Agreement on the Conservation of Albatrosses and Petrels

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New Zealand's Approach to Assessment of Risk to Seabirds Associated with Fishing-Related Mortality

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SUMMARY

A risk assessment framework is central to the implementation of New Zealand's revised (2013) NPOA-Seabirds. The risk assessment framework adopted is designed to assess the likelihood that the biological risk objective of New Zealand's NPOA-Seabirds will not be met. That is, it is an assessment of the extent to which incidental mortality from New Zealand fisheries exceeds a level that allows for the maintenance at a favourable conservation status or recovery to a more favourable conservation status for seabird populations that breed in New Zealand.

The method takes the "exposure-effects" approach rather the "likelihood-consequence" approach to risk assessment and is based on the spatio-temporal overlap of bird distributions and fishing effort, scaled by the vulnerability to capture of each species. The current implementation has developed through several iterations and improvements, and considers 70 seabird species or populations and all New Zealand fisheries likely to have non-trivial captures. Scalars and uncertainty for non-observable (cryptic) fatalities (e.g. from trawl warp strikes where the carcass is lost to the sea) were included.

Black petrel, Salvin's albatross, flesh-footed sheartwater, southern Buller's albatross, Chatham Island albatross, and NZ white-capped albatross were assessed as being at very high risk. Conversely, 44 species were assessed as being at very low risk. The remaining 20 species were assessed as being at low (7 species), medium (9 species), or high risk (4 species). Details are included in two reports tabled separately.

The framework does not address fishing-related mortality caused by non-commercial fishers or by fishing outside the New Zealand EEZ, or any potential indirect fisheries impacts, or any non-fishing impacts. Work is underway to address some of these limitations.

Enfoque de Nueva Zelandia para la evaluación del riesgo de las aves marinas asociado con la mortalidad relacionada con la pesca

Es fundamental contar con un marco de evaluación de riesgos para la implementación del Plan de Acción Nacional (NPOA) – Aves Marinas revisado (2013) de Nueva Zelandia. El marco de evaluación de riesgos adoptado está diseñado para evaluar las probabilidades de que no se cumpla el objetivo de riesgo biológico de NPOA-Aves Marinas de Nueva Zelandia. Es decir, es una evaluación del grado hasta el cual la mortalidad incidental de las pesquerías de Nueva Zelandia superan un nivel que permite mantener un estado de conservación favorable o una recuperación hacia un estado de conservación más favorable de las poblaciones de aves marinas que se reproducen en Nueva Zelandia.

El método adopta el enfoque "exposición-efectos" en lugar del enfoque "probabilidad-consecuencia" para la evaluación de riesgos, y se basa en la superposición espacio-temporal de las distribuciones de aves y el esfuerzo pesquero, medidos por la vulnerabilidad de capturar cada especie. La implementación actual se ha desarrollado a través de varias iteraciones y mejoras, e incluye 70 especies o poblaciones de aves marinas y todas las pesquerías de Nueva Zelandia que puedan tener capturas no triviales. Se incluyeron escalares e incertidumbre para accidentes fatales no observables (crípticos) (por ejemplo, a raíz de golpes con los cables de arrastre, donde la carcasa se pierde en el mar).

Se determinó que el petrel negro, el albatros Salvin, la fardela de patas pálidas, el albatros de Buller antártico, el albatros de las Islas Chatham, y el albatros de frente blanca de Nueva Zelandia tenían un riesgo muy elevado. Por el contrario, se determinó que 44 especies tenían un riesgo muy bajo. Se determinó que las 20 especies restantes tenían un riesgo bajo (7 especies), mediano (9 especies), o alto (4 especies). Se incluyen detalles en dos informes con tablas por separado.

El marco no aborda la mortalidad relacionada con la pesca provocada por pescadores no comerciales ni por la pesca fuera de la ZEE de Nueva Zelandia, ni cualquier efecto posible indirecto de las pesquerías o efectos no relacionados con la pesca. Se está trabajando para abordar algunas de estas limitaciones.

Approche de la Nouvelle-Zélande en matière de mortalité induite par la pêche : évaluation des risques qu'encourent les oiseaux marins

Un cadre pour l'évaluation des risques est essentiel à la mise en œuvre du nouveau PAN-Oiseaux marins de la Nouvelle-Zélande (2013). Le cadre qui a été adopté permet d'évaluer la probabilité d'atteindre les objectifs fixés par le PAN-Oiseaux marins de la Nouvelle-Zélande en matière de risques biologiques. Cette évaluation vise à déterminer si la mortalité accidentelle induite par les pêcheries néo-zélandaises a dépassé un seuil qui permet de maintenir les populations qui se reproduisent en Nouvelle-Zélande à un niveau de conservation favorable ou de rétablir les populations à un statut de conservation plus favorable.

Cette méthode favorise l'approche "effets de l'exposition" plutôt que l'approche "conséquences probables" et elle se base sur le chevauchement spatio-temporel de la répartition des oiseaux et des efforts de pêche, échelonné en fonction de la vulnérabilité de chaque espèce aux captures. La méthode actuelle a été plusieurs fois modifiée. D'après cette méthode, 70 espèces d'oiseaux marins ou populations dans toutes les pêcheries néo-zélandaises encourent des risques de capture non négligeables. Les aspects scalaires et l'incertitude entourant les décès (cryptiques) non observables (p. ex. en cas de collisions avec les funes, les carcasses disparaissent en mer) ont également été pris en considération.

Le pétrel noir, l'albatros de Salvin, le puffin à pieds pâles, l'albatros de Buller, l'albatros des îles Chatham et l'albatros à cape blanche de Nouvelle-Zélande font partie des espèces qui encourent de très nombreux risques. A l'inverse, 44 autres espèces n'encourent que très peu de risques. Les 20 espèces restantes encourent de faibles risques (7 espèces), des risques moyens (9 espèces) ou de nombreux risques (4 espèces). Davantage d'informations sont disponibles dans deux rapports rédigés séparément.

Le cadre ne tient pas compte de la mortalité induite par la pêche non commerciale ou par la pêche pratiquée en dehors de la zone économique exclusive de la Nouvelle-Zélande, ni des impacts potentiels indirects de la pêche, ni d'autres impacts non liés à la pêche. Des travaux sont en cours pour pallier ces manques.

1. BACKGROUND

New Zealand's seabird risk assessment framework follows the “exposure-effects” approach (US EPA 1998) in which risk is a function of the level of impact arising from a threatening activity measured on a continuous scale (in this case the number of seabirds of a given population potentially killed each year). This contrasts with the “likelihood-consequence” approach (Australia-New Zealand Standards 1999) which is more appropriate for discrete, low-probability events. “Exposure” refers to the level of the threat (the number of potential fatalities from a population) and “effect” refers to the consequence of that exposure (e.g. population decline). However, because impacts are not always known or readily observable, the exposure-effects approach often requires a two-stage process; an impact assessment to estimate numbers of seabirds killed by fishing each year is followed by an assessment to evaluate the population level effect (Sharp et al. 2009).

New Zealand's seabird risk assessment framework can usefully be conceptualised in Hobday et al.'s (2007) hierarchical structure:

- level 1 risk assessments use expert knowledge to characterise risks on a qualitative scale;
- level 2 risk assessments apply "semi-quantitative" methods using available data in a standardized and reproducible algorithmic approach; and
- level 3 risk assessments are fully-quantitative and data intensive, generally including population modelling and simulations of threats and alternate risk management strategies, equivalent to a comprehensive fisheries stock assessment model.

Underlying the hierarchical risk assessment approach is the idea of risk screening wherein activities identified with reasonable certainty as "low risk" can be "screened out", allowing resources to be focused on the remaining higher risk activities. Hierarchical risk assessments are designed to tolerate Type I errors (false positives) to avoid Type II errors (false negatives), so activities are screened out only when there is reasonable certainty that the risk is low. In this context, it is important to distinguish risk assessment from normal estimation. Whereas normal estimation strives for a lack of bias, and a fair assessment of uncertainty, risk assessment is designed to answer the question "how bad could things be and be consistent with our data?"

2. HISTORY OF NEW ZELAND'S SEABIRD RISK ASSESSMENT FRAMEWORK

Captures of seabirds in New Zealand commercial fisheries have been monitored by government observers for many years but it is only recently that the focus has shifted to assessing the population-level consequences of fishing-related mortality. Baird et al. (2006) reviewed risk assessment approaches that might be suitable, and initial semi-quantitative assessments on selected species were conducted by Baird and Gilbert in 2006 (published 2010) and Fletcher et al. (2008). Recognising that these assessments were able to cover only those species and fisheries for which reasonable observer coverage was available, a comprehensive qualitative (level 1) risk assessment was conducted in 2008 (Rowe 2010) across all fisheries and New Zealand seabirds (within New Zealand fisheries waters).

The level 2 method underlying the current framework arose initially from a workshop in 2008 attended by experts in New Zealand fisheries, seabird-fishery interactions, seabird biology, population modelling, and ecological risk assessment. The overall framework was described by Sharp et al. (2011) and has been variously applied and improved in multiple iterations (Waugh et al. 2009, Richard et al. 2011, Richard and Abraham 2013 and Richard et al. 2013). The method estimates the encounter rate of each seabird species with each fishery group as a function of the spatial overlap of distributions of the seabird and relevant fishing effort. These estimates are compared with observed captures to estimate the vulnerability of each species (observable captures per encounter) to each fishery group. Summing across fisheries and including scalars for non-observable (cryptic) fatalities leads to estimates of total potential fatalities (i.e., population-level mortality) from all New Zealand commercial fisheries. These potential fatalities are evaluated with reference to estimates of population size and biological characteristics to yield estimates of population-level risk. The method offers the following necessary advantages:

- risk is assessed for each distinct population or species;
- the method does not rely on the existence of universal or representative fisheries observer data to estimate seabird mortality;
- the method does not rely on complex population models because risk is estimated as a function of biological parameters that are generally widely available;
- the method assigns risk to each species in an absolute sense (rather than as ranks), allowing the definition of performance standards and monitoring of trends over time;
- impact and risk scores are quantitative and scalable between fisheries or areas, so that risk at a species level can be disaggregated among different fisheries or areas based on their proportional contribution to total impact;
- the method allows explicit statistical treatment and propagation of uncertainty from input parameters to estimates of risk; and
- the method readily incorporates new information.

Richard et al. (2011) applied this method for sixteen commercial fishery groups and 64 New Zealand seabird species, using the approximate method of Niel and Lebreton (2005) to estimate PBR (after Wade 1998) as an index of the ability of a given population to sustain anthropogenic fatalities. Inshore fisheries were identified as responsible for most risk, reflecting high uncertainty arising from low levels of observer coverage, high effort levels, and high spatial overlap with the distributions of vulnerable seabird species. Commercial set net fisheries could not be included in that analysis despite having been identified by Rowe et al. (2010) as posing substantial risk to seabirds. Instead, the level 1 and level 2 results were combined to generate risk estimates for all New Zealand commercial fisheries. This combination of level 1 and level 2 risk estimates also allowed some cross-checking of results and the identification of anomalous, misleading estimates in both assessments.

Throughout 2012, the risk assessment was re-assessed and updated and the revised version was published early in 2013 (Richard et al. 2013), including the following significant improvements:

- the number of seabird populations assessed increased from 64 to 70;
- estimated population sizes, biological parameters, and spatial distributions were updated where possible;
- spatial overlap was evaluated separately for breeding and non-breeding seasons for each species to account for seasonal variation in the distributions of both seabirds and fishing effort;
- commercial set net fisheries were included in the analysis, obviating the need to combine level 1 and level 2 analyses;
- the analysis was made more relevant to current levels of fishing-related mortality by using only fishing effort since 2006 when major improvements to mitigation were introduced
- captures were estimated in a single model where vulnerability for each interaction is the product of a fishery group-specific vulnerability and a species-specific vulnerability. In this way capture rates for rare species or poorly-observed fisheries

are informed and constrained by capture data from more common species or better-observed fisheries;

- systematic bias in estimates of PBR made for seabird populations using the method described by Nile and Lebreton (2005) was corrected
- simulations were used to develop corrected estimates of PBR (described by Richard and Abraham (2013) in a detailed report tabled separately) that would allow a population to remain at, or recover to, at least half the carrying capacity with high certainty.

3. KEY FEATURES OF NEW ZEALAND'S CURRENT RISK ASSESSMENT

The method is noteworthy in that it:

- is comprehensive across all New Zealand commercial fisheries thought to have non-trivial captures
- covers all New Zealand breeding seabird species thought likely to have non-trivial fishing-related mortality
- is based on spatial and temporal (breeding vs non-breeding) overlap of birds and fishing
- estimates "potential fatalities", rather than observable captures; this includes cryptic fatalities and precautionary treatment of poor data, consistent with the hierarchical risk assessment approach
- estimates a risk ratio as potential fatalities divided by potential biological removals (PBR, after Wade 1998), to enable assessment of likelihood of meeting the biological objective in New Zealand's NPOA-seabirds
- corrects a systematic bias for seabirds demographics that is inherent in Niel and Lebreton's (2005) approach to estimating PBR; this is done using a novel simulation approach (Richard and Abraham 2013, see also Dillingham and Fletcher 2011)
- has a non-standard treatment of PBR; the recovery factor (f) is considered separately from the risk ratio which is calculated using f = 1 (hence, PBR_1)
- is readily expandable to include fishing-related mortality outside New Zealand's EEZ

4. ESTIMATED RISK TO NEW ZEALAND SEABIRDS FROM NEW ZEALAND COMMERCIAL FISHERIES

The 2013 level 2 risk assessment (Richard et al. 2013) successfully resolved anomalous results identified in the 2011 version (Richard et al. 2011) and generates up-to-date risk estimates for 70 seabird populations across all New Zealand commercial fisheries posing significant risks (Table 1, Figure 1). Comprehensive results are described in a detailed report by Richard et al. (2013) tabled separately.

For the purposes of implementing New Zealand's NPOA-seabirds, the numerical risk ratio scores (annual potential fatalities divided by potential biological removals with a recovery factor of 1.0) were binned into five risk categories based on the median and 95% confidence range of the risk ratio (Annex 1).

Black (Parkinson's) petrel and Salvin's albatross were estimated to have >95% likelihood that the risk ratio (using PBR_1) was greater than 1, and another four species, flesh-footed shearwater, southern Buller's albatross, Chatham Island albatross, and NZ white-capped albatross, were also classified as at "very high risk", having a risk ratio with a median above 1 or with the upper 95% confidence limit above 2.

Northern Buller's albatross, Gibson's albatross, Cape petrel, and Antipodean albatross were classified as at "high risk" because they had a median risk ratio above 0.3 or the upper 95% confidence limit above 1.

Most risk in the current assessment was attributed to inshore fisheries, primarily flatfish trawl, followed by snapper, bluenose, and other inshore bottom-longline fisheries, and domestic surface-longliners targeting swordfish or big-eye tuna. Risks from deepwater trawl fisheries were generally estimated to be low, but some species are at higher risk from large-vessel trawl fisheries targeting hoki, scampi and squid. Richard et al.'s (2013) estimates of risk for diving seabirds were substantially lower than might have been predicted from Rowe's (2010) expert-based assessment.

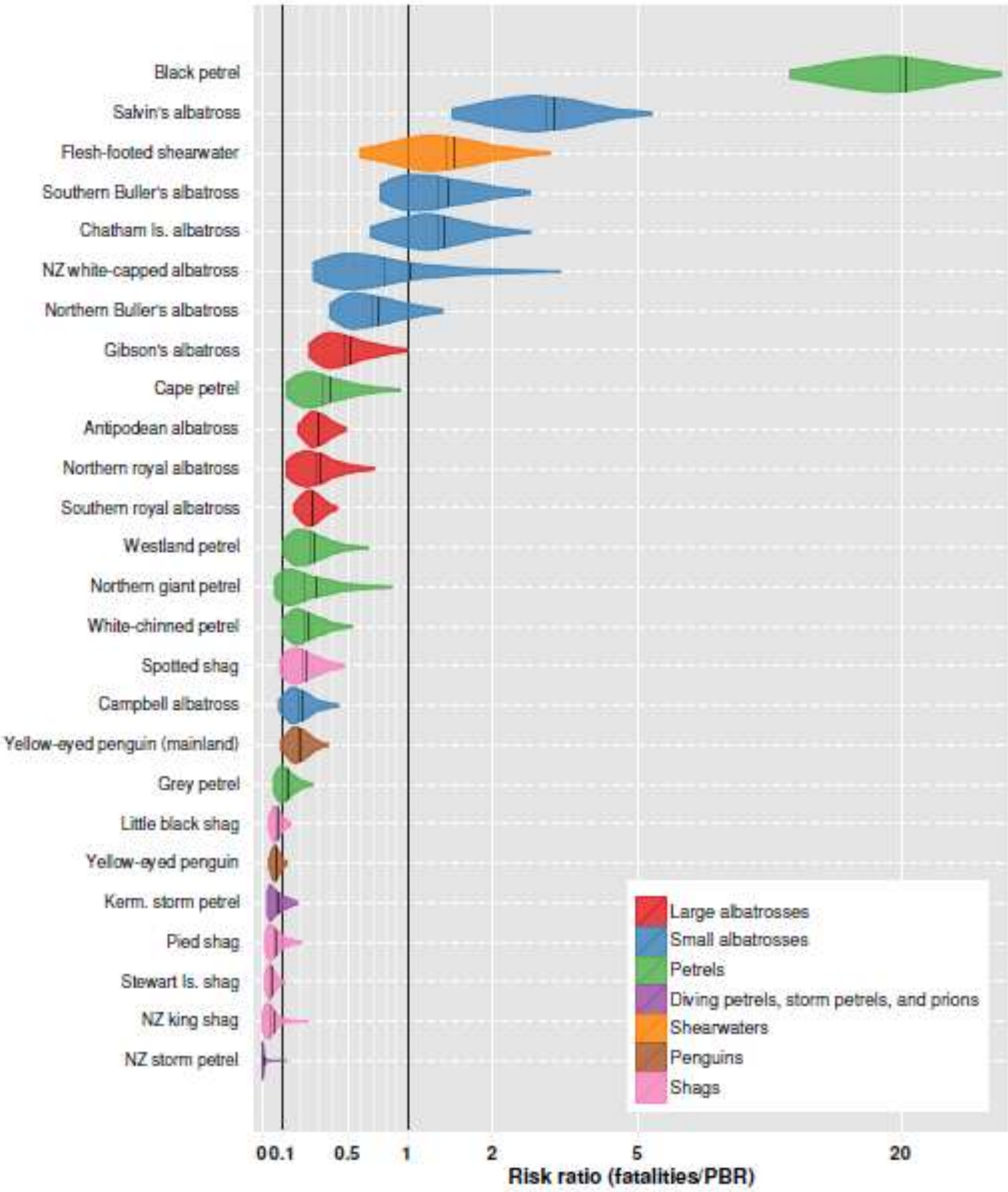

Figure 1 (reproduced from Richard et al. 2013): Risk ratio (total APF/PBR) with the recovery factor f set at 1 for the 26 species or populations with the highest risk ratios. The risk ratio is displayed on a logarithmic scale, with the threshold of the number of potential bird fatalities equalling the PBR with f = 0:1 and f = 1 indicated by the two vertical black lines. The 95% confidence intervals of the risk ratios are indicated by the coloured shapes, including the mean (solid black line), and median (grey line). Species are listed in decreasing order of the median risk ratio, excluding 44 species with a risk ratio of almost zero. The risk ratio for yellow-eyed penguin relates only to the mainland population.

Table 1 (reproduced from Richard et al. 2013): Potential Biological Removal (PBR_1, i.e., with a recovery factor f = 1), total annual potential fatalities (APF) in trawl, longline, and set-net fisheries, risk ratio with f = 1 (RR = APF=PBR1), and the probability (percentage) that APF > PBR with f = 1, f = 0:5, and f = 0:1 (P1, P0.5, and P0.1, respectively). Species are ordered in decreasing order of the median risk ratio. The risk ratio of yellow-eyed penguin refers to the mainland population only. Another 51 species were assessed to have a median risk ratio of <0.1 * PBR_1)

	PBR_1		APF		Risk ratio		P_1	$P_{0.5}$	$P_{0.1}$
	Mean	95% c.i.	Mean	95% c.i.	Median	95% c.i.			
Black petrel	74	47-117	1 440	1 070-1 900	19.90	11.40-32.80	100.00	100.00	100.00
Salvin's albatross	975	521-1 740	2 690	2 100-3 420	2.88	1.47-5.41	99.80	100.00	100.00
Flesh-footed shearwater	590	288-1 200	780	523-1 090	1.41	0.59-2.94	80.60	99.00	100.00
Southern Buller's albatross	513	270-831	663	520-839	1.32	0.75-2.58	79.20	100.00	100.00
Chatham Island albatross	159	94-264	205	136-316	1.30	0.68-2.59	78.20	99.70	100.00
NZ white-capped albatross	4 040	908-9 840	2 830	2 080-3 790	0.78	0.28-3.13	36.20	76.70	100.00
Northern Buller's albatross	617	325-1000	418	312-560	0.69	0.38-1.36	17.20	82.30	100.00
Gibson's albatross	260	132-425	121	86-164	0.48	0.25-1.00	2.52	45.40	100.00
Cape petrel	840	283-1 890	254	175-361	0.33	0.12-0.93	1.74	23.30	99.10
Antipodean albatross	295	203-419	89	63-121	0.30	0.18-0.49	0.00	2.06	100.00
Northern royal albatross	396	164-782	108	72-160	0.29	0.12-0.70	0.30	11.70	99.50
Southern royal albatross	441	302-630	116	82-160	0.27	0.16-0.43	0.00	0.30	100.00
Westland petrel	241	142-384	63	28-129	0.25	0.10-0.66	0.10	7.68	97.90
Northern giant petrel	217	66-486	47	18-103	0.23	0.06-0.85	1.44	13.60	87.40
White-chinned petrel	7 920	3 280-15 800	1 670	1 210-2 330	0.22	0.10-0.53	0.04	3.54	97.10
Spotted shag	3 780	1 730-7 570	745	485-1 100	0.21	0.09-0.48	0.00	1.64	94.60
Campbell black-browed albatross	1 020	514-1 830	192	111-324	0.19	0.08-0.44	0.00	1.12	94.00
Yellow-eyed penguin (mainland)	184	122-272	35	19-56	0.19	0.09-0.37	0.00	0.06	96.00
Grey petrel	2 170	1 010-3 900	247	169-364	0.12	0.06-0.27	0.00	0.00	65.10

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ANNEX 1: DEFINING RISK CATEGORIES

The NPOA-Seabirds relies on assessment of risk to prioritise the implementation of management actions and measure performance in achieving NPOA-Seabirds objectives. For instance, one of the 5-year objectives involves moving all seabirds in the very high risk category to a lower level of risk within the 5-year period. To implement this framework, definitions of various categories of risk are required.

Five categories of risk have been defined to reflect the full range of scenarios without overly complicating understanding (very low, low, medium, high and very high risk). The definitions incorporate the following ideas:

i) a risk ratio that expresses the estimated level of impact as a proportion of the maximum impact level that would enable achievement of the biological risk objective;

ii) a range of risk ratios are calculated to reflect the level of uncertainty around the estimated values (95% confidence intervals);

iii) triggers are related to both the median risk ratio value and upper confidence limits of the range of risk ratios to ensure that uncertainty is explicitly considered in decision making;

iv) the categories are mutually exclusive so that any given species can only fall into one risk category; and,

v) the categories should be able to be stated mathematically.

The definitions (expressed in general terms and also stated probabilistically (where F is commercial fishing-related potential fatalities, PBR1 is the PBR as calculated in Richard et al. 2013, with recovery factor f set equal to 1, and p<2.5% is technically equivalent to being within the upper limit of the 95% confidence range) are:

- Very High – median risk ratio is greater than 1.0, stated probabilistically p(F>PBR1) ≥ 50% OR p(F>2.0PBR1) ≥ 2.5%
- High – median risk ratio is less than or equal to 1.0 and the entire range is less than 2.00 (if the range extends above 2.00 then the risk is Very High), stated probabilistically p(F>PBR1) <50% AND p(F>2.0PBR1) <2.5%
- Medium – median risk ratio is less than or equal to 0.30 and the entire range is less than 1.0 (if the range extends above 1.0 then the risk is High), stated probabilistically p(F>0.30PBR1) <50% AND p(F>1.0PBR1) <2.5%
- Low – median risk ratio is less than or equal to 0.10 and the entire range is less than 0.30 (if the range extends above 0.30 then the risk is Medium), stated probabilistically p(F>0.10PBR1) <50% AND p(F>0.50PBR1) <2.5%, and
- Very Low – the entire range is less than 0.10 (if the range extends above 0.10 then the risk is Low), stated probabilistically p(F>0.1PBR1) <2.5%.