomass ratios (P/B). Such stocks can usually sustain higher exploitation rates and, if depleted, could recover more rapidly than comparatively less productive stocks.

The *productivity* axis may therefore incorporate life-history characteristics that determine or are reliable indicators of productivity. These include: maximum size; size-at-maturity; maximum age; age-at-maturity; reproductive strategy; fecundity; trophic level.

Susceptibility is the degree to which a species interacts with and is impacted by a fishery. Susceptibility should consider the effects of fisheries encounters, especially those that lead directly or indirectly to mortality, but it may also incorporate the notion of catchability, i.e. behaviour and distribution of the species relative to the distribution and other technical characteristics of the fishery.

PSA attempts to rank a single species relative to the other species in the analysis, along each of the two axes. This may be done for any combination of *productivity-susceptibility* characteristics considered relevant. However, given that there are multiple factors that may be considered relevant, a composite index for each of the axes may also be derived. The final results may then be ranked by their position on each axis and by a single risk score calculated as the Euclidian distance from the origin of the graph.

If there is confidence in the variables chosen for inclusion and in the quality of the data used for the PSA, it may enable prioritisation of species for more detailed assessments. If data quality is poor or data is lacking it provides a means for focussing monitoring and research efforts in order to obtain that data. It may also inform decisions on management and conservation measures if it constitutes the best scientific information available.

[3] This definition obtained from the FAO Fisheries Glossary: http://www.fao.org/fi/glossary/

2.2. Susceptibility

The data used to derive indicators of susceptibility was obtained from the SPC database described above (Section 1.2.). Data queries were performed in order to determine CONDITION AT CAPTURE, LENGTH AT CAPTURE and FATE.

CONDITION AT CAPTURE

There are six categories into which CONDITION AT CAPTURE is classified by observers:

A0: Alive (not further classified)

A1: Alive – injured or distressed

A2: Alive – healthy

A3: Barely alive

D: Dead

U: Unknown condition

The proportion of observations in conditions A3 and D was calculated, with the implicit assumption that the distribution of condition for those recorded as U was represented by the other observations[4]:

CONDITION AT CAPTURE = %Dead = [(A3+D) / (A0+A1+A2+A3+D)]

Susceptibility was considered to be proportional to CONDITION AT CAPTURE.

LENGTH AT CAPTURE

The ratios of LENGTH AT CAPTURE / MAXIMUM LENGTH and LENGTH AT CAPTURE / LENGTH AT MATURITY were calculated, with the result being proportional to susceptibility, under the assumption that natural mortality is higher at smaller size (see discussion and cited papers in Working Paper BIO-8 from SCTB17) and that fishing mortality is therefore a smaller component of total mortality than for larger sizes.

FATE

The ratio of DISCARDS / (DISCARDS + RETAINED) was used as an index of FATE. The initial assumption was that DISCARDS are made in the same CONDITION as originally recorded. However, on further consideration this was not deemed appropriate. There are many different subcategories under both DISCARDS and RETAINED and for at least one of these it can be assumed that what has been discarded will not survive: this is for cases where shark fins have been removed and the trunk discarded (Code: DFR). It was therefore necessary to correct the figure for DISCARDS: D* = DISCARDS – (DFR / DISCARDS). Risk under this category was then considered to be inversely proportional to D*. When presenting the productivity-susceptibility plots the corrected PROPORTION RETAINED (i.e. R* = 100 – D*) is used, in order to maintain the general pattern of the plots: bottom left corner = low risk; top-right corner = high risk.

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[4] This is the same approach used to estimate total mortality in ST IP-1, whereby the proportion A3+D is assumed not to survive the encounter.

Finally, two different composite indices for *susceptibility* S were calculated.

S1 = 1/3 × [(LENGTH AT CAPTURE / **MAXIMUM LENGTH**) + CONDITION AT CAPTURE + PROPORTION RETAINED]

S2 = 1/3 × [(LENGTH AT CAPTURE **/ LENGTH AT MATURITY**) + CONDITION AT CAPTURE + PROPORTION RETAINED]

The results were rescaled to fall between 0 and 1 and the PROPORTION RETAINED includes the proportion of shark discards from which fins were removed as discussed above.

2.3. Productivity

Productivity was calculated using data obtained from the literature on maximum size, size-at-maturity; maximum age, age-at-maturity, and reproductive strategy. The size metrics considered were all length-based rather than weight-based. Weight is proportional to volume and therefore tends to increase with $length^3$, so length was considered the more sensitive metric. It is also easiest to measure and most often available, allowing published lengths to be compared with those measured by observers.

There are various ways to measure length, e.g. total length, fork length, wing diameter for rays, curved/straight carapace length for turtles. It was not possible to standardise all the length measurements used to populate the databases available. However, when length ratios were calculated, care was taken to ensure that the measures used were comparable.

Length measures are not so appropriate for seabirds and so age data were obtained (Cleo Small *pers. comm.*). However, comparable age data were not available for many other species and so they were not used in the derivation of composite indices for productivity. This did not preclude the analysis of seabirds in the PSA but they are only considered in the plots of CONDITION AT CAPTURE versus REPRODUCTIVE STRATEGY.

REPRODUCTIVE STRATEGY was considered categorically:

- 1: Broadcast spawners
- 2: Egg layers
- 3: Live bearers

These categories 1–3 represent decreasing productivity and therefore increasing risk.

Fecundity data (i.e. the number of offpring generated per year) for live-bearing sharks was also obtained from the primary literature (Cortes 2000) in order to illustrate how some sharks are more/less productive than others and thus at less/more risk respectively.

For the final PSA plots (Figures 6 and 7) a composite index for *productivity* P was calculated as:

P = (REPRODUCTIVE STRATEGY/3) + (LENGTH AT MATURITY / MAXIMUM LENGTH)

2.4. Number of species for which data were available

The full list of target and non-target associated species comprised 236 species and 79 species groups. Information on life-history and fisheries characteristics determining productivity and susceptibility for these was obtained to the extent listed below:

Productivity

Maximum length (L_{MAX})	214 species
Maximum age (A_{MAX})	82 species
Length at maturity (L_{MAT})	106 species
Age at maturity (A_{MAT})	92 species
Reproductive strategy	All species and species groups
Composite index P	54 species

Susceptibility

Length at capture (L_{CAP})	LL	151 species	50 species groups
L_{CAP} / L_{MAX}	LL	142 species	-
CONDITION	LL	165 species	51 species groups
FATE	LL	187 species	61 species groups
	PS	73 species	29 species groups
Composite index S1	LL	119 species	
Composite index S2	LL	75 species	

3. RESULTS

Figures 1 provides a simple PSA based on only two characteristics: CONDITION AT CAPTURE and MAXIMUM LENGTH. There is no obvious relation between the two variables but none was expected. The results are nonetheless revealing, particularly as it is possible to include a large number of species, but conclusions are better drawn from the plots using the composite indices (Figures 6 and 7).

Figure 2 illustrates the life stage (juvenile/mature) at which the longline fishery impacts the species concerned. From this it is apparent, for example, that the turtles encountered are mostly juvenile, as are many of the sharks, while the target species and other teleosts are largely mature.

Figure 3 illustrates the fact that most seabirds are dead at the time of capture, while most turtles and sharks are not (note that the sample sizes for the highest risk species in this plot – CNX: whitenose shark and RHN: whale shark – are very small). Figure 4 illustrates the fact that birds and turtles are not subsequently retained (note that the sample size for MAH: northern giant petrel, is only 3 individuals for longline and 148 individuals for purse seine). The highest risk group identified in this analysis for longline and in the results for purse seine (Figure 5) are the sharks. While some of these are rarely encountered (e.g. GTF: guitarfishes; 9 observed caught on longline; 0 observed caught on purse seine) others are frequently encountered (e.g. BSH: blue shark; 270 423 observed caught on longline. FAL: silky shark; 32 591 observed caught on longline and 42 497 observed caught by purse seine). Table 2 lists the sharks ranked according to their fecundity; while it would be reasonable to conclude that blue shark is still a relatively low risk as it is one of the most fecund of shark species, silky shark by contrast is one of the least fecund species and therefore at relatively high risk.

The resulting patterns from the two formulations used to develop composite indices for susceptibility (Figures 6 and 7) are quite similar. The species comprising the group with the highest apparent risk (BLR; TRB; CNX; AML; CCP; LMD; HDQ; CCL) is actually rarely encountered, with the exception of AML: grey reef shark, and CCL: blacktip shark , both of which are Annex 1 highly migratory species (see Table 1). There is another group of 16 shark species that also has high apparent risk. Of these, FAL: silky shark, SMA: short-finned mako, POR: porbeagle, and OCS: oceanic whitetip, are the most observed caught (Table 1) yet they have fecundity less than 15 (Table 2), so they are not especially productive, compared to hammerhead sharks (fecundity > 30) and blue shark (fecundity > 60). This puts them at much greater risk than other shark species.

For the teleosts, the most at-risk species are the tunas and billfish plus wahoo and mahi mahi, reflecting the fact that they are target species; their risk scores are therefore due mostly to high susceptibility rather than low productivity. However, stock assessments may still reveal these species to be at risk from overfishing (see SA WP-1 and SA WP-2).

4. DISCUSSION AND CONCLUSIONS

No species were excluded *a priori* from this analysis, even if they are rarely encountered. This is because part of the point of the exercise is to consider the *inherent* risk to species due to their life-history characteristics in the absence of full information concerning fishing mortality. Even where catch estimates are obtained (see ST IP-1) there is still no information as to the relative importance of that mortality in the population dynamics of the species concerned. Nonethless, those catch estimates as well as a cursory glance at Table 1 detailing the numbers of individuals observed caught will provide some indication of the confidence one can have in properties calculated from fisheries data and some measure of the extent of fleet-wide fisheries interactions.

The results on CONDITION AT CAPTURE for birds (Figure 3) are unsurprising and demonstrate that effective conservation measures must prevent capture in the first place. For turtles, effective conservation measures can be also directed at treatment post-capture as the survival of these live but probably distressed and fatigued animals may depend on the crew dehooking the turtle without damaging it, and then allowing it to recuperate.

The average proportion landed alive for all shark categories in longline fisheries is 64%. The average whole-body retention rate for all shark categories is 43% of observed catch. The rest is discarded, but a large proportion of these sharks have had their fins removed: of the total shark discards in the longline fisheries, the average proportion that have had their fins removed and trunk discarded is 50%; for purse seine fisheries this rises to 70%. Thus the average proportion discarded alive is 31% for longline and 39% for purse seine. Conservation measures that prohibited the removal of fins from sharks should therefore be effective, assuming the same whole-body retention rate, as the average proportion discarded alive might be expected to rise to the same figure that is landed alive.

Future PSAs should try to derive life-history characteristics for the species groups, where this is appropriate, in order to be able to include more of the observed catch data in the PSAs. However, many species groups are comprised of species that can have quite different life history characteristics (e.g. BIZ, SHK, TUN, TTX) and therefore productivity and susceptibility. The extent to which observed catches are identified to species level has a big influence on the extent to which PSAs may be carried out and the confidence that may be placed in the results. Improving observer coverage and the ability of observers to identify catch to species level is therefore paramount in order to improve the quality of scientific information and advice concerning non-target associated and dependent species. This is particularly true for purse seine fisheries, where LENGTH and CONDITION AT CAPTURE data are also rarely recorded, thus precluding productivity-susceptibility analysis except in terms of PROPORTION RETAINED (PURSE SEINE) versus REPRODUCTIVE STRATEGY (Figure 7).

The extent of vertical and horizontal habitat overlap with fishing effort (e.g. Figure 8) would be an important factor to include in a composite index of susceptibility in future PSAs. Although the information necessary in order to do this with any precision is not likely to exist for all species of interest, it should still be possible to develop an index of spatial vulnerability in both vertical and horizontal dimensions.

There are certainly cases where the available data were poor quality to the point of being misleading. A precautionary approach was always adopted and data that was obviously wrong was not used. However, where the best information available was plausible it was not excluded. In the aftermath of this exercise it is anticipated that a new set of data quality conditions will be added to the observer databases and also that anyone with access to more up-to-date data and information, particularly on life-history characteristics, will make that available to public resource databases such as *Fishbase*. It is also anticipated that the SC will encourage further research into the fundamental biological characteristics of the more poorly understood target and non-target associated species, based on their risk ranking.

References and bibliography

For this exercise, data on life-history characteristics were obtained from Cortes (2000) for sharks, Hoelzel (2002) for marine mammals, and from the *Fishbase*[5] database for the teleosts. The Status of New Zealand Fisheries website (http://services.fish.govt.nz/indicators/) also proved to be a useful resource. A full list of primary sources is not provided here.

Cortes E (2000) Life history patterns and correlations in sharks. Reviews in Fisheries Science 8: 299–344

Hoelzel AR (2002) Marine Mammal Biology. An evolutionary approach. Blackwell Publishing, Oxford, 432 pp

The following papers from SC2 are referred to in this paper:

ST IP-1 Oceanic Fisheries Programme. Estimates of annual catches in the WCPFC Statistical Area. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia

SA WP-1 Hampton, J., Langley, A., Kleiber, P. Stock assessment of yellowfin tuna in the western and central Pacific Ocean, including an analysis of management options. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. NOAA Fisheries, Honolulu, Hawaii

SA WP-2 Hampton, J., A. Langley, A., and P. Kleiber. Stock assessment of bigeye tuna in the western and central Pacific Ocean, including an analysis of management options. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. NOAA Fisheries, Honolulu, Hawaii

EB WP-14 Hobday, A. J., A. Smith, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, T. Walker. Ecological risk assessment for the effects of fishing: methodology. CSIRO, Pelagic Fisheries and Ecosystems

[5] Froese, R. and D. Pauly. Editors. 2006.FishBase. www.fishbase.org version (06/2006)

Figure legends

Figure 1. PSA plot for CONDITION AT CAPTURE versus MAXIMUM LENGTH. This plot is not designed to portray any relationship between the two variables but to highlight those species that have low productivity, denoted in this case by relatively high MAXIMUM LENGTH, and which are unlikely to survive capture, denoted by CONDITION AT CAPTURE. Those species considered to be at relatively low risk are found at the bottom left of the plot and those considered to be at high risk are found at the top right.

Figure 2. LENGTH AT CAPTURE versus MAXIMUM LENGTH. Those species that fall above the 1:1 line are mature when captured and therefore considered at relatively higher risk than those that fall below the line, which are caught when juvenile. This conclusion assumes that fishing mortality is a smaller component of total mortality for younger, smaller individuals than for those that are larger and older.

Figure 3. PSA plot for CONDITION AT CAPTURE versus REPRODUCTIVE STRATEGY. Those species considered to be at relatively low risk are found at the bottom left of the plot and those considered to be at high risk are found at the top right.

Figure 4. PSA plot for PROPORTION RETAINED (LONGLINE) versus REPRODUCTIVE STRATEGY. In this case PROPORTION RETAINED has been corrected to include the proportion of discards from which fins had been removed. Those species considered to be at relatively low risk are found at the bottom left of the plot and those considered to be at high risk are found at the top right.

Figure 5. PSA plot for PROPORTION RETAINED (PURSE SEINE) versus REPRODUCTIVE STRATEGY. In this case PROPORTION RETAINED has been corrected to include the proportion of discards from which fins were removed. Those species considered to be at relatively low risk are found at the bottom left of the plot and those considered to be at high risk are found at the top right.

Figure 6. PSA plot using composite indices for *productivity* and *susceptibility*. In this case *susceptibility* S is calculated as: S = 1/3 × [(**LENGTH AT CAPTURE / MAXIMUM LENGTH**) + CONDITION AT CAPTURE + PROPORTION RETAINED] and *productivity* P is calculated as P = (REPRODUCTIVE STRATEGY/3) + LENGTH AT MATURITY / MAXIMUM LENGTH. The results were rescaled to fall between 0 and 1. The PROPORTION RETAINED has been corrected to include the proportion of discards from which fins were removed.

Figure 7. PSA plot using composite indices for *productivity* and *susceptibility*. In this case *susceptibility* S is calculated as: S = 1/3 × [(**LENGTH AT CAPTURE / LENGTH AT MATURITY**) + CONDITION AT CAPTURE + PROPORTION RETAINED] and *productivity* P is calculated as P = (REPRODUCTIVE STRATEGY/3) + LENGTH AT MATURITY / MAXIMUM LENGTH. The results were rescaled to fall between 0 and 1. The PROPORTION RETAINED has been corrected to include the proportion of discards from which fins were removed.

Figure 8. Spatial distribution of longline fishing effort, observer effort, observed bird encounters and observed turtle encounters

Figure 1

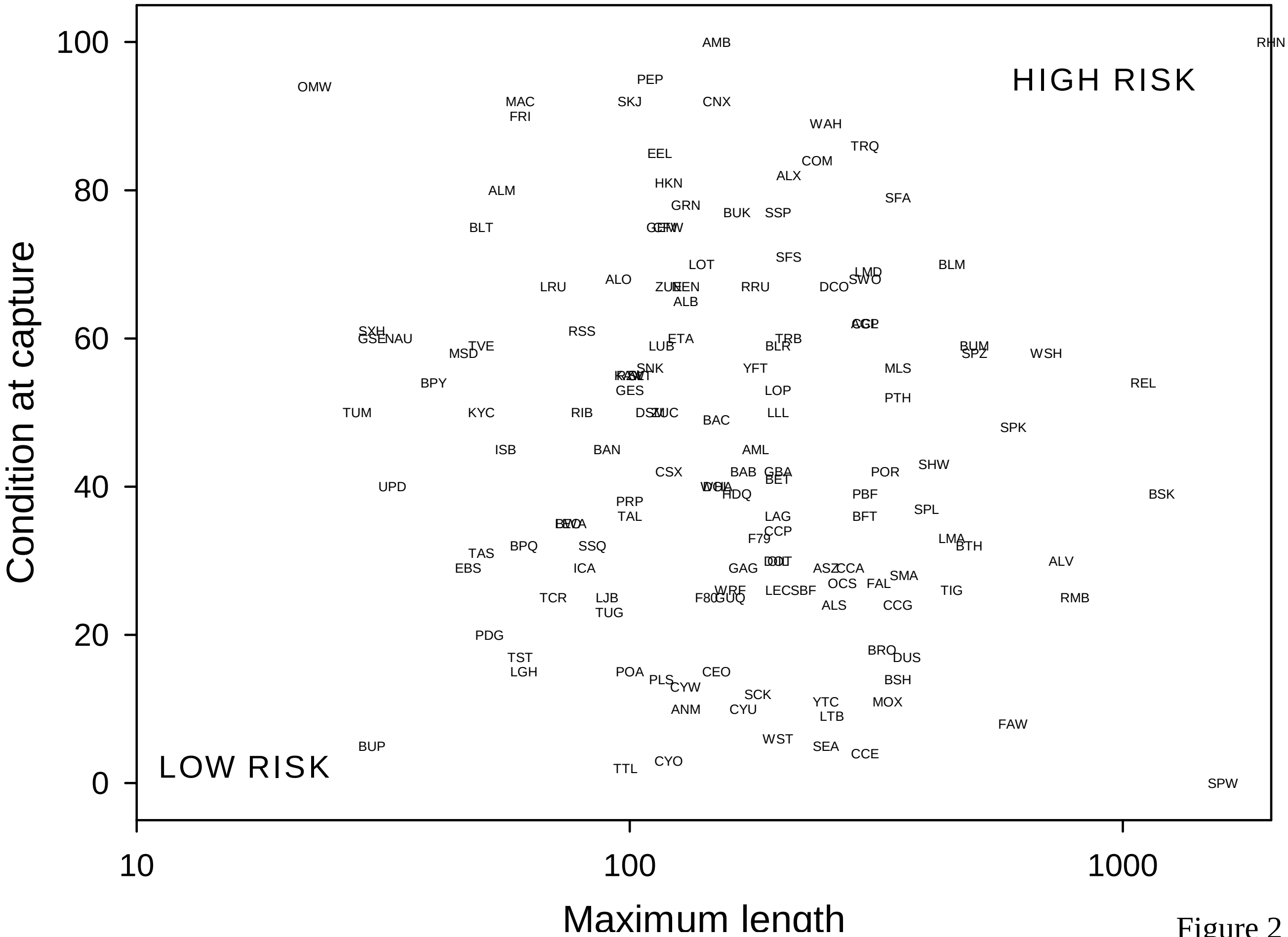


Figure 2

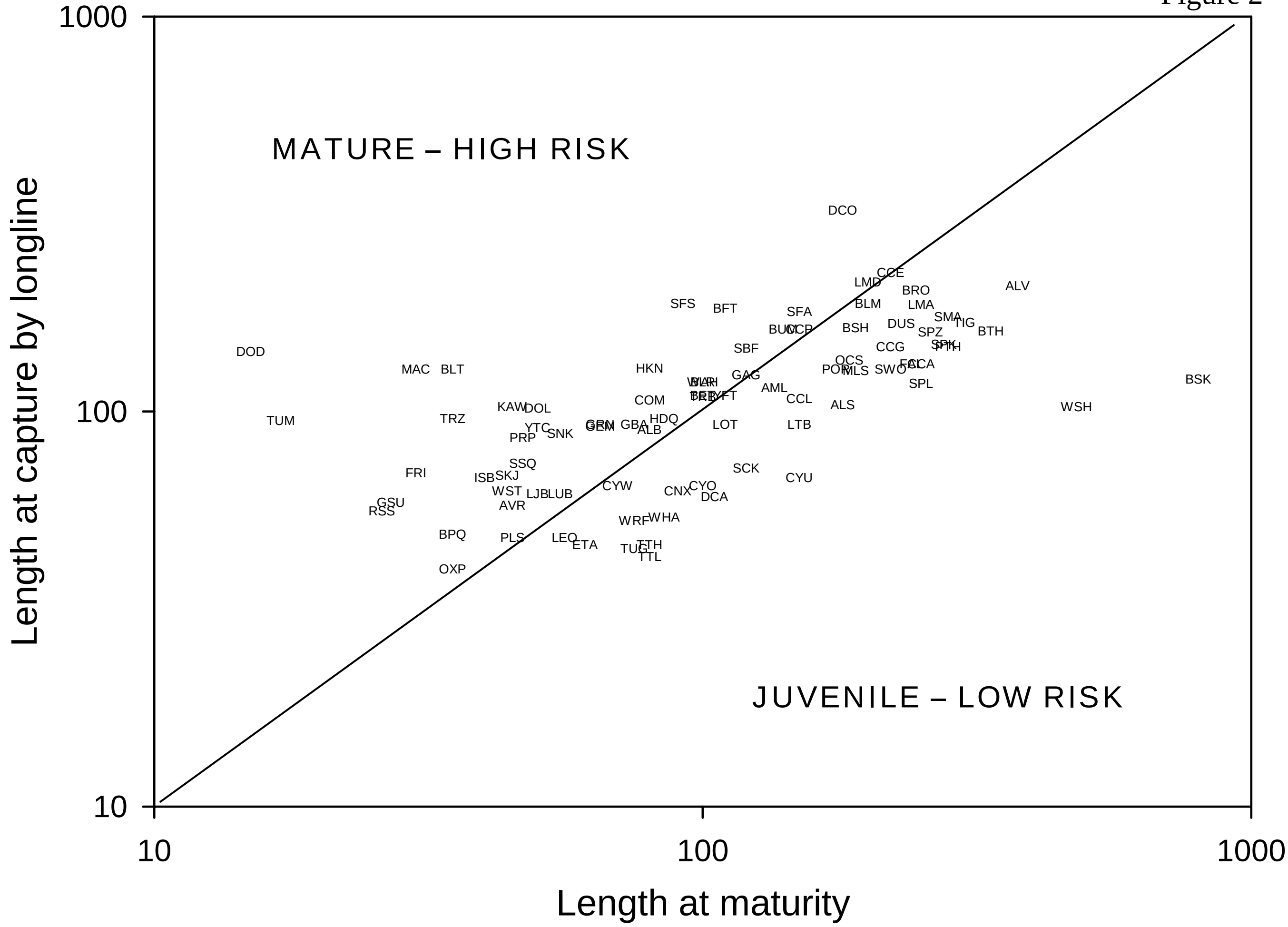
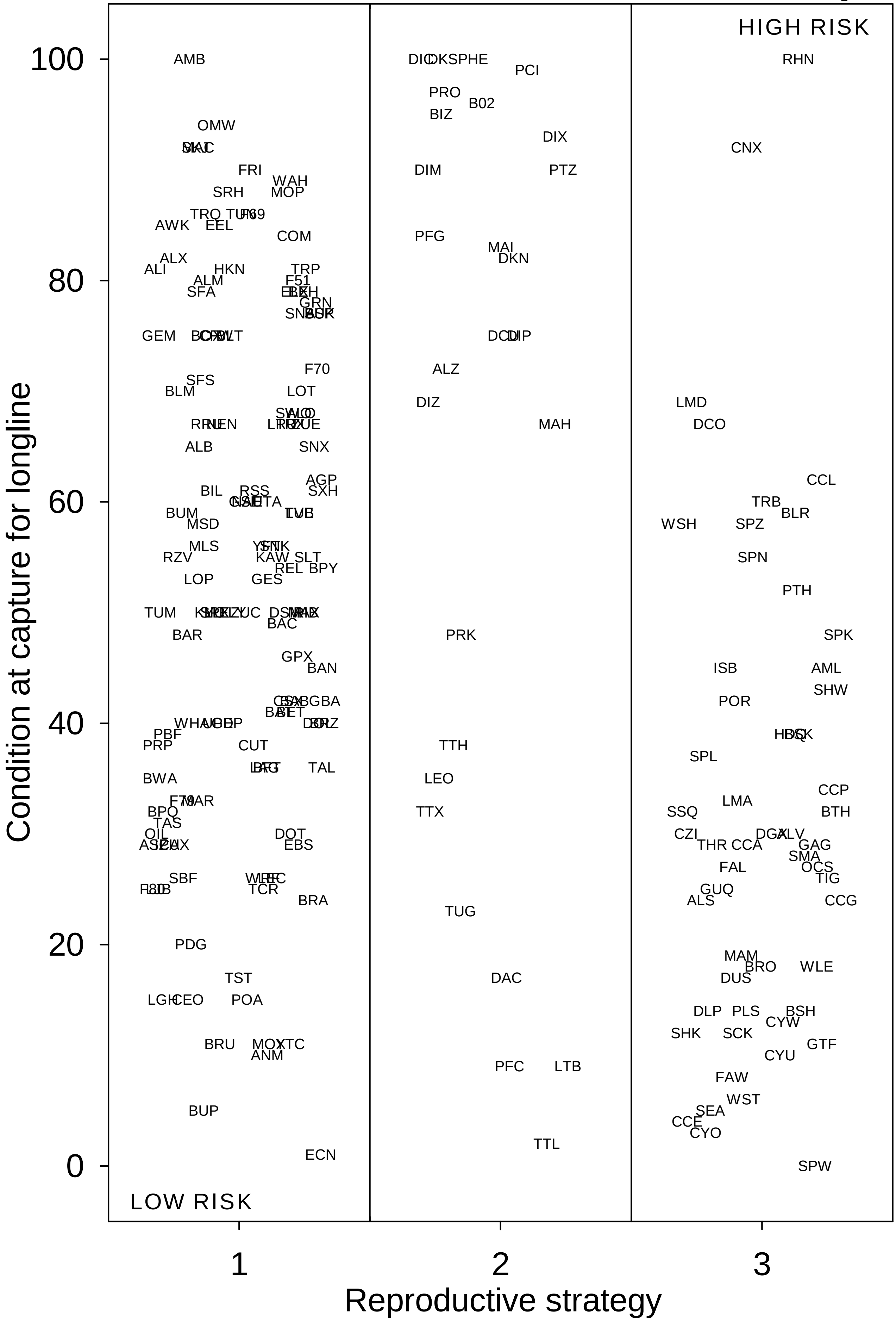


Figure 3


HIGH RISK
LOW RISK
Condition at capture for longline
Reproductive strategy
100
80
60
40
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0
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2
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AMB
OMW
FRI
WAH
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MOP
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TRP
ALM
F51
SFA
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GEM
F70
SFS
BLM
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ALB
SNX
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Figure 4

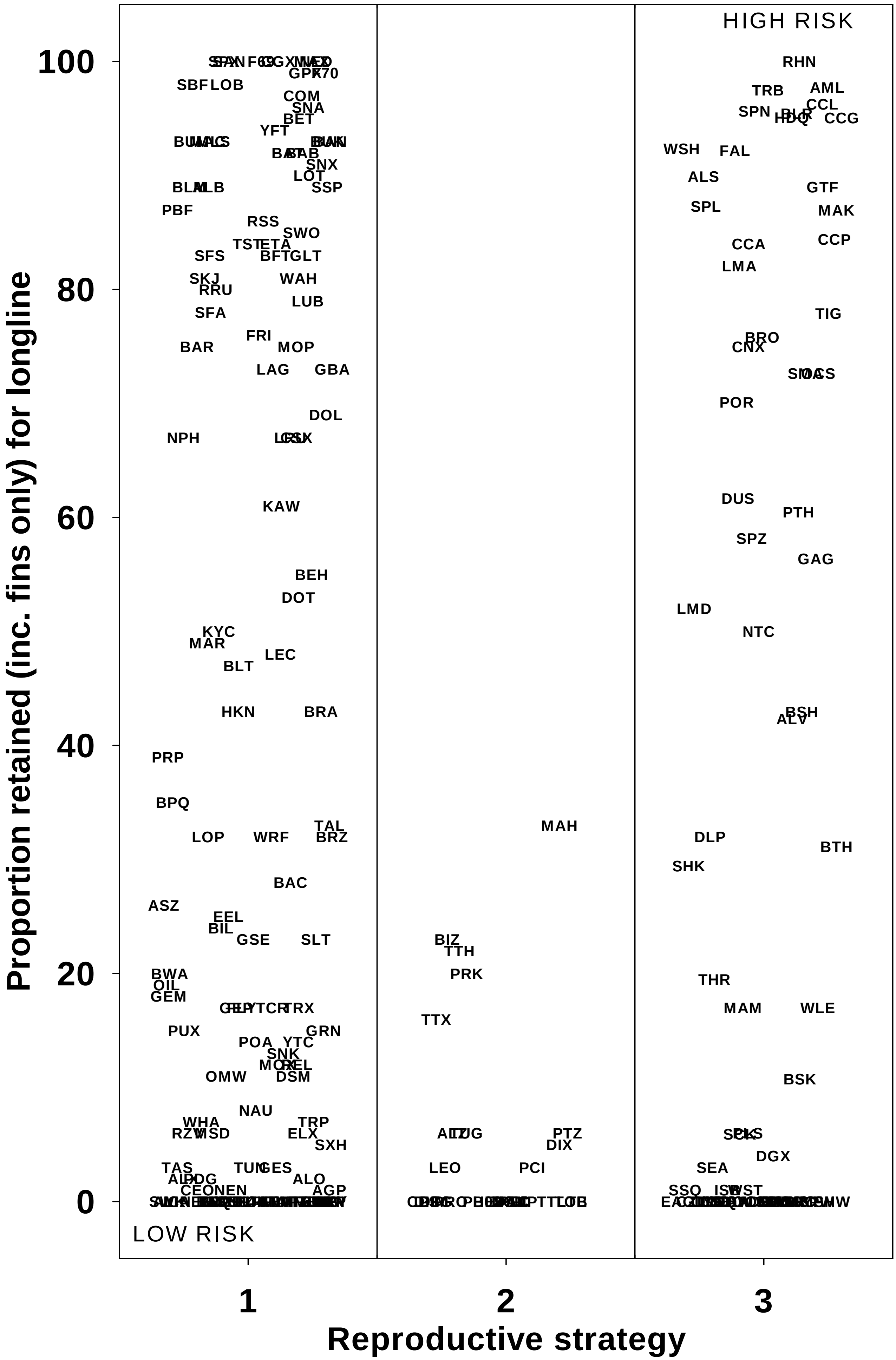
HIGH RISK
LOW RISK
Proportion retained (inc. fins only) for longline
Reproductive strategy
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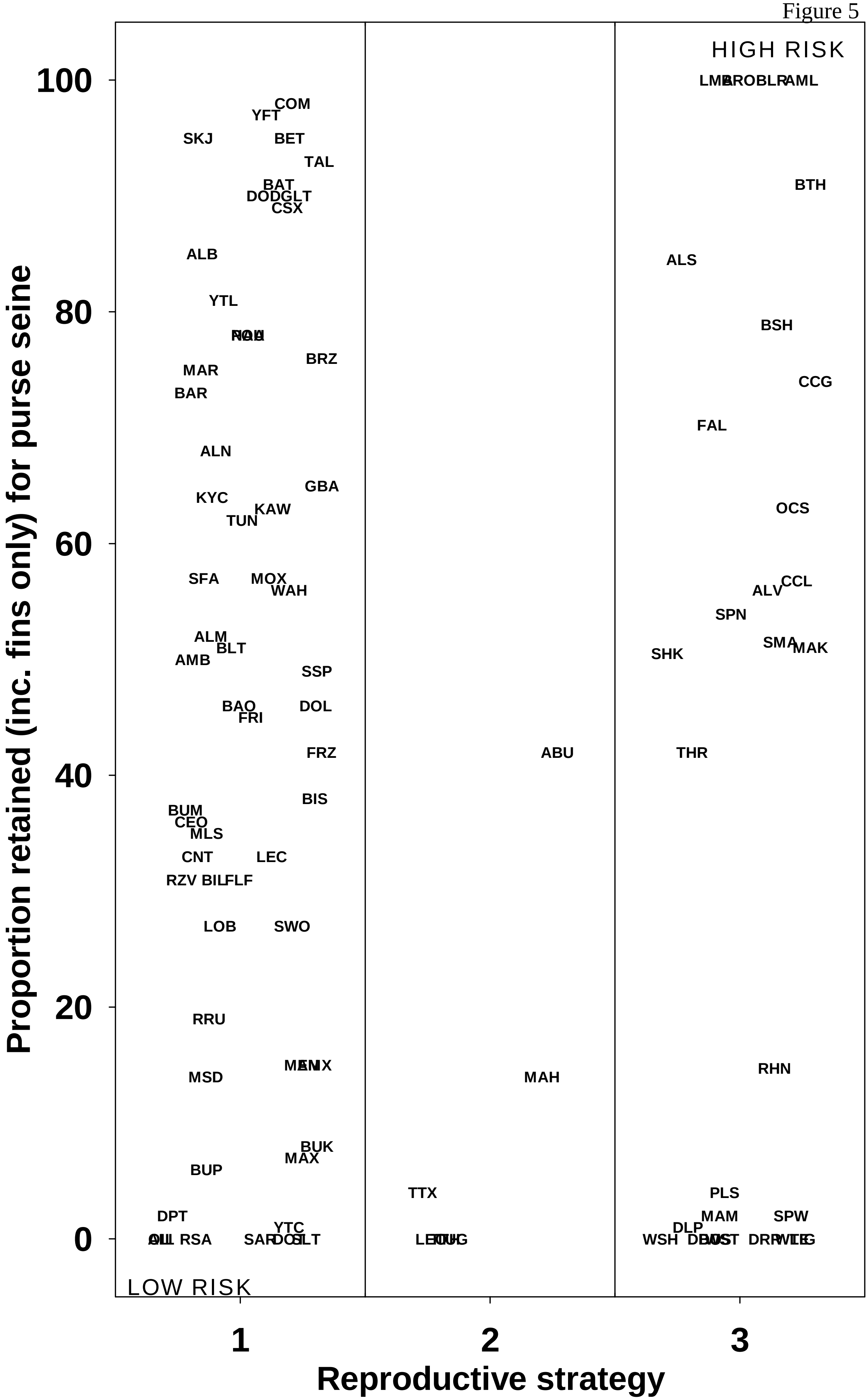
Figure 5


HIGH RISK
LOW RISK
Proportion retained (inc. fins only) for purse seine
Reproductive strategy
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OCS
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ALV
SPN
SHK
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PLS
MAM
SPW
DLP
WSH
DRR

Figure 6

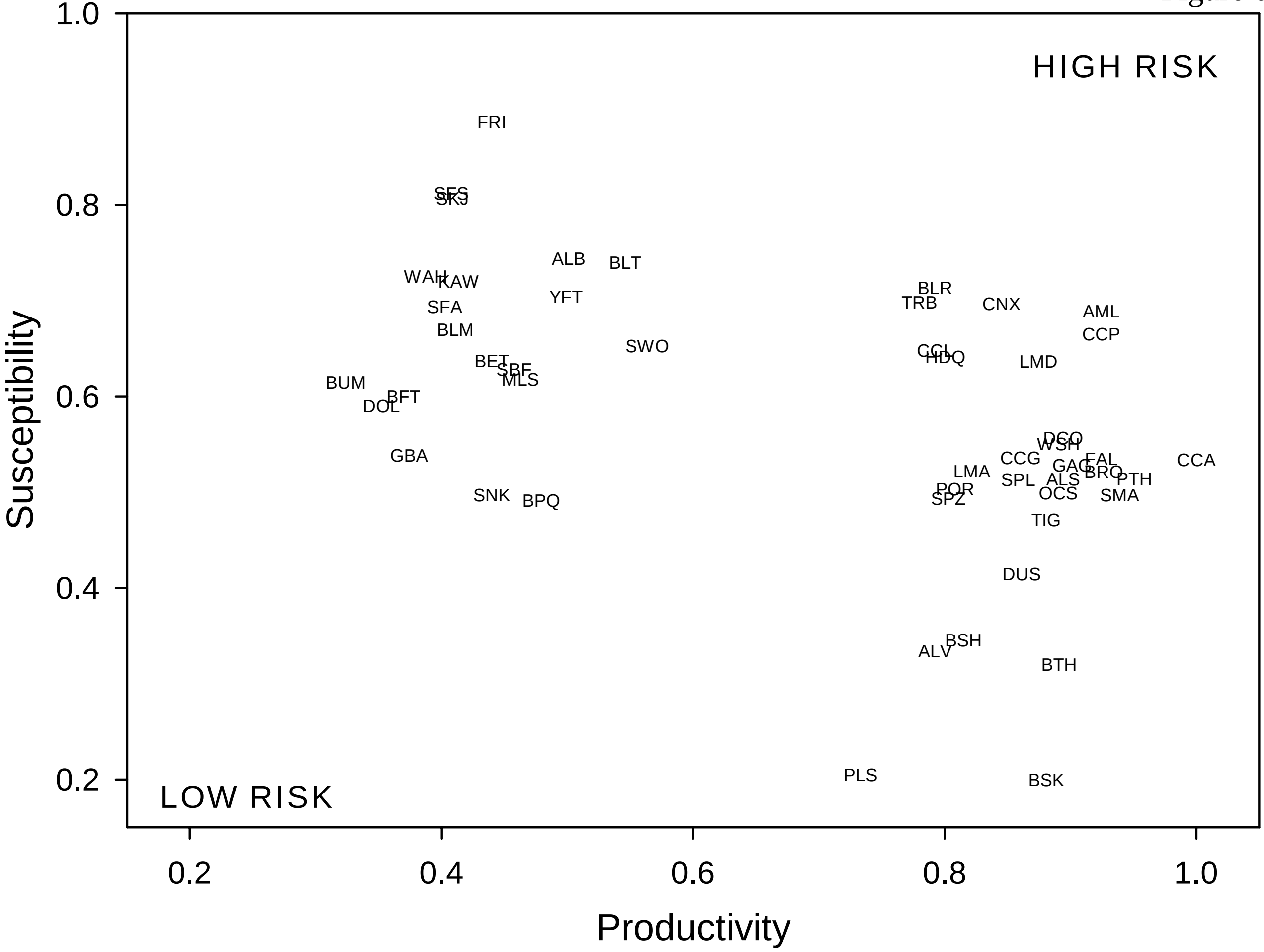

Figure 7

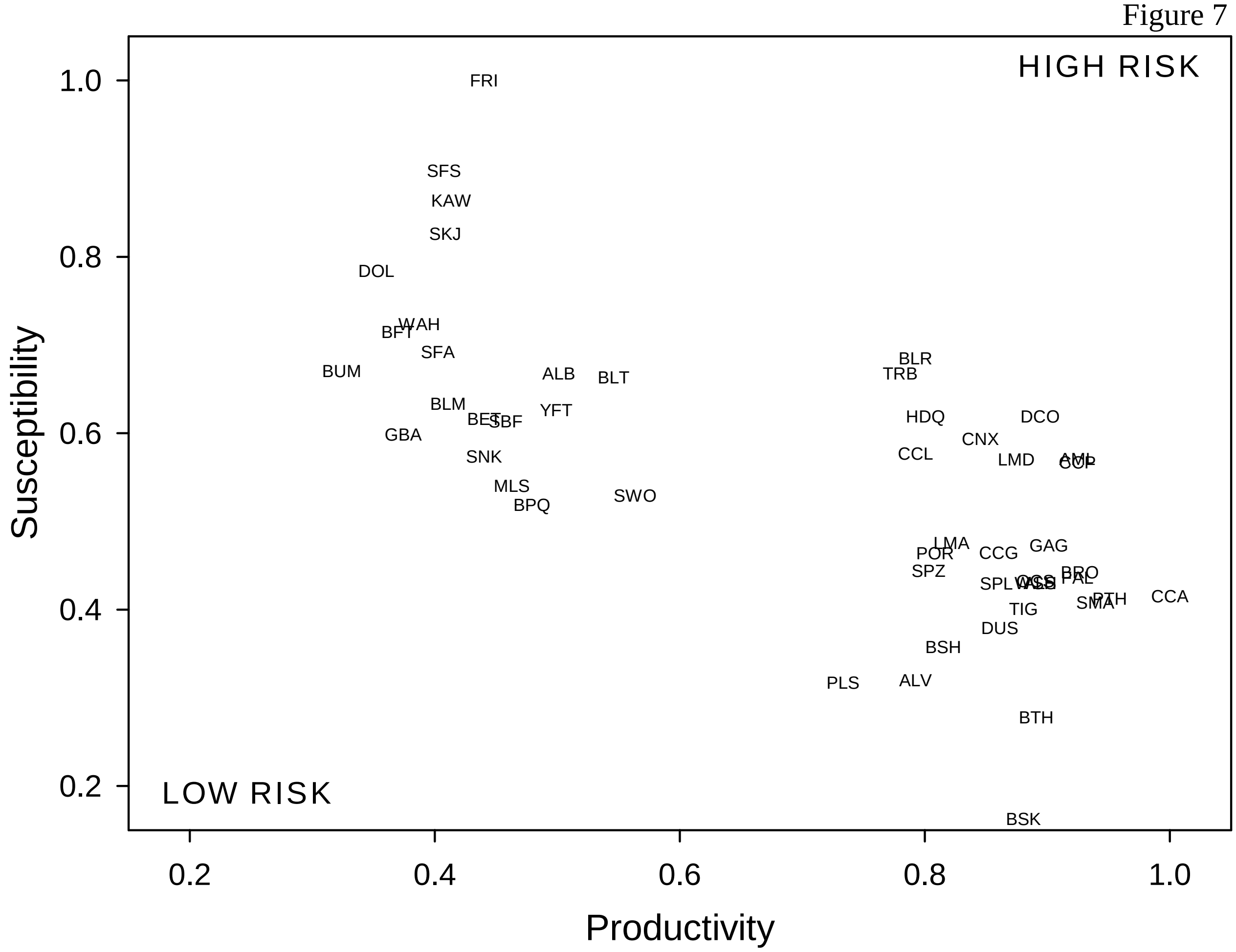

Figure 8

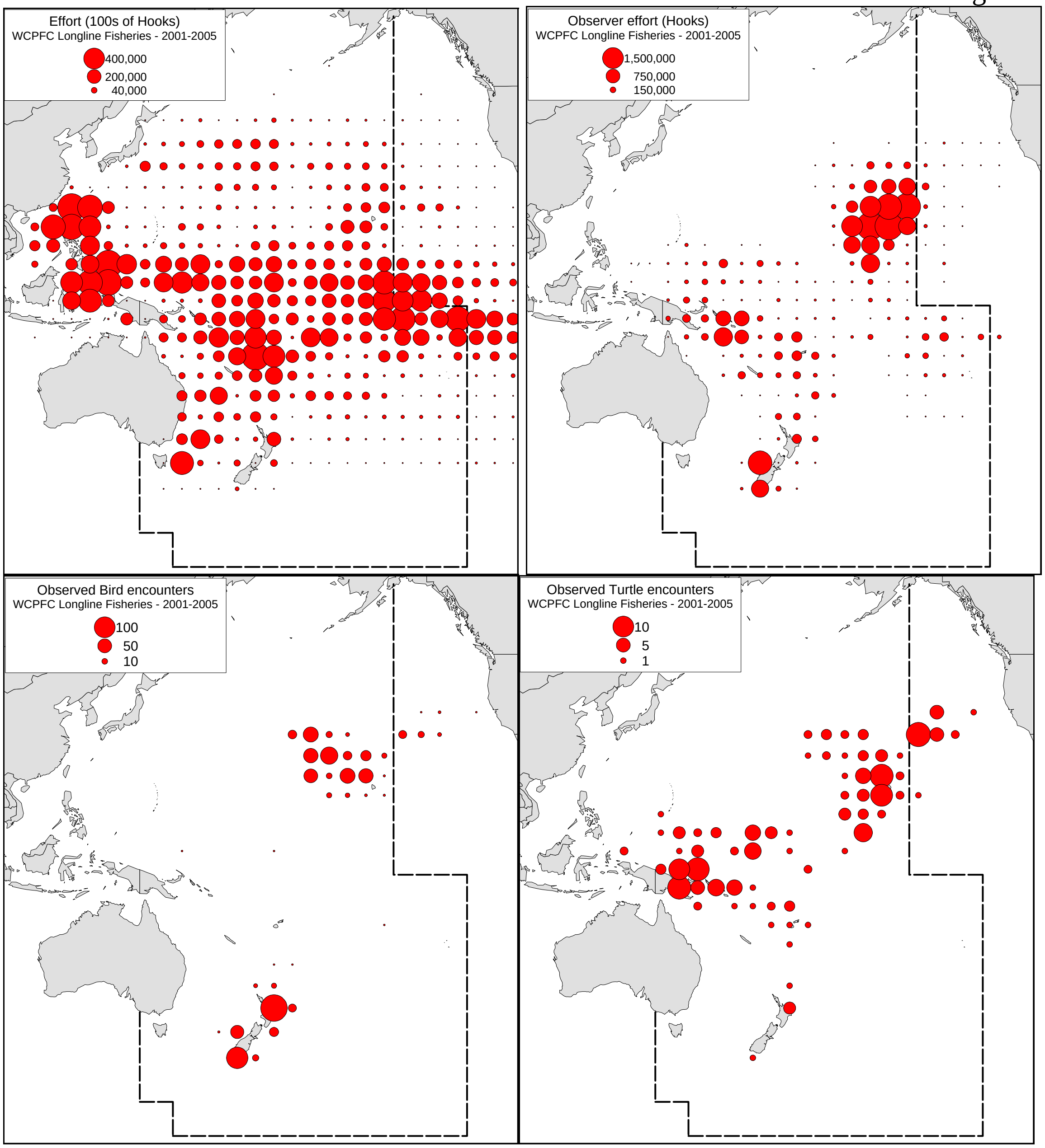
Effort (100s of Hooks)
WCPFC Longline Fisheries - 2001-2005
400,000
200,000
40,000
Observer effort (Hooks)
WCPFC Longline Fisheries - 2001-2005
1,500,000
750,000
150,000
Observed Bird encounters
WCPFC Longline Fisheries - 2001-2005
100
50
10
Observed Turtle encounters
WCPFC Longline Fisheries - 2001-2005
10
5
1

Table legend

Table 1.

Latin name	latin name for species/family
Species code	FAO code
HMS	Y if listed as a highly migratory species under UNCLOS Annex 1
IUCN	If classified under IUCN red list scheme (see below)
LL	Number of individuals observed caught on longline
PS	Number of individuals observed caught on purse seine
LL len	Average length of longline caught individuals
LL con	Average condition (%Dead + dying) of longline caught individuals
LL: D/(D+R)	Proportion of longline caught individuals discarded
LL: %DFR	Proportion of discards that have had fins removed
LL: D*	Corrected proportion discarded (considers finned fish as retained)
LL: R*	Corrected proportion retained (100 - D*)
PS: D/(D+R)	Proportion of purse seine caught individuals discarded
PS: %DFR	Proportion of discards that have had fins removed
PS: D*	Corrected proportion discarded (considers finned fish as retained)
PS: R*	Corrected proportion retained (100 - D*)
Lmat	length at maturity (cm)
Linf	L infinity (cm)
Lmax	Maximum length (sm)
Amat	Age at maturity (yrs)
Amax	Maximum age (yrs)
RS	Reproductive strategy 1: broadcast spawners; 2: egg layers; 3: live bearers

Table 2.

Fec	Fecundity: number of pups per year

Code	species	Latin name	HMS	IUCN	LL	PS	LL len	LL con	LL: D/(D+R)	LL: %DFR	LL: D*	LL: R*	PS: D/(D+R)	PS: %DFR	PS: D*	PS: R*	Lmat	Linf	Lmax	Amat	Amax	RS
ABU	SARGENT MAJOR	*Abudefduf saxatilis*				1156							58		58	42			23			2
AGP	RIBBON FISH	*Agrostichthys parkeri*			167		70	62	99		99	1							300			1
ALB	ALBACORE	*Thunnus alalunga*	Y	DD	296309	25175	90	65	11		11	89	15		15	85	80	140	130	5	20	1
ALI	LANCETFISHES	Alepisaurus spp.			17596	1	105	81	100		100	0	100		100	0						1
ALJ	PORCUPINE FISH	*Allomycterus jaculiferus*			1	55													30			1
ALM	FILEFISH (UNICORN LEATHERJACKET)	*Aluterus monoceros*			6	5160	97	80					48		48	52			55			1
ALN	FILEFISH (SCRIBBLED LEATHERJACKET)	*Aluterus scriptus*			5	1500	36		100		100	0	32		32	68			110			1
ALO	SHORTSNOUTED LANCETFISH	*Alepisaurus brevirostris*			3422	1	80	68	98		98	2							95			1
ALS	SILVERTIP SHARK	*Carcharhinus albimarginatus*	Y		1317	426	104	24	24	58	10	90	31	50	16	85	180		260			3
ALV	THRESHER	*Alopias vulpinus*	Y		1670	13	208	30	62	7	58	42	44		44	56	375	650	750	7	20	3
ALX	LONGSNOUTED LANCETFISH	*Alepisaurus ferox*			106114	1	108	82	98		98	2							210			1
ALZ	ALBATROSS	Diomedea spp			699			72	94		94	6										2
AMB	GREATER AMBERJACK	*Seriola dumerili*			3	96		100					50		50	50	100	150	150	4		1
AML	GREY REEF SHARK	*Carcharhinus amblyrhynchos*	Y	LR/nt	2489	17	115	45	15	85	2	98	100	100	0	100	135	190	180	7	18	3
AMX	AMBERJACKS	Seriola spp				10977							85		85	15						1
ANM	SLENDER SNIPE EEL	*Nemichthys scolopaceus*			10			10	100		100	0						100	130			1
ASZ	RAZORBACK SCABBARDFISH	*Assurger anzac*			89		220	29	74		74	26							250			1
AVR	GREEN JOBFISH	*Aprion virescens*			1		58										45	66	112	5		1
AWK	SAWTOOTH EELS NEI	Serrivomer spp			7		150	85														1
B02	CAMPBELL IS BLACK-BROWED MOLLYMAWK	*Diomedea melanophrys impavida*			52			96	100		100	0								10		2
BAB	BLACKFIN BARRACUDA	*Sphyraena genie*			135		93	42	8		8	92							170			1
BAC	BARRACUDA (S. JELLO)	*Sphyraena jello*			343	3	93	49	72		72	28						148	150			1
BAI	RAYS, SKATES AND MANTAS	Batoidimorpha (Hypotrmata)			204	37	47	15	96		96	4	89		89	11						
BAN	BARRACUDA (S. PUTNAMIAE)	*Sphyraena putnamiae*			194	21	89	45	7		7	93						70	90			1
BAO	LONGFIN BATFISH	*Platax teira*				192							54		54	46			45			1
BAR	BARRACUDAS (UNIDENTIFIED)	Sphyraena spp.			3603	8275	88	48	25		25	75	27		27	73						1
BAT	BATFISHES	Platax spp			19	7749	88	41	8		8	92	9		9	91						1
BBW	BEAKED WHALE, BLAINVILLE'S	*Mesoplodon densirostris*		DD	1														470			3
BEH	SCABBARD FISH, FROSTFISH	Benthodesmus spp			20		219	79	45		45	55										1
BET	BIGEYE	*Thunnus obesus*	Y	VU	194225	9571778	110	41	5		5	95	5		5	95	100	180	200	4	10	1
BFT	ATLANTIC BLUEFIN TUNA	*Thunnus thynnus*	Y	DD	26	2	183	36	17		17	83					110		300	4		1
BIL	MARLINS, SAILFISHES, SPEARFISHES (UNIDENTIFIED)	Istophoridae, Xiphiidae	Y		607	34	149	61	76		76	24	69		69	31						1
BIS	BIGEYE SCAD	*Selar crumenophthalmus*			8	2	37		100		100	0	62		62	38			70			1
BIZ	BIRD (UNIDENTIFIED)				1542	1		95	77		77	23										2
BLM	BLACK MARLIN	*Makaira indica*	Y		2055	1931	188	70	11		11	89					200		450	5	20	1
BLR	BLACKTIP REEF SHARK	*Carcharhinus melanopterus*	Y	LR/nt	587	1	119	59	35	87	5	95	100	100	0	100	100		200			3
BLT	BULLET TUNA	*Auxis rochei*	Y		9	117087	50	75	53		53	47	49		49	51	35	45	50	2		1
BOX	SCABBARD FISH	*Aphanopus spp*			13		90	75	100		100	0										1
BPQ	PACIFIC POMFRET	*Brama japonica*	Y		363		49	32	65		65	35					35	65	61	4	9	1
BPY	PRICKLY FANFISH	*Pterycombus petersii*	Y		57		34	54	100		100	0							40			1
BRA	BRAMID SPECIES	Brama spp	Y		476	6	34	24	57		57	43										1
BRO	BRONZE WHALER SHARK	*Carcharhinus brachyurus*	Y	NT	293	1	203	18	39	38	24	76	100	100	0	100	245	385	325	19	30	3
BRU	SOUTHERN RAYS BREAM	*Brama australis*	Y		102		63	11	80													1
BRZ	POMFRETS AND OCEAN BREAMS	Bramidae	Y		1749	4648	58	40	68		68	32	24		24	76						1
BSH	BLUE SHARK	*Prionace glauca*	Y	LR/nt	270423	152	163	14	92	38	57	43	96	78	21	79	190	300	350	8	23	3
BSK	BASKING SHARK	*Cetorhinus maximus*	Y	VU	148		121	39	92	3	89	11					800	1000	1200	18	45	3
BTF	BATFISH	*Halieutaea maoria*				6													30			1
BTH	BIGEYE THRESHER	*Alopias superciliosus*	Y		6820	7	160	32	85	19	69	31	100	91	9	91	335	422	488	12	20	3
BUK	BUTTERFLY TUNA / KINGFISH	*Gasterochisma melampus*			5660	30	136	77	7		7	93	92		92	8			165			1
BUM	BLUE MARLIN	*Makaira nigricans*	Y		11461	2700	162	59	7		7	93	63		63	37	140	650	500	4	28	1
BUP	PACIFIC RUDDERFISH	*Psenopsis anomala*			22	1104		5	100		100	0	94		94	6	15	28	30			1
BWA	BLUENOSE (BLUENOSE WAREHOU)	*Hyperoglyphe antarctica*			16			35	80		80	20					40	60	76	4	15	1
CAX	SEA CATFISHES	Arridae			19		62	16	11		11	89										

Code	species	Latin name	HMS	IUCN	LL	PS	LL len	LL con	LL: D/(D+R)	LL: %DFR	LL: D*	LL: R*	PS: D/(D+R)	PS: %DFR	PS: D*	PS: R*	Lmat	Linf	Lmax	Amat	Amax	RS
CCA	BIGNOSE SHARK	*Carcharhinus altimus*	Y		31		132	29	100	84	16	84					250		280			3
CCE	BULL SHARK	*Carcharhinus leucas*	Y	LR/nt	25		225	4									220	325	300	15	25	3
CCG	GALAPAGOS SHARK	*Carcharhinus galapagensis*	Y	NT	738	7	146	24	15	67	5	95	100	74	26	74	220	230	350	7	15	3
CCL	BLACKTIP SHARK	*Carcharhinus limbatus*	Y	LR/nt	1754	250	108	62	22	83	4	96	90	52	43	57	150	200	300	7	12	3
CCP	SANDBAR SHARK	*Carcharhinus plumbeus*	Y	LR/nt	272	1	162	34	52	70	16	84					150	190	200	15	23	3
CEO	RUDDERFISH	*Centrolophus niger*			3823	31	86	15	99		99	1	64		64	36			150			1
CFW	POMPANO DOLPHINFISH	*Coryphaena equiselis*	Y		8			75									22	60	120		4	1
CGX	CARANGIDAE (TREVALLIES)	Carangidae			3	9	107		0		0	100										1
CNT	OCEAN TRIGGERFISH (SPOTTED)	*Canthidermis maculatus*				92660							67		67	33			50			1
CNX	WHITENOSE SHARK	*Nasolamia velox*	Y		12		63	92	25		25	75					90		150			3
COM	SPANISH MACKEREL (NARROW-BARRED)	*Scomberomorus commerson*			39	98	107	84	3		3	97	2		2	98	80	155	240		22	1
CPS	CARPET SHARK	*Cephaloscyllium isabellum*		LC	2				100		100	0							100			2
CSX	BIGEYE TREVALLY	*Caranx sexfasciatus*			19	5540	129	42	33		33	67	11		11	89		80	120			1
CUP	DRIFTFISH (MAN-O-WAR)	*Cubiceps spp*			1				100		100	0										1
CUT	HAIRTAILS, CUTLASSFISHES	Trichiuridae			8		99	38	100		100	0										1
CWN	MANEFISHES NEI	Caristius spp			1																	1
CYO	CENTROSCYMNUS COELOLEPIS	*Centroscymnus coelolepis*		NT	76		65	3	100		100	0					100		120			3
CYP	CENTROSCYMNUS CREPIDATER	*Centroscymnus crepidater*		LC	4				100		100	0					80		130			3
CYU	PLUNKETS SHARK	*Scymnodon plunketi*			41		68	10	100		100	0					150		170			3
CYW	SMOOTH SKIN DOGFISH	*Centroscymnus owstoni*		LC	3554		65	13	100		100	0					70		130			3
CZI	DEEPWATER DOGFISH	Centroscymnus spp			1036		83	30	100		100	0										3
DAC	CAPE PIGEON	*Daption capense*			8			17	100		100	0										2
DBO	BOTTLENOSE DOLPHIN	*Tursiops truncatus*	Y	DD	4	72			100		100	0	100		100	0			260	8		3
DCA	SHOVELNOSE DOGFISH	*Deania calcea*		LC	1		61		100		100	0					105	120	122	25	35	3
DCO	COMMON DOLPHIN	*Delphinus delphis*	Y	LR/lc	3	74	324	67	100		100	0					180		260	6	20	3
DCU	NEW ZEALAND WHITE CAPPED MOLLYMAWK	*Diomedea cauta*		NT	41			75	100		100	0								6		2
DDU	DUSKY DOLPHIN	*Lagenorhynchus obscurus*	Y	DD	2		91						50						210	6		3
DGA	DIOGENICHTHYS ATLANTICUS	*Diogenichthys atlanticus*			1												2		2			1
DGX	DOG FISHES	Squalidae			180	10	69	30	96		96	4										3
DIC	GREY HEADED ALBATROSS	*Diomedea chrysostoma*		VU	14			100	100		100	0								12		2
DIM	BLACK-BROWED MOLLYMAWK	*Diomedea melanophris*		EN	26			90	100		100	0								10		2
DIO	PORCUPINE FISHES (FAMILY)	Diodontidae			1	5																1
DIP	SOUTHERN ROYAL ALBATROSS	*Diomedea epomophora*		VU	12			75	100		100	0								8		2
DIX	WANDERING ALBATROSS	*Diomedea exulans*		VU	130			93	95		95	5								11	70	2
DIY	PORCUPINE FISH	*Dioden hystrix*																	91			1
DIZ	LAYSAN ALBATROSS	*Diomedea immutabilis*		VU	584			69												9	50	2
DKN	BLACK-FOOTED ALBATROSS	*Diomedea nigripes*			776			82														2
DKS	SALVIN'S ALBATROSS	*Diomedea salvini*			9			100														2
DLP	DOLPHINS / PORPOISES (UNIDENTIFIED)	Delphinidae	Y		7	59		14	68		68	32	99		99	1						3
DOD	GIZZARD SHAD (KONOSHIRO)	*Clupanodon punctatus*			1	16	142						10		10	90	15	27	32		5	1
DOL	MAHI MAHI / DOLPHINFISH / DORADO	*Coryphaena hippurus*	Y		82018	87369	102	40	31		31	69	54		54	46	50	170	150	1	4	1
DOT	DOGTOOTH TUNA	*Gymnosarda unicolor*			65	1	129	30	47		47	53	100		100	0			200			1
DPN	DOLPHIN, SPOTTED	*Stenella attenuata*	Y	LR/cd	1														260	12		3
DPT	DECAPTURUS SP. - MUROAJI	Decapturus spp.				8838							98		98	2						1
DRR	RISSO'S DOLPHIN	*Grampus griseus*	Y	DD	7	11			100		100	0	100		100	0			400			3
DSI	SPINNER DOLPHIN	*Stenella longirostris*	Y	LR/cd	2	4			100		100	0							235	6		3
DSM	DEALFISH (DESMODEMA POLYSTICTUM)	*Desmodema polystictum*			31		147	50	89		89	11							110			1
DSP	SPOTTED DOLPHINS	Stenella spp.	Y	LR/cd	1	1	188															3
DUS	DUSKY SHARK	*Carcharhinus obscurus*	Y	LR/nt	515		167	17	54	29	38	62	100		100	0	230	350	365	18	35	3
EAG	EAGLE RAY	*Myliobatis tenuicaudatus*		LC	8				100		100	0							150			3
EBS	BRILLIANT POMFRET	*Eumegistus illustris*	Y		51		52	29											47			1
ECN	SUCKERFISH - REMORAS	Echeneidae			9230			1	100		100	0										1
EEL	YELLOWEDGE GROUPER	*Epinephelus flavolimbatu*			12		140	85	75		75	25						96	115		35	1
ELX	EEL	Nemichthyidae			51		126	79	94		94	6										1
ETA	DEEPWATER RED SNAPPER	*Etelis carbunculus*			7		46	60	16		16	84					61	120	127			1
F44	CRAB				4		3		100		100	0										1
F51	LYCONUS SP.	Lyconus sp.			23			80	100		100	0										1
F69	COD (UNIDENTIFIED)				108		59	86	0		0	100										1
F70	EMPORER (UNIDENTIFIED)				290		52	72	1		1	99										1

Code	species	Latin name	HMS	IUCN	LL	PS	LL len	LL con	LL: D/(D+R)	LL: %DFR	LL: D*	LL: R*	PS: D/(D+R)	PS: %DFR	PS: D*	PS: R*	Lmat	Linf	Lmax	Amat	Amax	RS
F79	KING-OF-SALMON	*Trachipterus altivelis*			3			33											183			1
F80	TAPERTAIL RIBBONFISH	*Trachipterus fukuzakii*			4			25											143			1
F82	PLATYBERYX SP.	Platyberyx sp.			1																	1
F83	SPRATS	*Sprattus antipodum, S. mueller*			1																	1
F84	SMALL SCALED BROWN SLICKHEAD	*Alepocephalus australis*			3		31		100		100	0							60			1
F85	LARGE HEADED SLICKHEAD	Rouleina sp.			1																	1
FAL	SILKY SHARK	*Carcharhinus falciformis*	Y	LR/lc	32591	42497	132	27	20	61	8	92	96	69	30	70	240	315	320	10	23	3
FAW	FALSE KILLER WHALE	*Pseudorca crassidens*		LR/lc	18	11		8	100		100	0							600			3
FLF	FILEFISHES	Cantherines(=Navodon)spp			1	13079	79		100		100	0	69		69	31						1
FLY	FLYING FISHES	Exocoetidae			12	7		50	83		83	17										1
FRI	FRIGATE TUNA	*Auxis thazard*	Y		21	453007	70	90	24		24	76	55		55	45	30	50	60		5	1
FRZ	FRIGATE AND BULLET TUNAS	*Auxis thazard, A. rochei*	Y			6867							58		58	42						1
GAG	SCHOOL SHARK	*Galeorhinus galeus*		VU	2921		124	29	49	11	44	56					120	165	170	15	50	3
GBA	GREAT BARRACUDA	*Sphyraena barracuda*			5378	1810	93	42	27		27	73	35		35	65	75	180	200	4		1
GEM	GEMFISH (SOUTHERN OR SILVER KINGFISH)	*Rexea solandri*			203	1	92	75	82		82	18					65		116	5	16	1
GEP	SNAKE MACKERELS AND ESCOLARS	Gempylidae			538		120	40	83		83	17										1
GES	SNAKE MACKEREL	*Gempylus serpens*			30248		93	53	97		97	3							100			1
GLT	GOLDEN TREVALLY	*Gnathanodon speciosus*			6	792	80		17		17	83	10		10	90		104	110			1
GPX	GROUPER (UNIDENTIFIED)	Epinephelus spp			74		80	46	1		1	99										1
GRN	BLUE GRENADIER / HOKI	*Macruronus novaezelandiae*			1591		93	78	85		85	15					65	103	130		25	1
GSE	SOAPFISH	*Grammistes sexlineatus*			7		23	60	77		77	23							30			1
GSU	SNAPPER	*Pagrus auratus*			1		59										27	65	70		11	1
GTF	GUITARFISHES, ETC. NEI	Rhinobatidae			9		173	11	11		11	89										3
GUQ	CENTROPHORUS SQUAMOSUS	*Centrophorus squamosus*		VU	4			25	100		100	0					130	145	160			3
HDQ	BULLHEAD SHARKS	Heterodontiformes		LR/LC/NT	121		96	39	14	65	5	95					85	165		12		3
HFD	PELAGIC BUTTERFISH	*Schedophilus maculatus*			3		72		100		100	0							30			1
HIC	SEAHORSE	Hippocampus spp		DD/VU	1				100		100	0										3
HKN	HAKE	*Merluccius australis*			22		129	81	57		57	43					80	115	120	8	30	1
HXT	SHARPSNOUTED SEVENGILL SHARK	*Heptranchias perlo*		NT	1				100		100	0					100		140			3
ICA	RAGFISH	*Icichthys australis*			7			29	100		100	0							81			1
ISB	COOKIE CUTTER SHARK	*Isistius brasiliensis*			117		68	45	99		99	1					40		56			3
KAW	KAWAKAWA	*Euthynnus affinis*	Y		25	46242	103	55	39		39	61	37		37	63	45	85	100	3		1
KIW	KILLER WHALE	*Orcinus orca*	Y	LR/cd	1	14													975	15		3
KPW	PYGMY KILLER WHALE	*Feresa attenuata*		DD		1													260			3
KYC	DRUMMER (BLUE CHUB)	*Kyphosus cinerascens*			2	27350	57	50	50		50	50	36		36	64		48	50			1
LAG	OPAH (MOONFISH)	*Lampris guttatus*			22699	2	97	36	27		27	73							200			1
LEC	ESCOLAR	*Lepidocybium flavobrunneum*			29006	5	91	26	52		52	48	67		67	33			200			1
LEO	OLIVE RIDLEY TURTLE	*Lepidochelys olivacea*		EN	129	13	48	35	97		97	3	100		100	0	56		75	12	60	2
LFZ	SILVER-CHEEKED TOADFISH	*Lagocephalus sceleratus*			1														110			1
LGH	PELAGIC PUFFER	*Lagocephalus lagocephalus*			120			15											61			1
LHX	SEAGULLS NEI	Larus spp			1																	2
LJB	TWO-SPOT RED SNAPPER	*Lutjanus bohar*			8		62	25									50	82	90		13	1
LLL	CRESTFISH	*Lophotus lacepede*			275		120	50											200			1
LMA	LONG FINNED MAKO	*Isurus paucus*	Y	VU	777	28	187	33	69	74	18	82	100	100	0	100	250		450			3
LMD	SALMON SHARK	*Lamna ditropis*		DD	98	40	213	69	96	50	48	52					200		305			3
LOB	TRIPLE-TAIL	*Lobotes surinamensis*			4	2851	196		2		2	98	73		73	27			110	1	3	1
LOP	CRESTFISH/UNICORNFISH	*Lophotus capellei*			156		118	53	68		68	32							200			1
LOT	LONGTAIL TUNA	*Thunnus tonggol*			10		93	70	10		10	90					110		140			1
LRU	SHARPTOOTH JOBFISH	*Pristipomoides typus*			6			67	33		33	67					28	52	70		11	1
LTB	LEATHERBACK TURTLE	*Dermochelys coriacea*		CR	76	3	93	9	100		100	0					150		257	9	30	2
LUB	EMPORER RED SNAPPER	*Lutjanus Sebae*			231		62	59	21		21	79					55	85	116		35	1
MAC	ATLANTIC MACKEREL	*Scomber scombrus*			14		60	92	7		7	93					30	41	60	3	17	1
MAH	NORTHERN GIANT PETREL	*Macronectes halli*			3	148	101	67	67		67	33	86		86	14				10		2
MAI	SOUTHERN GIANT PETREL	*Macronectes giganteus*		VU	6			83	100		100	0								10		2
MAK	MAKO SHARKS	Isurus spp.	Y	LR/NT/VU	3081	418	161		15	13	13	87	96	49	49	51						3
MAM	MARINE MAMMAL (UNIDENTIFIED)	Mammalia			16	1133	143	19	83		83	17	98		98	2						3
MAN	MANTA RAYS (UNIDENTIFIED)	Mobulidae			382	1706	62	13	96		96	4	95		95	5						
MAP	BARRACUDINA	*Magnisudis prionosa*			8				100		100	0							55			1
MAR	MARLIN				52	7	154	33	51		51	49	25		25	75						1

Code	species	Latin name	HMS	IUCN	LL	PS	LL len	LL con	LL: D/(D+R)	LL: %DFR	LL: D*	LL: R*	PS: D/(D+R)	PS: %DFR	PS: D*	PS: R*	Lmat	Linf	Lmax	Amat	Amax	RS
MAS	SLIMY MACKEREL	*Scomber japonicus*			1	24											35	42	60	2	13	1
MAX	MACKEREL (UNIDENTIFIED)	Scombridae			5	181832		50	0		0	100	93		93	7						1
MEN	BLACK TRIGGERFISH	*Melichthys niger*			3	41340	52		100		100	0	85		85	15			50			1
MEW	MELON-HEADED WHALE	*Peponocephala electra*		LR/lc	1														250			3
MIL	MILKFISH	*Chanos chanos*				12											80		180	6	15	1
MLS	STRIPED MARLIN	*Tetrapturus audax*	Y		26349	962	127	56	7		7	93	65		65	35	190	300	350	3	10	1
MOP	SUNFISH	Mola spp			8		52	88	25		25	75										1
MOX	OCEAN SUNFISH	*Mola mola*			3520	457	89	11	88		88	12	43		43	57		336	333			1
MSD	MACKEREL SCAD / SABA	*Decapturus macarellus*			4	746247	34	58	94		94	6	86		86	14			46			1
NAD	FLATBACK TURTLE	*Natator depressus*		DD	1		27												100	30	100	2
NAU	PILOT FISH	*Naucrates ductor*			10	378	32	60	92		92	8	22		22	78		29	34			1
NEB	BLUE COD	*Parapercis colias*			2				100		100	0					15	25	45	2	17	1
NED	NEEDLEFISHES	Tylosurus spp			4				0		0	100										1
NEN	BLACK GEMFISH	*Nesiarchus nasutus*			314		94	67	99		99	1							130			1
NMW	DRIFT FISHES NEI	Nomeus spp			1		86															1
NPH	JAPANESE SPANISH MACKEREL = SAWARA	*Scomberomorus niphonius*			3		130		33		33	67						100	100			1
NSL	HOOKERS SEA LION	*Phocarctos hookeri*		VU	1														325	5	23	3
NTC	BROADSNOUTED SEVENGILL SHARK	*Notorynchus cepedianus*		DD	3				100	50	50	50					200		290	16	32	3
OCS	OCEANIC WHITETIP SHARK	*Carcharhinus longimanus*	Y	VU	12060	6894	135	27	57	52	27	73	90	59	37	63	185	285	270	5	22	3
OCZ	OCTOPUS	*Octopus maorum*			2			50	100		100	0										
ODH	BIGEYE SAND SHARK	*Odontaspis noronhai*			1				100		100	0							360			3
ODN	TOOTHED WHALES NEI (BLACKFISH)	Odontoceti			2	27																3
OIL	OILFISH	*Ruvettus pretiosus*			16209	4	90	30	81		81	19	100		100	0			200			1
OMW	OMOSUDID	*Omosudis lowei*			42			94	89		89	11							23			1
OTH	OTHER FISH	Teleostii			275	616	116	29	40		40	60	25	42	15	86						
OXP	BUTTERFISH / GREENBONE	*Odax pullus*			1		40		100		100	0					35	52	40		11	1
PBF	PACIFIC BLUEFIN TUNA	*Thunnus orientalis*			271	10	113	39	13		13	87						300	300	4	16	1
PCI	GREY PETREL	*Procellaria cinerea*			131			99	97		97	3										2
PDG	FALSE FROSTFISH	*Paradiplospinus gracilis*			40		220	20	98		98	2							52			1
PDM	GREAT-WINGED PETREL	*Pterodroma macroptera*			1																	2
PEP	YELLOW-BELLIED SEA SNAKE	*Pelamis platurus*			25		140	95	96		96	4							110			
PFC	FLESH-FOOTED SHEARWATER	*Puffinus carneipes*			243			9	100		100	0								7		2
PFG	SOOTY SHEARWATER	*Puffinus griseus*			22			84	100		100	0								6		2
PHE	LIGHT-MANTLED SOOTY ALBATROSS	*Phoebetria palpebrata*		NT	38			100	100		100	0								12	40	2
PLS	PELAGIC STING-RAY	*Dasyatis violacea*			16412	174	48	14	94		94	6	96		96	4	45	116	116	3	9	3
PLZ	RIGHT-EYED FLOUNDERS	*Pleuronectidae*				2																1
POA	RAY'S BREAM / ATLANTIC POMFRET	*Brama brama*	Y		62844	433	46	15	86		86	14	22		22	78			100		9	1
POR	PORBEAGLE SHARK	*Lamna nasus*		VU	18560		128	42	83	64	30	70					175	280	330	14	26	3
PRK	BLACK PETREL	*Procellaria parkinsoni*		VU	23			48	80		80	20								8		2
PRO	WHITE-CHINNED PETREL	*Procellaria aequinoctialis*		VU	34			97	100		100	0								7		2
PRP	ROUDI ESCOLAR	*Promethichthys prometheus*			203		86	38	61		61	39					47	94	100	4	11	1
PSC	MAN-O-WAR FISH	*Psenes cyanophrys*				67													20			1
PTH	PELAGIC THRESHER	*Alopias pelagicus*	Y		1549		146	52	79	50	40	61					280	200	350	8	29	3
PTZ	PETRELS	Procellaria spp			212			90	94		94	6										2
PUA	PUFFERFISH	*Sphoeroides pachygaster*			3				100		100	0							40			1
PUX	PUFFERS (FAMILY)	Tetraodontidae			60			29	85		85	15										1
RAJ	SKATE	Rajidae			11				100		100	0										
REL	OARFISH	*Regalecus glesne*			18	1	118	54	88		88	12							1100			1
REM	REMORA SPECIES	Remora spp.			16735	7	75	25	99		99	1	100		100	0						
RHN	WHALE SHARK	*Rhincodon typus*	Y	VU	2	168		100	50	100	0	100	98	13	85	15	700	1400	2000	30	100	3
RIB	MORID COD (RIBALDO)	*Mora moro*			6		38	50	100		100	0							80			1

Code	species	Latin name	HMS	IUCN	LL	PS	LL len	LL con	LL: D/(D+R)	LL: %DFR	LL: D*	LL: R*	PS: D/(D+R)	PS: %DFR	PS: D*	PS: R*	Lmat	Linf	Lmax	Amat	Amax	RS
RMB	GIANT MANTA	*Manta birostris*		NT	4	3		25									450		800	6	20	
RMJ	MANTA RAY	*Mobula japanica*		NT	13	2	45		100		100	0							310			
RMT	CHILEAN DEVIL RAY	*Mobula tarapacana*		DD	85	2	38		100		100	0	100		100	0			300			
RMV	MOBULA (A.K.A. DEVIL RAY)	Mobula spp.			2																	
RRU	RAINBOW RUNNER	*Elagatis bipinnulata*			257	1415633	74	67	20		20	80	81		81	19		98	180			1
RSA	AMBERSTRIP SCAD	*Decapterus maruadsi*				50							100		100	0		27	25		9	1
RSS	GOLDLINED SEABREAM (SEA BREAM)	*Rhabdosargus sarba*			33		56	61	14		14	86					26		80			1
RXX	ESCOLAR (REXEA SPECIES)	Rexea spp			1		58															1
RZV	SLENDER SUNFISH	*Ranzania laevis*			1403	24	64	55	94		94	6	69		69	31			100			1
SAN	SAND LANCES NEI	*Ammodytes spp*			1		86		0		0	100										1
SAR	SAROTHERODON GALILAEUS	*Sarotherodon galilaeus*				188							100		100	0	23	30	41	2		1
SBF	SOUTHERN BLUEFIN TUNA	*Thunnus maccoyii*	Y	CR	76062	3	145	26	2		2	98					120	220	225	9	20	1
SCK	SEAL SHARK / BLACK SHARK	*Dalatias licha*		DD	66		72	12	97	3	94	6					120		182			3
SEA	NEW ZEALAND FUR SEAL	*Arctocephalus forsteri*			516		109	5	97		97	3							250	12		3
SEU	WHITE WAREHOU	*Seriolella caerulea*			1				100		100	0							65		12	1
SFA	SAILFISH (INDO-PACIFIC)	*Istiophorus platypterus*	Y		4215	1234	179	79	22		22	78	43		43	57	150	260	350		13	1
SFS	FROSTFISH (SILVER SCABBARDFISH)	*Lepidopus caudatus*			340		188	71	17		17	83					92	180	210		7	1
SHK	SHARKS (UNIDENTIFIED)	Elasmobranchii			4249	23479	145	12	83	15	71	29	99	50	50	51						3
SHL	BAXTERS LANTERN DOGFISH	*Etmopterus baxteri*		LC	1				100		100	0					65		75			3
SHW	SHORT-FINNED PILOT WHALE	*Globicephala macrorhynchus*	Y	LR/cd	9	3		43	100		100	0							415	20		3
SKJ	SKIPJACK	*Katsuwonus pelamis*	Y		44498	2.60E+08	69	92	19		19	81	5		5	95	44	84	100	1	3	1
SLT	SLENDER TUNA	*Allothunnus fallai*			270	1	86	55	77		77	23	100		100	0			105			1
SMA	SHORT FINNED MAKO	*Isurus oxyrhinchus*	Y	LR/nt	7913	634	174	28	48	43	27	73	99	51	49	51	280	320	360	20	28	3
SNA	SNAPPERS (LUTJANIDAE)	Lutjanus spp.			75		65	77	4		4	96										1
SNK	BARRACOUTA (SNOEK)	*Thyrsites atun*			762		88	56	87		87	13					55	91	110	3	10	1
SNX	SNAPPERS, JOBFISHES NEI	Lutjanidae			22	2	60	65	9		9	91										1
SPK	GREAT HAMMERHEAD	*Sphyrna mokarran*	Y	DD	65	1	148	48									275		600		25	3
SPL	SCALLOPED HAMMERHEAD	*Sphyrna lewini*	Y	LR/nt	300		118	37	31	59	13	87					250	330	400	15	35	3
SPN	HAMMERHEAD SHARKS	Sphyrna spp.	Y		1476	26	145	55	29	85	4	96	96	52	46	54						3
SPW	SPERM WHALE	*Physeter macrocephalus*		VU	2		254	0	100		100	0	98		98	2			1600	20		3
SPX	SALPS	Salpidae			2		64	50	0		0	100										1
SPZ	SMOOTH HAMMERHEAD	*Sphyrna zygaena*	Y	LR/nt	69		159	58	89	53	42	58					260		500			3
SQU	SQUIDS	Ommastrephidae, Loliginidae			1	153							25		25	75						
SRH	SILVER SPRAT / SILVER-STRIPPED ROUND HERRING	*Spratelloides gracilis*			8		54	88									4	8	6	0		1
SRX	RAYS, STINGRAYS, MANTAS NEI	Rajiformes			56	2	45	2	100		100	0										
SSP	SHORT-BILLED SPEARFISH	*Tetrapturus angustirostris*	Y		18918	138	134	77	11		11	89	51		51	49			200			1
SSQ	VELVET DOGFISH	Scymnodon squamulosus			618		74	32	99		99	1					47		84			3
STI	RAYS (TORPEDINIDAE, NARKIDAE)	*Torpedinidae narkidae dasyatid*			94	2	64	23	93		93	7	100		100	0						
STT	RAYS (DASYATIDIDAE)	Dasyatididae			159	9	41	13	99		99	1	87		87	13						
SWK	STOMIATIDAE	Stomias spp			1				100		100	0										1
SWO	SWORDFISH	*Xiphias gladius*	Y	DD	44362	153	128	68	15		15	85	73		73	27	220	240	300	9	20	1
SXH	BLACK MACKEREL	*Scombrolabrax heterolepis*			201		30	61	95		95	5							30			1
SXX	SEALS	Otariidae, phocidae			3	0	199		100		100	0										3
TAL	BIG-SCALED POMFRET	*Taractichthys longipinnis*	Y		3872	11	61	36	67		67	33	7		7	93			100			1
TAS	FLATHEAD POMFRET	*Taractes asper*	Y		290		42	31	97		97	3							50			1
TBA	SMALLSPOTTED DART	*Trachinotus baillonii*				4													60			1
TCR	DAGGER POMFRET	*Taractes rubescens*	Y		1116		61	25	83		83	17							70			1
THR	THRESHER SHARKS NEI	Alopias spp.	Y		1473	105	226	29	97	17	81	19	100	42	58	42						3
TIG	TIGER SHARK	*Galeocerdo cuvier*	Y	LR/nt	505	2	168	26	69	68	22	78	100		100	0	300	390	450	9	28	3
TOE	ELECTRIC RAY	*Torpedo fairchildi*		DD	13				100		100	0							100			2
TRB	WHITETIP REEF SHARK	*Triaenodon obesus*	Y	LR/nt	75		109	60	10	75	3	98					100		210	8	20	3
TRP	DEALFISH (TRACHIPTERUS SPP.)	Trachipterus spp.			195			81	93		93	7										1
TRQ	DEALFISH / RIBBON FISH	*Trachipterus trachypterus*			8426		164	86	100		100	0							300			1
TRX	DEALFISHES	*Trachypteroidei*			6		154	67	83		83	17										1
TRZ	TREVALLY	*Pseudocaranx dentex*			1		96										35		122		49	1
TSQ	ARROW SQUID (WELLINGTON FLYING SQUID)	*Nototodarus sloanii*			5			40	100		100	0										
TST	SICKLE POMFRET / MONCHONG	*Taractichthys steindachneri*	Y		44539	30	54	17	16		16	84							60		8	1

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TTH	HAWKSBILL TURTLE	*Eretmochelys imbricata*		CR	16	13	46	38	78		78	22	100		100	0	80			3		2
TTL	LOGGERHEAD TURTLE	*Caretta caretta*		EN	186	2	43	2	100		100	0					80		98	25	80	2
TTX	MARINE TURTLE (UNIDENTIFIED)	Testudinata			104	107	44	32	84		84	16	96		96	4						2
TUG	GREEN TURTLE	*Chelonia mydas*		EN	53	7	45	23	94		94	6	100		100	0	75		91	35	80	2
TUM	YELLOWTAIL SCAD	*Atule mate*			2	19899	95	50					0				17	30	28			1
TUN	TUNA (UNIDENTIFIED)	Thunnini			1992	832056	83	86	97		97	3	38		38	62						1
TUT	TUBBIA TASMANICA	*Tubbia tasmanica*			1				100		100	0							67			1
TVE	SPOTTED FANFISH	*Pteraclis velifera*	Y		27		49	59	100		100	0							50			1
UPD	SCALY STARGAZER	*Pleuroscopus pseudodorsalis*			5		29	40	100		100	0							33			1
USE	COTTONMOUTH JACK	*Uraspis secunda*			LL		27												50			1
UXA	BROWN STARGAZER	*Xenocephalus armatus*			1				100													1
WAH	WAHOO	*Acanthocybium solandri*			26404	17630	119	89	19		19	81	44		44	56	100	240	250	2	5	1
WHA	HAPUKU (HAPUKU WRECKFISH)	*Polyprion oxygeneios*			53		54	40	93		93	7					85	125	150	12	60	1
WLE	WHALE (UNIDENTIFIED)	Cetacea			17	8	277	18	83		83	17	100		100	0						3
WRF	BASS GROPER	*Polyprion americanus*		DD	50		53	26	68		68	32					75	120	160		70	1
WSH	GREAT WHITE SHARK	*Carcharodon carcharias*	Y	VU	125	2	103	58	51	85	8	92	100		100	0	480	650	700	12	35	3
WST	WHIP STINGRAY	*Dasyatis akajei*		NT	105	10	63	6	99		99	1	100		100	0	44	150	200			3
YFT	YELLOWFIN	*Thunnus albacares*	Y	LR/lc	160955	3.40E+07	110	56	6		6	94	3		3	97	110	150	180	3	8	1
YSA	WHITE TAIL DOGFISH	*Scymnodalatias albicauda*		DD	2				100		100	0							111			3
YSM	ROUGHSKIN DOGFISH	*Scymnodon macracanthus*			78														68			3
YTC	AMBERJACK / GIANT YELLOWTAIL	*Seriola lalandi*			148	2782	91	11	86		86	14	99		99	1	50		250	2		1
YTL	AMBERJACK (LONGFIN YELLOWTAIL)	*Seriola rivoliana*				19							19		19	81			64			1
ZUC	SCALLOPED RIBBONFISH	*Zu cristatus*			2			50											118			1
ZUE	DEALFISH (SCALLOPED)	*Zu elongatus*			3			67	100		100	0							120			1

Code	Species	Latin name	HMS	IUCN	LL	PS	LL con	LL: D/(D+R)	LL: %DFR	PS: D/(D+R)	PS: %DFR	Amat	Amax	Fec
RHN	WHALE SHARK	*Rhincodon typus*	Y	VU	2	168	100	50	100	98	13	30	100	300
NTC	BROADSNOUTED SEVENGILL SHARK	*Notorynchus cepedianus*		DD	3			100	50			16	32	85
BSH	BLUE SHARK	*Prionace glauca*	Y	LR/nt	270423	152	14	92	38	96	78	8	23	60
YSA	WHITE TAIL DOGFISH	*Scymnodalatias albicauda*		DD	2			100						59
TIG	TIGER SHARK	*Galeocerdo cuvier*	Y	LR/nt	505	2	26	69	68	100		9	28	55
CYU	PLUNKETS SHARK	*Scymnodon plunketi*			41		10	100						36
YSM	ROUGHSKIN DOGFISH	*Scymnodon macracanthus*			78									34
SPZ	SMOOTH HAMMERHEAD	*Sphyrna zygaena*	Y	LR/nt	69		58	89	53					33
SPL	SCALLOPED HAMMERHEAD	*Sphyrna lewini*	Y	LR/nt	300		37	31	59			15	35	26
SPN	HAMMERHEAD SHARKS	*Sphyrna spp.*	Y		1476	26	55	29	85	96	52			25
GAG	SCHOOL SHARK	*Galeorhinus galeus*		VU	2921		29	49	11			15	50	23
CYO	CENTROSCYMNUS COELOLEPIS	*Centroscymnus coelolepis*		NT	76		3	100						20
CYW	SMOOTH SKIN DOGFISH	*Centroscymnus owstoni*		LC	3554		13	100						20
BRO	BRONZE WHALER SHARK	*Carcharhinus brachyurus*	Y	NT	293	1	18	39	38	100	100	19	30	15
HXT	SHARPSNOUTED SEVENGILL SHARK	*Heptranchias perlo*		NT	1			100						15
SCK	SEAL SHARK / BLACK SHARK	*Dalatias licha*		DD	66		12	97	3					15
SMA	SHORT FINNED MAKO	*Isurus oxyrhinchus*	Y	LR/nt	7913	634	28	48	43	99	51	20	28	15
SPK	GREAT HAMMERHEAD	*Sphyrna mokarran*	Y	DD	65	1	48						25	15
HDQ	BULLHEAD SHARKS	*Heterodontiformes*		LR/LC/NT	121		39	14	65			12		13
SHL	BAXTERS LANTERN DOGFISH	*Etmopterus baxteri*		LC	1			100						12
CCE	BULL SHARK	*Carcharhinus leucas*	Y	LR/nt	25		4					15	25	10
DUS	DUSKY SHARK	*Carcharhinus obscurus*	Y	LR/nt	515		17	54	29	100		18	35	10
FAL	SILKY SHARK	*Carcharhinus falciformis*	Y	LR/lc	32591	42497	27	20	61	96	69	10	23	10
LMA	LONG FINNED MAKO	*Isurus paucus*	Y	VU	777	28	33	69	74	100	100			10
MAK	MAKO SHARKS	*Isurus spp.*	Y	LR/NT/VU	3081	418		15	13	96	49			10
OCS	OCEANIC WHITETIP SHARK	*Carcharhinus longimanus*	Y	VU	12060	6894	27	57	52	90	59	5	22	10
CCA	BIGNOSE SHARK	*Carcharhinus altimus*	Y		31		29	100	84					9
CCG	GALAPAGOS SHARK	*Carcharhinus galapagensis*	Y	NT	738	7	24	15	67	100	74	7	15	9
DCA	SHOVELNOSE DOGFISH	*Deania calcea*		LC	1			100				25	35	9
ISB	COOKIE CUTTER SHARK	*Isistius brasiliensis*			117		45	99						9
WSH	GREAT WHITE SHARK	*Carcharodon carcharias*	Y	VU	125	2	58	51	85	100		12	35	9
CCP	SANDBAR SHARK	*Carcharhinus plumbeus*	Y	LR/nt	272	1	34	52	70			15	23	8
BSK	BASKING SHARK	*Cetorhinus maximus*	Y	VU	148		39	92	3			18	45	6
CYP	CENTROSCYMNUS CREPIDATER	*Centroscymnus crepidater*		LC	4			100						6
GUQ	CENTROPHORUS SQUAMOSUS	*Centrophorus squamosus*		VU	4		25	100						6
ALS	SILVERTIP SHARK	*Carcharhinus albimarginatus*	Y		1317	426	24	24	58	31	50			5
AML	GREY REEF SHARK	*Carcharhinus amblyrhynchos*	Y	LR/nt	2489	17	45	15	85	100	100	7	18	5
CCL	BLACKTIP SHARK	*Carcharhinus limbatus*	Y	LR/nt	1754	250	62	22	83	90	52	7	12	5
CNX	WHITENOSE SHARK	*Nasolamia velox*	Y		12		92	25						5
ODH	BIGEYE SAND SHARK	*Odontaspis noronhai*			1			100						5
ALV	THRESHER	*Alopias vulpinus*	Y		1670	13	30	62	7	44		7	20	4
BLR	BLACKTIP REEF SHARK	*Carcharhinus melanopterus*	Y	LR/nt	587	1	59	35	87	100	100			4
EAG	EAGLE RAY	*Myliobatis tenuicaudatus*		LC	8			100						4
PLS	PELAGIC STING-RAY	*Dasyatis violacea*			16412	174	14	94		96		3	9	4
WST	WHIP STINGRAY	*Dasyatis akajei*		NT	105	10	6	99		100				4
LMD	SALMON SHARK	*Lamna ditropis*		DD	98	40	69	96	50					3
POR	PORBEAGLE SHARK	*Lamna nasus*		VU	18560		42	83	64			14	26	3
THR	THRESHER SHARKS NEI	*Alopias spp.*	Y		1473	105	29	97	17	100	42			3
BTH	BIGEYE THRESHER	*Alopias superciliosus*	Y		6820	7	32	85	19	100	91	12	20	2
TRB	WHITETIP REEF SHARK	*Triaenodon obesus*	Y	LR/nt	75		60	10	75			8	20	2
					AVERAGE		**35**	**68**	**53**	**92**	**68**	**13**	**29**	**21**