NAFO Sci. Coun Studies, 37: 37–44

TABLE 1: AVAILABLE DATA

COMMON NAME: ATLANTIC COD

SPECIES: *Gadus morhua*

AREA: NORTHWEST ATLANTIC

STOCK: NORTHERN GULF OF ST. LAWRENCE (NAFO SUBDIV. 3PN+DIV. 4RS

CREATED BY: ALAIN FRÉCHET/ YVAN LAMBERT 2001-10-28

UPDATED BY:

Data status									
Year	**Stock size**	**Stock composition**	**Age**	**Sex ratio**	**Maturity**	**Fecundity**	**Weight**	**Condition**	**Additional data**
2001	√	√	√	(√)		(√)	√	√	√
2000	√	√	√	(√)			√	√	√
1999	√	√	√	(√)			√	√	√
1998	√	√	√	(√)	√	√	√	√	√
1997	√	√	√	(√)	√		√	√	√
1996	√	√	√	(√)			√	√	√
1995	√	√	√	(√)	√	√	√	√	√
1994	√	√	√	(√)	√		√	√	√
1993	√	√	√	(√)	√		√	√	√
1992	√	√	√	(√)	√		√	√	√
1991	√	√	√	(√)	√		√	√	√
1990	√	√	√	(√)	√		√	√	√
1989	√	√	√	(√)	√		√	√	√
1988	√	√	√	(√)	√		√	√	√
1987	√	√	√	(√)	√		√	√	√
1986	√	√	√	(√)	√		√	√	√
1985	√	√	√	(√)	√		√	√	√
1984	√	√	√	(√)	√		√	√	√
1983	√	√	√	(√)	√		√		
1982	√	√	√	(√)			√		
1981	√	√	√	(√)	√		√		
1980	√	√	√	(√)	√		√		
1979	√	√	√	(√)	√		√		
1978	√	√	√	(√)	√		√		
1977	√	√	√	(√)			√		
1976	√	√	√	(√)			√		

Data status									
Year	**Stock size**	**Stock composition**	**Age**	**Sex ratio**	**Maturity**	**Fecundity**	**Weight**	**Condition**	**Additional data**
1975	√	√	√	(√)			√		
1974	√	√	√	(√)			√		
1973					√				

TABLE 2: DATA BASIS, FORMAT AND QUALITY

COMMON NAME:	ATLANTIC COD		
AREA:	NORTHWEST ATLANTIC		
STOCK:	NORTHERN GULF OF ST. LAWRENCE (NAFO SUBDIV. 3PN+DIV. 4RS)		
REPRODUCTIVE STRATEGY:	DETERMINATE SPAWNER	**REF. NO.:**	11,12
TIMING OF SPAWNING:	APRIL JUNE	**REF. NO.:**	14, 15
OPTIMAL TIME FOR MATURITY SAMPLING:	JANUARY-MAY	**REF. NO.:**	13

Data basis, format and quality

Variables	Year range	Data basis (A/L/W)	Data origin	Sampling frequency	Notes on data, methods and contents	Ref. No.
Stock size	1974-2001	A	CL	Q	No landings between 1994-1996 moratorium	1,2.3
	1978-1994	A	S	JANUARY JULY-AUGUST		
	1984-2001	A	S		VPA estimates	
Stock composition	1974-2000	A,L,W	S,CL	Y,Q	Poor data sampling in early years	2.3
Age determination	1974-2000		S,CL	Y,Q	No commercial otolith sampling in 1974-1976	2,3,4
Sex ratio					Assumed 1:1 could be extracted from survey data bases	
Maturity:						
A. Ogives (E)	1947-1950	A, L	S			5
	1973	L	S	JANUARY TO APRIL	By sex	6
	1978-1994	A, L, W	S	JANUARY APRIL-MAY	By sex	7
	1994-1995,1997-1998	L	S		By sex and by age from mean length at age	8,9
B. Skip of spawning	1997-1998	L,W	EC	LAB EXPT	Influence of condition factor on maturation	10
C. Spawning probability						

Data basis, format and quality						
Variables	**Year range**	**Data basis (A/L/W)**	**Data origin**	**Sampling frequency**	**Notes on data, methods and contents**	**Ref. No.**
D. Other	1995	L,W	S	APRIL-MAY	Histological and macroscopic stage of gonad development	9
Fecundity:						
A. Estimation	1995,1998	L,W	S	APRIL-MAY	Size range: 35-65 cm	10,11
	2001	L,W	S	MAY	Size range 35-65 cm samples collected but analysis not completed	
	1994-1996	L,W	EC	Lab expmt 35 females	Realised fecundity in relation to condition and temperature	10,11, 12
B. First time vs. repeat spawners						
C. Atresia						
D. Other						
Weight:						
A. Commercial fisheries data	1974-2000	A,L,W	CL	M,Q,Y		1,2,3
B. Survey data	1978-1994	A,L,W	S	JANUARY, AUGUST	Estimated means	2
	1990-2001	A,L,W	S		Estimated means	1,2,3
C. Other	1995-2000	A,L,W	CL,S	JULY, OCTOBER	Sentinel surveys: fixed and mobile gears	2,3
Condition:						
A. Fulton	1988-2000	L, W	S	AUGUST		2,3,13
	1984-1995	L, W	S	JANUARY		13
	1995-2000	L, W	S,CL	JULY-OCTOBER	Sentinel fixed gears	2,3
	1995-2000		S,CL	JULY, OCTOBER M,Q	Sentinel mobile gears	2,3
	1993-1995	L,W	S,CL	APRIL-MAY	Seasonal variations in the condition factor	13, 14
	1994,1995, 1997,1998	L,W	S		Condition factor in relation to maturity stage	10, 11
B. HSI	1994-2000	L, W	S	AUGUST		3
	1995-2001	L, W	S,CL	JULY TO OCTOBER	Sentinel fixed gears	2,3
	1995-2000		S,CL	JULY, OCTOBER M,Q	Sentinel mobile gears	2,3
	1993-1995	L,W	S,CL		Seasonal variations in the HSI	13
C. Energy	1993-1995	L,W	S,CL	M,Q	Seasonal variations in somatic, liver and gonad energy contents	13

Data basis, format and quality						
Variables	**Year range**	**Data basis (A/L/W)**	**Data origin**	**Sampling frequency**	**Notes on data, methods and contents**	**Ref. No.**
D. Other	1994-2001	L, W	S	AUGUST	Liver and muscle dry weights	2,3
	1995-2001	L, W	S,CL	JULY TO OCTOBER	Sentinel fixed gears: liver and muscle dry weights	2,3
	1995-2000	L,W	S,CL	JULY, OCTOBER M,Q	Sentinel mobile gears: liver and muscle dry weights	2,3
	1993-1995	L,W	S,CL		Biochemical composition of tissues (lipids, proteins) and seasonal variations in dry weights of muscle, liver and gonads	13,15
Egg viability:						
A. Egg quality	1993-1995		S	MAY-JUNE	Eggs from plankton samples	16
	1995-1996	L,W	EC	Lab expmt APRIL-AUGUST	Egg batches spawned under controlled T° conditions	17
B. Fertilisation success						
C. Egg mortality	1995-1996	L,W	EC	Lab expmt APRIL-AUGUST	Egg batches spawned under controlled T° conditions	17
D. Other						
Larval viability:						
A. Hatching success	1995-1996	L,W	EC	Lab expmt APRIL-AUGUST	Egg batches spawned under controlled T° conditions	17
B. Larvae quality						
C. Mortality						
D. Other						
Spawning time	1985,1987, 1991,1992		S	MAY-JUNE	Egg (plancton) surveys	18
	1993-1995		S	APRIL-MAY	Hydroacoustic, bottom trawl and planckton samples	8
Contamination						
Environmental key factors						
Other factors or parameters						

TABLE 3: STUDIES OF REPRODUCTIVE POTENTIAL

COMMON NAME:	ATLANTIC COD
AREA:	NORTHWEST ATLANTIC
STOCK:	NORTHERN GULF OF ST. LAWRENCE (NAFO SUBDIV. 3PN+DIV. 4RS)

Estimation of reproductive potential			
Subject	**Brief description**	**Year range**	**Ref. No.**
Potential or realized egg production	Egg production estimated from applying relationship between length, condition and fecundity in 1995 and 1998 to condition factor data between 1984 and 1998	1984-1998	10
Viable egg and larvae production	Egg size, energy content, egg survival, hatching success, larval size	1995-1996	17,19
Critical life stages			
Environmental influences	Effect of UV radiation on cod eggs and larvae.	1996-1997	20,21,22
Stock recruitment relations	Spawning stock biomass *vs* recruits (SSB from VPA and surveys)	1974-1997	23,24
Other studies	Realised fecundity of captive fish	1993-1995	11

TABLE 4: DATA SOURCES

COMMON NAME:	ATLANTIC COD
AREA:	NORTHWEST ATLANTIC
STOCK:	NORTHERN GULF OF ST. LAWRENCE (NAFO SUBDIV. 3PN+DIV. 4RS)

Data sources (literature reference or contact person)
1. MPO. 2001. La morue du nord du golfe du Saint-Laurent en 2000. MPO-Sciences, Rapport sur l'état des stocks A4-01.
2. FRECHET, A., and P. SCHWAB. 1998. Assessment of the northern Gulf of St. Lawrence cod stock (3Pn, 4RS) in 1997. *DFO Can. Stock Ass. Sec. Res. Doc.*, No. 127.
3. A. FRÉCHET, Fisheries and Oceans Canada, Institut Maurice-Lamontagne, Mont-Joili, QC G5H 3Z4 (frecheta@dfo-mpo.gc.ca).
4. FRÉCHET, A., and D. GASCON. 1986. Une nouvelle matrice de capture à l'âge pour le stock de morue des divisions 4RS, 3Pn. *CSCPCA Doc. Rech.*, No. 104, 34p.
5. FLEMING, A. M. 1960. Age, growth and sexual maturity of cod (*Gadus morhua* L.) in the Newfoundland area, 1947-1950. *J. Fish. Res. Bd. Can.*, **17**(6): 775-809.
6. MINET, J.P. 1977. Dynamics and yield assessment of the northern Gulf of St. Lawrence cod stock (ICNAF Div. 4R-4S-3Pn). *ICNAF Sel. Papers*, **3**: 33-44.
7. TRIPPEL, E. A., M. J. MORGAN, A. FRECHET, C. ROLLET, A. SINCLAIR, C. ANNAND, D. BEANLANDS, and L. BROWN. 1997. Changes in age and length at sexual maturity of northwest Atlantic cod, haddock and pollock stocks, 1972-1995. *Can. Tech. Rept. Fish. Aquat. Sci.*, No. 2157.
8. OUELLET, P., LAMBERT, and M. CASTONGUAY. 1997. Spawning of Atlantic cod (*Gadus morhua*) in the northern Gulf of St. Lawrence: a study of adult and egg distributions and characteristics. *Can. J. Fish. Aquat. Sci.*, **54**: 198-210.
9. LAMBERT, Y. Fisheries and Oceans Canada, Institut Maurice Lamontagne, Monti-Joli, QC G5H 3Z4 (lamberty@dfo-mpo.gc.ca).
10. LAMBERT, Y., J. D. DUTIL, and P. OUELLET. 2000. Nutritional condition and reproductive success in wild fish populations. *In*: Proceedings of the 6th International Symposium on the Reproductive Physiology of Fish. N. Norberg, O.S. Kjesbu, G.L. Taranger, E. Andersson, and S.O. Stefansson. Bergen 4-9 July 1999, 77-84 p.
11. LAMBERT, Y., and J. D. DUTIL. 2000. Energetic consequences of reproduction in Atlantic cod (*Gadus morhua*) in relation to spawning level of somatic energy reserves. *Can. J. Fish. Aquat. Sci.*, **57**: 815-825.

Data sources (literature reference or contact person)
12. OUELLET, P., Y. LAMBERT, and I. BÉRUBÉ. 2001. Cod egg characteristics and viability in relation to low temperature and maternal nutritional condition. *ICES J. Mar. Sci.*, **58**: 672-686.
13. LAMBERT, Y., and J. D. DUTIL. 1997. Condition and energy reserves of Atlantic cod (*Gadus morhua*) during the collapse of the northern Gulf of St. Lawrence stock. *Can. J. Fish. Aquat. Sci.*, **54**: 2388-2400.
14. DUTIL, J.D., Y. LAMBERT, G. A. CHOUINARD, and A. FRÉCHET. 1995. Fish condition: what should we measure in cod (*Gadus morhua*)? *DFO Atl. Fish. Res. Doc.*, No. 11.
15. LAMBERT, Y., and J. D. DUTIL. 1997. Can simple condition indices be used to monitor and quantify seasonal changes in the energy reserves of Atlantic cod (*Gadus morhua*)? *Can. J. Fish. Aquat. Sci.*, **54**(Suppl. 1): 104-112.
16. OUELLET, P. 1997. Characteristics and vertical distribution of Atlantic cod (*Gadus morhua*) eggs in the northern Gulf of St. Lawrence, and the possible effect of cold water temperature on recruitment. *Can. J. Fish. Aquat. Sci.*, **54**: 211-213..
17. OUELLET, P., Y. LAMBERT, and I. BÉRUBÉ. 2001. Cod egg characteristics and viability in relation to low temperature and maternal nutritional condition. *ICES Journal of Marine Science*, **58**: 672-686.
18. OUELLET, P., J. P. ALLARD, and J. F. ST-PIERRE. 1994. Distribution des larves d'invertébrés décapodes (Pandalidae, Majidae) et des oeufs et des larves de poissons dans le nord du golfe du Saint-Laurent en mai et juin de 1985 à 1987 et 1991-1992. *Rapport technique canadien des sciences halieutiques et aquatiques*, 2019.
19. DUTIL, J. D., M. CASTONGUAY, M. O. HAMMILL, P. OUELLET, Y. LAMBERT, D. CHABOT, H. BROWMAN, D. GILBERT, A. FRÉCHET, J. A. GAGNÉ, D. GASCON, and L. SAVARD. 1988. Environmental influences on the productivity of cod stocks: some evidence for the northern Gulf of St. Lawrence, and required changes in management practices. *Can. Stock Ass. Sec. Res. Doc.*, No. 18.
20. BÉLAND, F., H.I. BROWMAN, C.A. RODRIGUEZ, and J.F. ST. PIERRE. 1999. Effect of solar ultraviolet radiation (280-400 nm) on the eggs and larvae of Atlantic cod (*Gadus morhua*). *Can.J. Fish. Aquat. Sci.*, **56**: 1058-1067.
21. KOUWENBERG, J. H. M., H. I. BROWMAN, J. J. CULLEN, R. F. DAVIS, J. F. ST. PIERRE, and J. A. RUNGE. 1999. Biological weighting of ultraviolet (280-400 nm) induced mortality in marine zooplankton and fish. I. Atlantic cod (*Gadus morhua*) eggs. *Marine Biology*, **134**: 269-284.
22. KUHN, P. S., H. I. BROWMAN, R. F. DAVIS, J. J. CULLEN, and B. L. McARTHUR. 1999. Modeling the effects of ultraviolet radiation on embryos of *Calanus finmarchicus* and Atlantic cod (*Gadus morhua*) in a mixing environment. *Limnology and Oceanography*, **45**: 1797-1806.
23. SWAIN, D. P., and M. CASTONGUAY. 2000. Final report of the 2000 annual meeting of the Fisheries Oceanography Committee including the report of the workshop on the cod recruitment dilemma. *DFO Can. Stock Ass. Sec. Res. Doc.*, No. 17.
24. CASTONGUAY, M. 2000. The northern Gulf of St. Lawrence cod stock – background information on recruitment. *DFO Can. Stock Ass. Sec. Res. Doc.*, No. 106.