Witch Flounder in Divisions 3NO

Recommendation for 2016 and 2017
Scientific Council noted that this is a newly reopened fishery. Acceptable risk levels have not yet been specified, but to allow the stock to continue to increase towards B_{msy}, exploitation in 2016 and 2017 should not exceed ⅔ F_{msy}, corresponding to catches of 2 172 t and 2 225 t respectively. Catches at this level will have a 3% risk of exceeding F_{lim} and <1% risk of driving the stock below B_{lim}.

Management objectives
The NAFO Fisheries Commission reintroduced a 1 000 t quota in 2015. Bycatches in commercial fisheries directed for other species should be kept to a minimum. General convention objectives (GC Doc. 08/3) are applied.
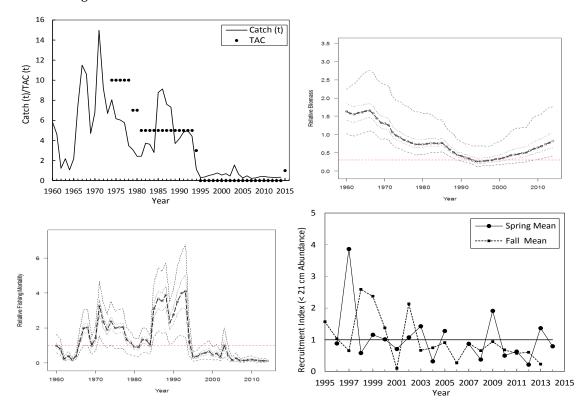
Convention objectives	Status	Comment/consideration		
Restore to or maintain at B_{msy}	🟡	B increasing. $B_{lim} < B_{2016} < B_{msy}$	🟢	OK
Eliminate overfishing	🟢	$F < F_{msy}$	🟡	Intermediate
Apply Precautionary Approach	🟢	Stock in safe zone of PA Framework	🔴	Not accomplished
Minimise harmful impacts on living marine resources and ecosystems	🟡	VME closures in effect, no specific measures.	⚪	Unknown
Preserve marine biodiversity	⚪	Cannot be evaluated		

Management unit
The management unit is NAFO Divs. 3NO. The stock mainly occurs in Div. 3O along the southwestern slopes of the Grand Bank. In most years the distribution is concentrated toward this slope but in certain years, a higher percentage may be distributed in shallower water.

Stock status
The stock size has steadily increased since 1999 and is now at 81% B_{msy}. There is very low risk (<1%) of the stock being below B_{lim} or F being above F_{lim}. Recruitment (juveniles < 21 cm) since 2005 has generally been lower than average.

Reference points

Reference points were estimated from the surplus production model. Scientific Council considers that 30% B_{msy} is a suitable biomass limit reference point (B_{lim}) and F_{msy} a suitable fishing mortality limit reference point.

Projections and risk analyses

All projections assumed that the catch in 2015 was equal to the TAC of 1,000 t. The probability that $F > F_{lim}$ in 2015 was less than 1%. The probability of $F>F_{lim}$ increases to 26% at an F of 85% F_{MSY}. The population is projected to grow and the probability that the biomass in 2018 is greater than the biomass in 2014 is high under all scenarios. The population is projected to remain below B_{msy} for all levels of F examined with a probability of greater than 50%.

	Projections with catch in 2015 = 1 000 t	
	Projected Yield (t) Median (80% CI)	Projected Relative Biomass (B_y /B_{msy}) Median (80% CI)
F_{2015}=0.019		
2016	1048 (932 - 1175)	0.95 (0.56 - 1.52)
2017	1096 (922 - 1291)	1.00 (0.59 - 1.58)
2018		1.04 (0.65 - 1.63)
75% F_{2015}=0.014		
2016	784 (696 - 882)	0.91 (0.56 - 1.52)
2017	822 (696 - 970)	0.96 (0.60 - 1.58)
2018		1.01 (0.63 - 1.64)
125% F_{2015}=0.024		
2016	1307 (1163 - 1475)	0.91 (0.57 - 1.51)
2017	1357 (1155 - 1606)	0.95 (0.59 - 1.56)
2018		0.99 (0.61 - 1.60)
⅔F_{msy}=0.04		
2016	2172 (1384 - 3267)	0.92 (0.56 - 1.53)
2017	2225 (1433 - 3327)	0.94 (0.58 - 1.54)
2018		0.96 (0.60 - 1.57)
75% F_{msy}=0.047		
2016	2549 (1623 - 3849)	0.91 (0.57 - 1.52)
2017	2602 (1663 - 3888)	0.93 (0.58 - 1.54)
2018		0.94 (0.59 - 1.54)
85% F_{msy}=0.054		
2016	2936 (1878 - 4429)	0.91 (0.56 - 1.53)
2017	2970 (1893 - 4412)	0.92 (0.57 - 1.52)
2018		0.93 (0.58 - 1.52)

Yield (t) and risk of $F > F_{lim}$, $B < B_{lim}$ and $B < B_{msy}$ for projected F values of F_{2015}, 75% F_{2015}, 125% F_{2015} 2/3 F_{msy} 75% F_{msy}, and 85% F_{msy}.

	Yield		P(F_year > F_lim)		P(B_year < B_lim)			P(B_year < B_msy)			P(B_2018 > B_2014)
	2016	2017	2016	2017	2016	2017	2018	2016	2017	2018	
F_{2015} (0.019)	1048	1096	<1%	<1%	<1%	<1%	<1%	59%	55%	50%	73%
75%F_{2015} (0.014)	784	822	<1%	<1%	<1%	<1%	<1%	60%	55%	50%	74%
125% F_{2015} (0.024)	1307	1357	<5%	<5%	<1%	<1%	<1%	60%	56%	52%	72%
⅔ F_{msy} (0.04)	2172	2225	3%	3%	<1%	<1%	<1%	60%	57%	57%	69%
75%F_{msy} (0.047)	2549	2602	11%	11%	<1%	<1%	<1%	60%	58%	56%	68%
85% F_{msy} (0.054)	2936	2970	26%	26%	<1%	<1%	<1%	60%	58%	58%	67%

Assessment
Previously this stock was assessed using trends in survey indices.

A surplus production model in a Bayesian framework was accepted as the basis for the assessment of this stock. The input data were catch from 1960 - 2014, Canadian spring survey series from 1984 - 1990, Canadian spring survey series from 1991 - 2014 (no 2006) and the Canadian autumn survey series from 1990 - 2013 (no 2014).

A maximum sustainable yield (*MSY*) of 3760 (2965 - 4820) tons can be produced by total stock biomass of 59 680 (44 600 - 73 700) tons (B_{msy}) at a fishing mortality rate (F_{msy}) of 0.06 (0.05 - 0.09). The relative population size (median B/B_{msy}) was below B_{lim} (30% B_{msy}) from 1993-1998. Biomass has since increased to a level of 81% B_{MSY} in 2014. The probability of being below B_{lim} in 2014 is very low.

Human impact
Mainly fishery related mortality. Other potential sources (e.g. pollution, shipping, and oil-industry) are undocumented.

Biological and environmental interactions
Witch flounder is distributed mainly along the southwestern slopes of the Grand Bank.

Fishery
NAFO reopened a directed fishery in 2015 with a TAC of 1 000 t. Prior to the repoening, witch flounder were previously caught via bottom trawl as bycatch mainly in otter trawl fisheries of skate and Greenland halibut.

Recent catch estimates and TACs are:

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TAC[1]	ndf*	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	1.0
STATLANT 21	0.2	0.2	0.2	0.3	0.4	0.4	0.3	0.3	0.3	
STACFIS	0.5	0.2	0.3	0.4	0.4	0.4	0.3	0.3	0.3	

*ndf = no directed fishing

Effects of the fishery on the ecosystem
No specific information available. General impacts of bottom trawl gear on the ecosystem should be considered.

Special comments
No special comments.

Sources of Information
SCR Docs. 15/37, 38; SCS Docs. 15/04, 05, 06, 07; NAFO/GC Doc. 08