

## East and Southeast Newfoundland Atlantic Herring

### Background

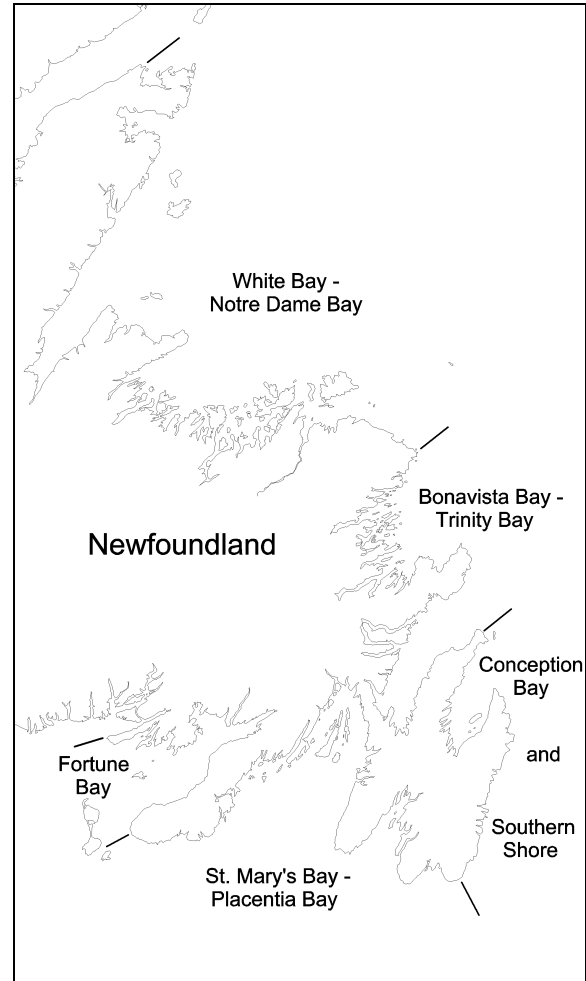
Herring (*Clupea harengus*) are distributed in the northwest Atlantic from Cape Hatteras to southern Labrador.

There are five herring stocks distributed along the east and southeast coasts of Newfoundland: White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, Conception Bay - Southern Shore, St. Mary's Bay - Placentia Bay, and Fortune Bay.

These herring migrate extensively on an annual basis through the coastal waters from near shore spawning grounds to feeding areas throughout the bays and returning to overwinter in deep coastal inlets.

Historically, the stocks have supported commercial food and bait fisheries. The fishery along the northeast coast developed in the mid 1970's and peaked during the late 1970's as a result of increased markets due to the collapse of the North Sea herring fishery. The fisheries in all stock areas were closed in the early 1980's due to declining stock sizes but were reopened in the mid 1980's with the recruitment of the 1982 year class. Although controlled by TAC's, the fisheries since then have been largely driven by market availability and in most years quotas have not been taken.

Separate stock status reports have been prepared within this document for all areas except Conception Bay - Southern Shore, due to the limited commercial fishery and lack of scientific data.



### Summary

- The stock status classification system, predicated upon a quantitative assessment and used for the management of these stocks since the mid 1990's, could not be utilized in this assessment due to the low commercial catches and relatively high bait catches that cannot be quantified.
- Based on Performance reports, including evaluation of abundance

indices and biological characteristics, in the two northern areas, White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay, abundance is low, possibly the lowest in twenty years. In St. Mary's Bay - Placentia Bay, abundance is low but increasing. In Fortune Bay, abundance is still at a high level relative to the 1980's and 1990's. With the exception of Fortune Bay, the other stocks are at low levels relative to peak levels in the 1970's.

- Year classes produced during the 1990's were generally weak, contributing to the low abundance. There is no quantitative evidence of strong recruitment.
- This assessment includes data to June of 2002. Consequently, 2002 catches are incomplete.

### ***Species Biology***

Historically, these stocks have been characterized by the predominance of spring-spawning herring; however, in recent years, autumn spawning herring have formed a substantial component of the commercial catch in Bonavista Bay - Trinity Bay and St. Mary's Bay - Placentia Bay.

Growth is most rapid at earlier ages, herring at age 4 being an average of 27 cm in length and at age 10, 35 cm. Growth rates declined through the 1990's in all areas.

In most areas, the age at which herring mature has remained stable. Most herring are mature by age 6 and can live in excess of 11 years. However, due to reduced growth rates herring are also smaller at age in recent years. This

affects fecundity (number of eggs produced). For example, a one centimetre reduction in the length at which 50% of herring mature results in a 12 – 16% reduction in fecundity (Hodder 1972).

Herring within the Newfoundland region are at the northern extent of their geographic range. Ideal conditions seldom exist and consequently strong recruitment is very sporadic.

It has been shown (Winters and Wheeler 1987) that when good survival of young herring (ie. recruitment) occurred through the 1960's to 1980's, it was largely influenced by suitable environmental conditions, principally warm overwintering water temperatures and high salinities prior to spawning.

Large year classes of herring produced in 1968 and 1969 supported the stocks through the 1970's. The moderately large 1982 year class allowed stocks to rebuild in the 1980's. Since then, the 1987 and 1996 year classes have been of moderate strength, but in some areas only. Ocean temperatures and salinities in the early to mid 1990's were below average and year classes produced during this period were weak. Since 1997, ocean temperatures have been warmer and similar to the long-term average; however, salinities have remained low. There is no evidence of strong recruitment of year classes during this period.

Herring are important as a prey for many species including other fish, sea birds and marine mammals.

Quantitative information on consumption of herring is available only for seals. Hammill and Stenson (2000) estimated

that, in 1996, seals consumed 36,000 t of herring in NAFO Div. 2J3KL, an area encompassing all of the Newfoundland herring stocks, except those in Fortune Bay and Gulf of St. Lawrence. From 1990 to 1996, it was estimated that the consumption of herring by seals in Atlantic Canada increased by 40%. Most of the herring consumed by seals are <30 cm in length.

### ***Methodology to Describe Stock Status***

For each stock area, current stock status and future prospects were summarized in a performance report. Observations on abundance indices, biological characteristics, and ecological considerations, were interpreted and then evaluated using the traffic light method (Caddy, 1998). This method uses a system of red (-), yellow (?), and green (+) lights to categorize indicators as 'cause for concern', 'uncertain', or 'positive'. In this assessment, 'uncertain' was defined as 'uncertainty of an interpretation', rather than precautionary uncertainty.

Five series of abundance indices were evaluated for each of the herring stocks including: research gillnet catch rates, acoustic survey biomass estimates, commercial gillnet catch rates, gillnet fisher observations, purse seine fisher observations, and recruitment estimates. Purse seine fisher observations were not available from Fortune Bay as there is no purse seine fishery in the area.

Biological characteristics, including age compositions, weights at age, and length and age at maturity were evaluated. Ecological considerations included predation by harp seals, and

changes in water temperature and salinity.

In evaluating current stock status and future prospects, only abundance indices and age compositions were considered. Current stock status was described based upon a qualitative evaluation of age composition data (range of mature age groups) and all abundance indices (excluding recruitment data).

Age compositions from research gillnets were considered to best represent population age structure, but age composition data from acoustic surveys and the commercial fishery were also included in the analysis.

Future prospects were described by evaluating the strength of the mature year classes and of recruiting year classes (since 1998). Recruitment data were available from research gillnet catch rates at age, from acoustic surveys, and from the commercial fishery.

The approach used to describe stock status in this assessment differs substantially from the previous most recent assessment in 2000 (Wheeler et al. 2001). Performance reports were compiled retrospectively from the 2000 assessment to compare results of the two methodologies in assessing stock status (Wheeler et al., in prep.).

## **White Bay - Notre Dame Bay**

### ***The Fishery***

Landings decreased from 1090 t in 2000 to 22 t in 2001. In addition to annual reported landings, an unknown amount

of herring (considered to be less than 500 t) is caught in the gillnet bait fishery.

Effort has declined since the 1980's. Purse seine effort in the fall fishery (sets per fisher) decreased by 88% from 1997 to 2000; there was no purse seine fishery in the fall of 2001. Gillnet effort (net nights fished per fisher) in the spring fishery, decreased, by 85% from 1996 to 2002.

Landings and TAC's ('000 t)

Year	1991	1992	1993	1994	1995	1996
TAC	13.5	13.5	13.5	13.5	1.2	1.6
Landings	8.7	5.6	1.7	1.4	1.6	0.7

Year	1997	1998	1999	2000	2001	2002
TAC	4.9	2.5	2.5	2.5	1.1	1.1
Landings	2.5	.7	1.1	1.1	<0.1	<0.1

1998-2001 provisional landings  
2002 provisional to end of June.

### Resource Assessment

#### Abundance Indices

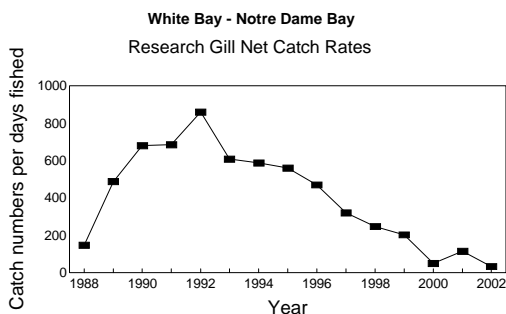


Figure 1. Research gillnet catch rates, White Bay – Notre Dame Bay.

Research gillnet catch rates (number of fish per nights fished) have decreased continuously since 1992; catch rates in 2002 were the lowest in the 15 year time series and are currently 3% of the peak in 1992.

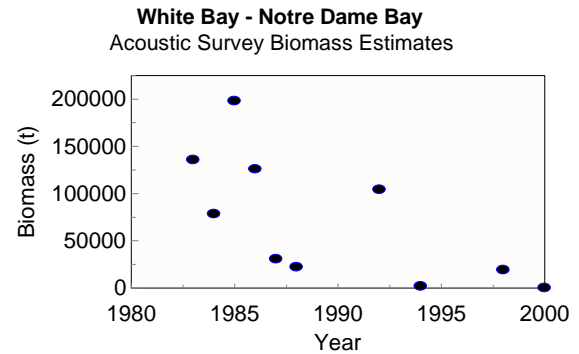


Figure 2. Acoustic survey biomass estimates, White Bay – Notre Dame Bay.

The biomass (t) estimated from an acoustic survey in the fall of 2000 was the lowest in the time series. There has been a decreasing trend in ten surveys conducted between 1983 and 2000. The 2000 estimate is < 1% of the peak in 1985.

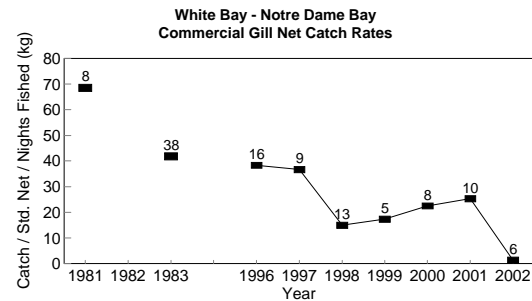


Figure 3. Commercial gillnet catch rates, White Bay – Notre Dame Bay (sample sizes above each point).

Commercial gillnet catch rates (kilograms per net per nights fished) have exhibited a decreasing trend in the seven year time series which began in 1996. The 2002 catch rate was the lowest in the series, and is 3% of the peak in 1996.

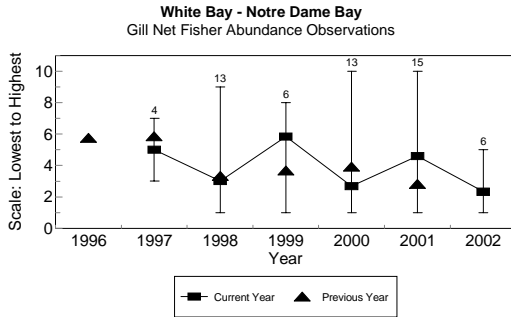


Figure 4. Commercial gillnet fisher observations on herring abundance, White Bay – Notre Dame Bay (line and rectangular markers represent mean responses for the current year; triangular markers represent perception in previous year from current year; vertical bars represent range of responses, and numbers above bars represent sample sizes).

Gillnet fishers indicated (on a ten point scale) that herring abundance in 2002 was below average and decreasing.

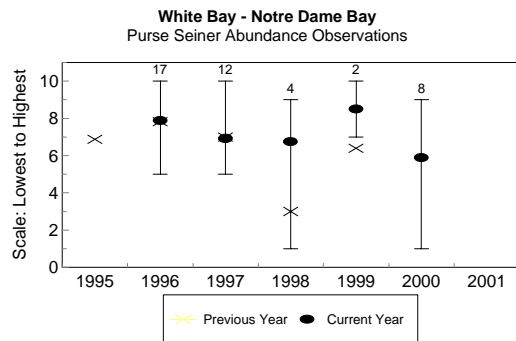


Figure 5. Commercial purse seine fisher observations on herring abundance, White Bay – Notre Dame Bay (circular markers represent mean responses for the current year; x's represent perception in previous year from current year; vertical bars represent range of responses, and numbers above bars represent sample sizes).

There was no purse seine fishery in the fall of 2001; purse seine fishers indicated (on a ten point scale) that herring abundance in 2000 was above average and stable.

Herring of the 1998 or subsequent year classes were not detected in the 2001 research gillnet program. Samples from

2002 have not yet been processed. Similarly, they were not detected in the 2000 acoustic purse seine survey. This suggests that recent year classes are not strong.

### Biological Characteristics

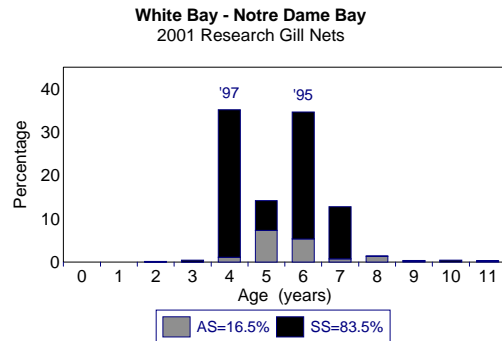


Figure 6. Age distribution from research gillnets fished in 2001, White Bay – Notre Dame Bay.

The age composition from the 2001 research gillnet catch was dominated by the 1995 and 1997 year classes with each accounting for approximately 35% of the catch. There were very few younger mature fish and few fish older than age 7. This was consistent with the age distribution from the 2000 acoustic survey.

Weights at age have decreased continuously during the 1980's and 1990's and, in 2001, were approximately 9% less than in the early 1990's and 25% less than in the early 1980's.

Herring are smaller at age than in the early 1980's. The length at which 50% of herring matured in 1982-1984 was approximately 31 cm; this decreased to 29 cm in 1999-2001 and would result in a concurrent reduction in fecundity. The age at which 50% of herring matured remained relatively consistent (4.5 to 5.0 years).

## Ecological Considerations

The proportion of herring in the diet of harp seals, in inshore areas of NAFO Div. 2J3KL, increased between the late 1980's and the mid 1990's, during a time when the harp seal population increased by approximately 44%, from 3.5 million to 5.2 million seals. It is not clear if this resulted in an increase in consumption of herring from the area due to the high variance associated with diet estimates and changes in sampling over this time period. No other predation information was available for this assessment.

Mean annual water temperatures (at 10 m) in Notre Dame Bay decreased from 5°C in 1990 to 3°C in 1992, but then increased gradually to 6°C in 1999, similar to the long term average.

Mean annual salinities (at 10 m) off St. John's decreased from 1990 to 1991 and have since remained below normal.

## Resource Status

With one exception (purse seine fisher observations in 2000), all abundance indices show that this stock is at a very low level, possibly the lowest since the stock was closed to fishing in the early 1980's. Mature year classes in the population are considered to be weak, contributing to this decline. The spawning stock is dominated by two age groups, with very few younger or older mature fish. Mean weights at age have decreased since the 1980's, and this may have resulted in increased fishing mortality per tonne of catch.

During this same period, there has been an increase in the proportion of herring

in the diet of harp seals, at a time when the seal population is increasing.

Stock status has not changed since the last assessment in 2000 when it was classified as very poor.

## Outlook

There is no evidence of strong recruitment of recent year classes from research gill net catches, the acoustic survey, or the commercial fishery.

The reduction in mean weights at age during the 1990's was coincident with a reduction in fecundity (ie. eggs deposited per female). Given the uncertainty in the relationship between fecundity and egg survival, the impact of this on recruitment is unknown.

Recruitment has been shown to be positively influenced by warm overwintering temperatures and high salinities during the overwintering period prior to spawning. Although recent water temperatures have been similar to long term averages, salinities have been below normal. Mature biomass will not increase in the near future.

Interpretation and evaluation of current status and future prospects is summarized in the attached performance report (Appendix 1).

## Bonavista Bay - Trinity Bay

### The Fishery

Landings decreased from 1090 t in 2000 to 490 t in 2001. In addition to annual reported landings, an unknown amount of herring (considered to be less than 300 t) is caught in the gillnet bait fishery. Mortality from discards in the 2001 fall purse seine fishery, due entirely to small fish, was reported to be approximately 350 t.

The 2001 fall purse seine fishery was concentrated in the northern part of Bonavista Bay. The 2002 spring gillnet fishery was not concentrated in one area but distributed throughout Bonavista and Trinity Bays.

Effort was less in the 1990's than in the 1980's. However, purse seine effort in the fall fishery (sets per fisher) has increased since first measured in 1996 and was the highest in 2001. Gillnet effort (net nights fished per fisher) in the spring fishery declined, by 79% from 1996 to 2002.

Landings and TAC's ('000 t)

Year	1991	1992	1993	1994	1995	1996
TAC	10.0	10.0	10.0	10.0	1.0	1.4
Landings	9.1	4.6	2.3	2.7	1.5	1.1

Year	1997	1998	1999	2000	2001	2002
TAC	1.6	2.5	2.5	2.5	3.5	3.5
Landings	1.1	1.0	1.4	1.1	0.5	0.4

1998-2001 provisional landings  
 2002 provisional to end of June

## Resource Assessment

### Abundance Indices

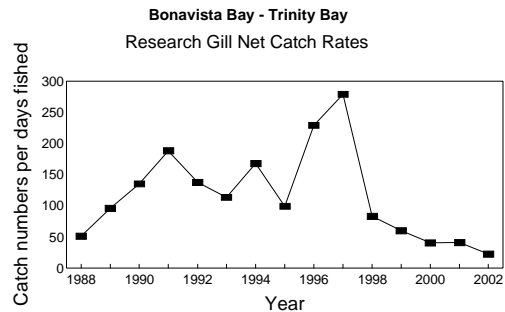


Figure 7. Research gillnet catch rates, Bonavista Bay – Trinity Bay.

Research gillnet catch rates (number of fish per nights fished) have decreased continuously since 1997; catch rates in 2002 were the lowest in the 15 year time series and are currently 8% of the peak in 1997.

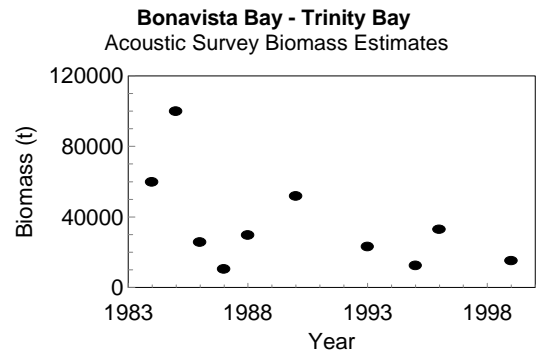


Figure 8. Acoustic survey biomass estimates, Bonavista Bay – Trinity Bay.

There was a decreasing trend in the biomass (t) estimates from ten acoustic surveys conducted between 1984 and 1999.

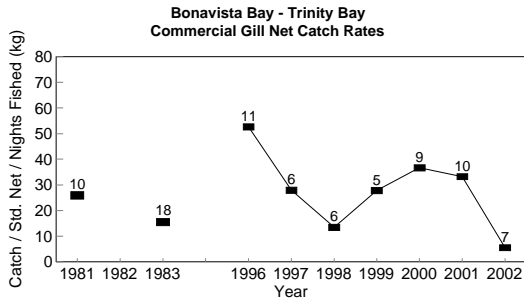


Figure 9. Commercial gillnet catch rates, Bonavista Bay – Trinity Bay (sample sizes above each point).

Commercial gillnet catch rates (kilograms per standard net per nights fished) have exhibited a large decrease from 2001 to 2002. The 2002 catch rate was the lowest in the seven year time series, and is 10% of the peak in 1996.

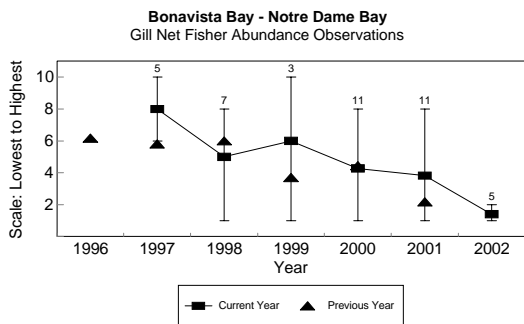


Figure 10. Commercial gillnet fisher observations on herring abundance, Bonavista Bay - Notre Dame Bay (line and rectangular markers represent mean responses for the current year; triangular markers represent perception in previous year from current year; vertical bars represent range of responses, and numbers above bars represent sample sizes).

Gillnet fishers indicated (on a ten point scale) that herring abundance in 2002 was below average and decreasing.

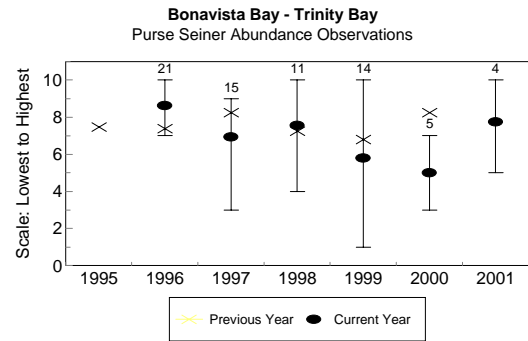


Figure 11. Commercial purse seine fisher observations on herring abundance, Bonavista Bay – Trinity Bay (circular markers represent mean responses for the current year; x's represent perception in previous year from current year; vertical bars represent range of responses, and numbers above bars represent sample sizes).

Purse seine fishers indicated (on a ten point scale) that herring abundance in 2001 was above average and increasing.

Herring from the 1998 year class were caught in the 2001 research gillnet program. Similarly, 1998 and 1999 year class fish were caught in the 2001 commercial fishery and were detected in the 1999 acoustic survey. The research gillnet catch rates at age (age 3 only), indicate that the 1998 year class is weak. The size of the 1999 year class has not been quantified but may be considered small since it has not appeared in the research gillnet catches.



## Biological Characteristics

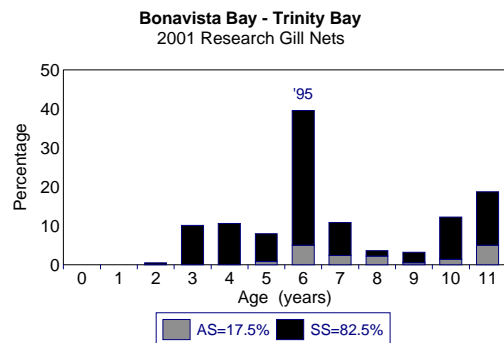


Figure 12. Age distribution from research gillnets fished in 2001, Bonavista Bay – Trinity Bay.

The age composition from the 2001 research gillnet catch was dominated by the 1995 year class which accounted for approximately 40% of the catch. Younger mature fish and fish older than age 7 were also well represented in the catch. This was consistent with the age distribution from the 2001 commercial fishery.

Weights at age have decreased continuously during the 1980's and 1990's and, in 2001, were approximately 8% less than in the early 1990's and 28% less than in the early 1980's.

Herring are smaller at age than in the early 1980's. The length at which 50% of herring matured in 1982-1984 was approximately 30 cm; this decreased to 29 cm in 1999-2001 and would result in a concurrent reduction in fecundity. The age at which 50% of herring mature remained relatively consistent (4.0 to 4.5 years).

## Ecological Considerations

The proportion of herring in the diet of harp seals, in inshore areas of NAFO Div. 2J3KL, increased between the late 1980's and the mid 1990's, during a time when the harp seal population increased by approximately 44%, from

3.5 million to 5.2 million seals. It is not clear if this resulted in an increase in consumption of herring from the area due to the high variance associated with diet estimates and changes in sampling over this time period. No other predation information was available for this assessment.

Mean annual water temperatures (at 10 m) in Bonavista Bay decreased from 5.5°C in 1990 to 3.5°C in 1992, but then gradually increased to 4.5°C in 2000, similar to the long term average.

Mean annual salinities (at 10 m) off St. John's decreased from 1990 to 1991 and have since remained below normal.

## Resource Status

With one exception (purse seine fisher observations in 2001), all abundance indices show that this stock is at a low level. Mature year classes in the population are considered to be weak, contributing to this decline.

Mean weights at age, reduced during the 1990's compared to the 1980's, may have led to increased fishing mortality per weight of fish caught. During this period, there has been an increase in the proportion of herring in the diet of harp seals, at a time when the seal population is increasing.

Although the age structure is dominated by a single age group (1995 year class), there remains a wide range of ages in the mature portion of the biomass.

Stock status has declined since the last assessment in 2000 when it was classified as good. Since then, mature year classes in the population have been shown to be weak, and there has

been a substantial decrease in commercial and research gillnet catch rates.

### **Outlook**

Recent year classes (1998 and 1999) were found in research gillnet catches, the acoustic survey, and the commercial fishery. The research gillnet data (age 3 only), indicate that the 1998 year class is weak, while the abundance of the 1999 year class has not been quantified.

The reduction in mean weights at age during the 1990's was coincident with a reduction in fecundity (ie. eggs deposited per female). Given the uncertainty in the relationship between fecundity and egg survival, the impact of this on recruitment is unknown.

Recruitment has been shown to be influenced by warm overwintering temperatures and high salinities during the overwintering period prior to spawning. Although recent water temperatures have been similar to long term averages, salinities have been below normal.

Any increase in mature biomass in the near future will depend upon the strength of the 1998 and 1999 year classes. As noted above, it appears the 1989 year class is weak.

Interpretation and evaluation of current status and future prospects is summarized in the attached performance report (Appendix 2).

## **St. Mary's Bay - Placentia Bay**

### ***The Fishery***

Landings in 2000 and 2001 were the same, 500 t. In addition to annual reported landings, an unknown amount of herring (considered to be less than 150 t) is caught in the gillnet bait fishery. There was minimal reported discard mortality in the 2002 winter/spring purse seine fishery.

The purse seine fishery, in March 2002, was concentrated along the eastern side of Placentia Bay, similar to recent years. The 2002 gillnet fishery, from mid February to early June, was mostly in Placentia Bay.

Effort increased from the 1980's to the 1990's. Purse seine effort (sets per fisher) peaked in 1997 and has since declined by 71%. Gillnet effort (net nights fished per fisher) peaked in 1998 and has since declined by 89%.

Landings and TAC's ('000 t)

Year	1991	1992	1993	1994	1995	1996
TAC	1.5	1.5	1.5	1.5	1.1	0.7
Landings	1.0	0.9	1.1	0.9	0.8	0.5

Year	1997	1998	1999	2000	2001	2002
TAC	6.6	2.0	2.0	2.0	2.0	2.0
Landings	4.0	2.3	0.3	0.5	0.5	1.1

1998-2001 provisional landings

2002 provisional to end of June

## Resource Assessment

### Abundance Indices

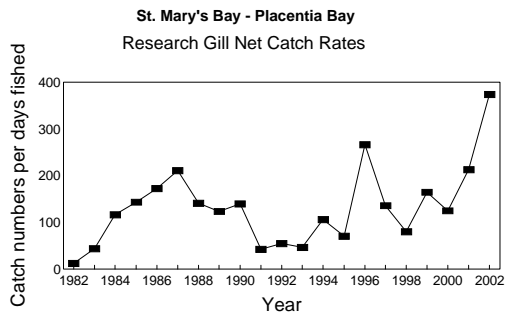


Figure 13. Research gillnet catch rates, St. Mary's Bay – Placentia Bay.

Research gillnet catch rates (number of fish per nights fished) decreased from 1996 to 1998 but have shown an increasing trend since then and are currently the highest in the 21 year time series.

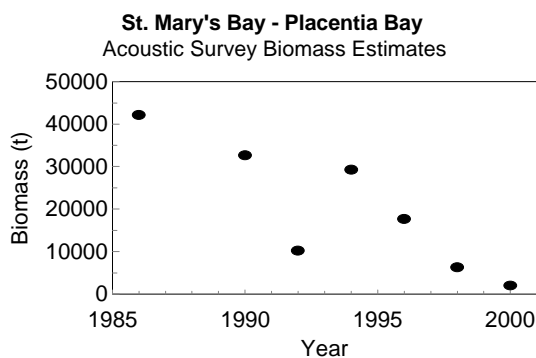


Figure 14. Acoustic survey biomass estimates, St. Mary's Bay – Placentia Bay.

The biomass (t) estimated from the most recent acoustic survey in the winter of 2000 was the lowest in the time series. There was a decreasing trend in ten surveys conducted between 1984 and 2000. The 2000 estimate was 5% of the peak in 1984.

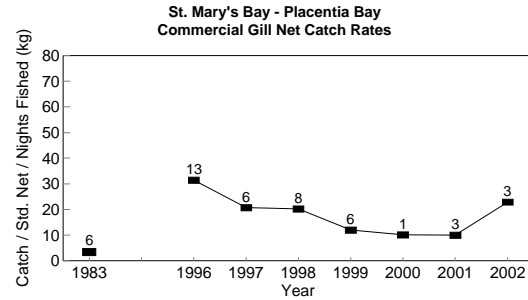


Figure 15. Commercial gillnet catch rates, St. Mary's Bay – Placentia Bay (sample sizes above each point).

Commercial gillnet catch rates (kilograms per standard net per nights fished) were stable at a low level from 1999 to 2001. They increased from 2001 to 2002 and are currently the second highest in the seven year time series.

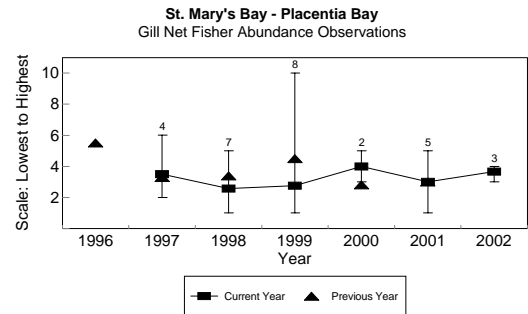


Figure 16. Commercial gillnet fisher observations on herring abundance, St. Mary's Bay – Placentia Bay (line and rectangular markers represent mean responses for the current year; triangular markers represent perception in previous year from current year; vertical bars represent range of responses, and numbers above bars represent sample sizes).

Gillnet fishers indicated (on a ten point scale) that herring abundance in 2002 was below average and stable.

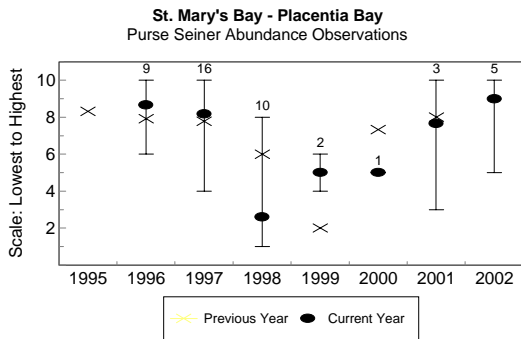


Figure 17. Commercial purse seine fisher observations on herring abundance, St. Mary's Bay – Placentia Bay (circular markers represent mean responses for the current year; x's represent perception in previous year from current year; vertical bars represent range of responses, and numbers above bars represent sample sizes).

Purse seine fishers indicated (on a ten point scale) that herring abundance in 2002 was above average and increasing.

Herring from the 1998 year class were caught in the 2001 research gillnet program only. Fish younger than 3 years of age were not caught in the 2001 commercial fishery, and were not detected in the 2000 acoustic survey. The research gillnet catch rates at age (age 3 only) indicate that the 1998 year class is weak.

**Biological Characteristics**

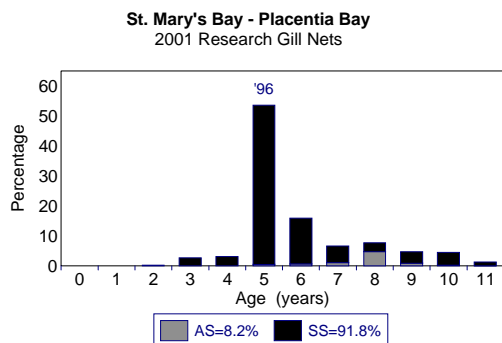


Figure 18. Age distribution from research gillnets fished in 2001, St. Mary's Bay – Placentia Bay.

The age composition from the 2001 research gillnet catch was dominated by the 1996 year class which accounted for approximately 55% of the catch. Although not evident in the research gillnet catch, older fish were represented in the 2001 commercial fishery and in the 2000 acoustic survey.

Weights at age have decreased continuously during the 1980's and 1990's and, in 2001, were approximately 19% less than in the early 1990's and 24% less than in the early 1980's.

Herring are smaller at age than in the early 1980's. The length at which 50% of herring matured in 1982-1984 was approximately 30 cm; this decreased to 29 cm in 1999-2001 and would result in a concurrent reduction in fecundity. The age at which 50% of herring mature remained relatively consistent (4.0 to 4.5 years).

**Ecological Considerations**

No predation information was available for this stock.

Mean annual water temperatures (at 10 m) in Placentia Bay decreased rapidly from 6.5°C in 1990 to 5.0°C in 1992, but then increased gradually to 7.0°C in 2000, similar to the long term average.

Mean annual salinities (at 10 m) off St. John's decreased from 1990 to 1991 and have since remained below normal.

**Resource Status**

Most data show that this stock is increasing due to the recruitment of the 1996 year class. Data from research gillnet catch rates at age, indicate that this year class is of moderate strength,

at best. Other mature year classes in the population are considered to be weak. Although a single age group dominates the mature population, a wide range of ages is present.

Mean weights at age, reduced during the 1990's compared to the 1980's, may have also led to increased fishing mortality per tonne of catch.

Although the stock status has been given a positive rating, this should be treated with caution because the mature biomass is largely dependent upon one year class. All other mature year classes are considered to be weak.

The status of this stock has not changed since the last assessment in 2000 when it was classified as moderate to good.

### **Outlook**

The recruiting 1998 year class was only present in the research gillnet catches. Based upon these data it appears to be weak. There is no evidence of the recruitment of subsequent year classes.

The reduction in mean weights at age during the 1990's was coincident with a reduction in fecundity (ie. eggs deposited per female). Given the uncertainty in the relationship between fecundity and egg survival, the impact of this on recruitment is unknown.

Recruitment has been shown to be influenced by warm overwintering temperatures and high salinities during the overwintering period prior to spawning. Although recent water temperatures have been similar to long term averages, salinities have been below normal. Any increase in mature biomass, in the near future, will depend

upon the strength of the 1998 year class.

Interpretation and evaluation of current status and future prospects is summarized in the attached performance report (Appendix 3).

## **Fortune Bay**

### ***The Fishery***

Landings increased from 850 t in 2000 to 1300 t in 2001. In addition to annual reported landings, an unknown amount of herring (considered to be less than 400 t) is caught in the gill net bait fishery in Fortune Bay.

In recent years, most landings have been by bar seine; in the spring of 2002, this fishery was concentrated in the Long Harbour area. The 2002 gillnet fishery, from early April to late June, was distributed throughout Fortune Bay. There is no purse seine fishery in Fortune Bay.

Effort in the 1980's and 1990's was very low. Gillnet effort (net nights fished per fisher) in the spring fishery peaked in 1997 but has since declined by 87%. No effort information is available from the bar seine fishery.

Landings and TAC's ('000 t)

Year	1991	1992	1993	1994	1995	1996
TAC	1.5	1.5	1.5	1.5	1.5	1.5
Landings	0.1	0.1	0.2	0.3	0.5	0.1

Year	1997	1998	1999	2000	2001	2002
TAC	5.4	5.4	5.4	5.4	2.7	2.7
Landings	0.1	<0.1	0.5	0.8	1.3	2.7

1998-2001 provisional landings

2002 provisional to end of June

## Resource Assessment

### Abundance Indices

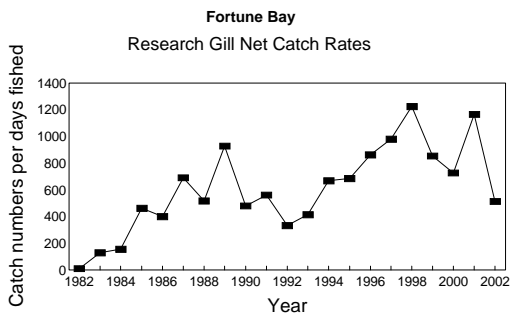


Figure 19. Research gillnet catch rates, Fortune Bay.

Research gillnet catch rates (number of fish per nights fished) decreased from 2001 to 2002. Although below average for the 21 year time series, catch rates are still high compared to those for other stocks and is thought to be reflective of abundance relative to other areas.

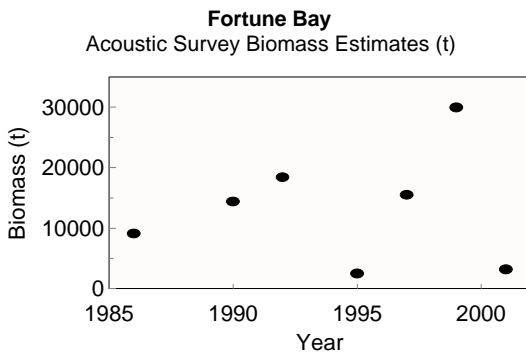


Figure 20. Acoustic survey biomass estimates, Fortune Bay.

The biomass (t) estimated from an acoustic survey in the winter of 2001 was the second lowest in the time series. There had been an increasing trend in six surveys conducted between 1986 and 1999. The 2001 estimate was 11% of the peak in 1999.

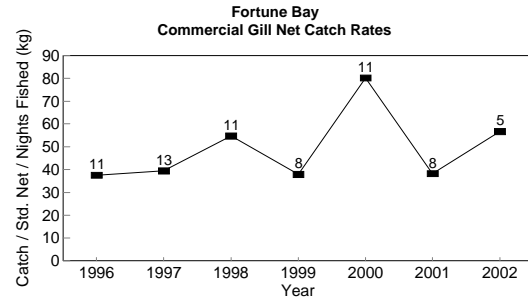


Figure 21. Commercial gillnet catch rates, Fortune Bay (sample sizes above each point).

Commercial gillnet catch rates (kilograms per standard net per nights fished) exhibited no trend and they have fluctuated at high levels for several years.

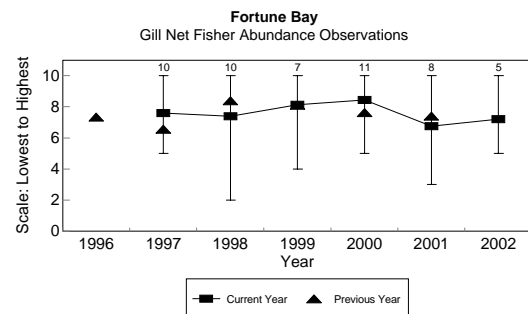


Figure 22. Commercial gillnet fisher observations on herring abundance, Fortune Bay (line and rectangular markers represent mean responses for the current year; triangular markers represent perception in previous year from current year; vertical bars represent range of responses, and numbers above bars represent sample sizes).

Gillnet fishers indicated (on a ten point scale) that herring abundance in 2002 was above average and stable.

Two recruiting (1998 and 1999) year classes were caught in the 2001 commercial fishery. Neither year class was caught in the 2001 research gillnets, nor were they detected in the 2001 acoustic survey suggesting that neither year class is large.

## Biological Characteristics

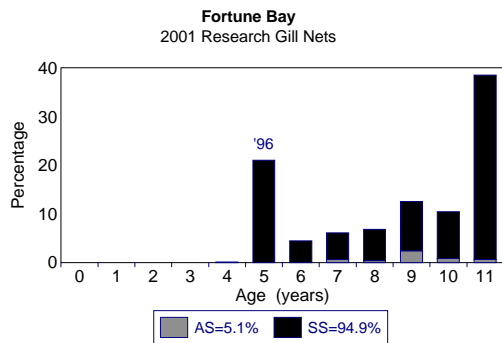


Figure 23. Age distribution from research gillnets fished in 2001, Fortune Bay.

The age composition from the 2001 research gillnet catch was dominated by fish aged 11+ which accounted for approximately 40% of the catch. The 1996 year class was the most dominant individual year class for ages 10 and less, accounting for approximately 20% of the catch. This year class was also dominant in the 2001 fishery and acoustic survey.

Weights at age have decreased continuously during the 1980's and 1990's and, in 2001, were approximately 19% less than in the early 1990's and 24% less than in the early 1980's.

Herring are smaller at age than in the early 1980's. The length at which 50% of herring matured in 1982-1984 was approximately 31 cm; this decreased to 29 cm in 1999-2001 and would result in a concurrent reduction in fecundity. The age at which 50% of herring mature increased from 4 to 5.

## Ecological Considerations

No predation information was available for this stock.

Water temperature data were not available for Fortune Bay. However, mean annual water temperatures (at 10 m) in Placentia Bay decreased rapidly from 6.5°C in 1990 to 5.0°C in 1992. Temperatures increased gradually to 7.0°C in 2000, similar to the long term average.

Mean annual salinities (at 10 m) off St. John's decreased from 1990 to 1991 and have since remained below normal.

## Resource Status

Most data show that this stock is still at a high level but it may be decreasing. From research gillnet catch rates at age, the 1996 year class has been shown to be of moderate strength, at best. Other mature year classes in the population are considered to be weak.

The status of this stock has not changed since the last assessment in 2000 when it was classified as moderate to good.

## Outlook

Given that older fish (age 11+) dominated the research gillnet catch in 2001, it is likely that mature biomass will decrease as these year classes die of natural mortality. The 1998 year class was evident only as a small percentage of the commercial catch, suggesting that this year class is not abundant. There is no evidence of strong recruitment from more recent year classes. Therefore, any change in mature biomass, in the near future, will depend upon the

strength of the 1998 year class. Its strength has not been quantified.

The reduction in mean weights at age during the 1990's was coincident with a reduction in fecundity (i.e. eggs deposited per female). Given the uncertainty in the relationship between fecundity and egg survival, the impact of this on recruitment is unknown.

Recruitment has been shown to be influenced by warm overwintering temperatures and high salinities during the overwintering period prior to spawning. Although recent water temperatures have been similar to long term averages, salinities have been below normal.

Interpretation and evaluation of current status and future prospects is summarized in the attached performance report (Appendix 4).

### ***Sources of Uncertainty***

Estimation of recruiting year class strength is important in evaluating the future prospects of these stocks. In most cases, recruitment data are limited and estimation of year class strength is scanty at best. However, strong year classes are normally seen across stock areas and quickly become dominant in most data sources. It poses more of a problem when recruiting year classes are of weak to moderate strength and predictions are required of their impact on trends in stock size.

The evaluation of and detection of trends in abundance from indices is dependent, among other things, upon the uncertainties associated with each index; usually, confidence intervals will be tighter when sample sizes are larger.

Due to the limited fishery and limited research, sample sizes for the indices in these assessments are generally small resulting in higher uncertainties.

### ***Management Considerations***

The stock status classification system, predicated upon a quantitative assessment and used for the management of these stocks since the mid 1990's, could not be utilized in this assessment due to the low commercial catches and relatively high bait catches that cannot be quantified.

Performance reports from this assessment provide a review of stock status and a more visual description of stock status; however, they do not provide absolute estimates of abundance.

### ***Industry Perspective***

Purse seine fishers in Bonavista Bay - Trinity Bay have identified the mixing of immature (non-commercial size) herring with mature (commercial size) herring as a major problem during the 2001 commercial fishery. Their optimistic view of stock status is based upon the observation of numerous mixed schools during the fishery.

Comments provided by numerous commercial gillnet and fixed gear fishers indicate that predation of herring by seals is a major concern, especially in northeast coast stock areas.



**For More Information**

Contact: John Wheeler  
Fisheries and Oceans  
Canada  
PO Box 5667  
St. John's, NL A1C 5X1

Tel: 709-772-2005  
Fax: 709-772-4188  
E-Mail: [WheelerJ@DFO-  
MPO.GC.CA](mailto:WheelerJ@DFO-MPO.GC.CA)

**References**

Caddy, J. F. 1998. A short review of precautionary reference points and some proposals for their use in data-poor situations. FAO Fisheries Technical Paper No. 379, 30 pp.

Hammil, M. O. and G. B. Stenson. 2000. Estimated prey consumption by harp seals, hooded seals, grey seals, and harbour seals in Atlantic Canada. J. Northw. Atl. Fish. Sci. Vol. 26: 1-23.

Hodder, V. M. 1972. The fecundity of herring in some parts of the Newfoundland area. INFAF Research Bulletin No. 9, 99-107.

Wheeler, J. P., B. Squires, and P. Williams. 2001. Newfoundland east and southeast coast herring - an assessment to the spring of 2000. C.S.A.S. Res. Doc. 2001/018, 129 p.

Wheeler, J. P., B. Squires, and P. Williams. Newfoundland east and southeast coast herring - an assessment to the spring of 2002. C.S.A.S. Res. Doc. (in prep.).

Winters, G. H. And J. P. Wheeler. 1985. Recruitment dynamics of spring-spawning herring in the northwest Atlantic. Can. J. Fish. Aquat. Sci. 44: 882-900.

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Newfoundland and Labrador Region  
Science, Oceans and Environment  
Branch

Fisheries and Oceans Canada  
PO Box 5667

St. John's NL A1C 5X1

Phone Number (709) 772-2027/8892

Fax Number (709) 772-6100

e-mail address richardsed@dfo-  
mpo.gc.ca

[www.dfo-mpo.gc.ca/csas](http://www.dfo-mpo.gc.ca/csas)

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**Appendix 2. Bonavista Bay - Trinity Bay Performance Report to the Spring of 2002 (this table should not be considered in isolation from the text of the Stock Status Report due to the risk of erroneous interpretation of overall stock status).**

<i>The Fishery</i>	<b>Observation</b>		
Reported Landings	Landings decreased from 1090 t in 2000 to 490 t in 2001; 14% of the TAC was taken in 2001; average landings of 2600 t during 1990's; peak landings of 12,000 t in 1977. To June 30, 2002 the catch was 391 t.		
Total Removals	In addition to reported landings in 2001, an unknown amount of herring (considered to be less than 300 t) was caught in the gill net bait fishery; mortality from discards in the purse seine fishery, due entirely to small fish, was reported to be approximately 350 t.		
Effort	Overall, effort was less in the 1990's than in the 1980's; gillnet effort has continued to decline, by 79% since 1996; purse seine effort increased since 1996 and was highest in 2001.		
Geographic Distribution of Fishery	The 2001 purse seine fishery, in October and November, was concentrated in the northern part of Bonavista Bay. The 2002 gillnet fishery, from mid April to mid June, was distributed throughout Bonavista and Trinity Bays.		
<b>Abundance Indices</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
Research Gillnet Catch Rates	Decreased from 2000 to 2002; lowest in 15 year time series; decreasing trend since 1992.	Current abundance very low and decreasing.	-
Acoustic Biomass Estimates	Decreasing trend in 10 surveys since 1984.	Abundance in 1999 low; much lower than in the 1980's. More recent information not available therefore no evaluation.	
Commercial Gillnet Catch Rates	Large decrease from 2001 to 2002; lowest in 7 year time series; 2002 = 6, mean = 28, maximum = 53.	Current abundance very low and decreasing.	-
Gillnet Fisher Observations	Abundance in 2002 perceived to be below average and declining.	Current abundance low and decreasing.	-
Purse Seine Fisher Observations	Abundance in 2001 perceived to be above average and increasing.	Current abundance increasing and no cause for concern.	+
Recruitment (year classes since 1998)	1998 and 1999 year classes detected in purse seine fishery and acoustic survey; however, no estimates are available.	Some evidence of recruitment; not quantified.	?
<b>Biological Characteristics</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
2001 Age Compositions (ages 4+)	Dominated by the 1995 year class; younger or older fish well represented.	Spawning biomass consists of a broad age composition.	+
Weight at Age	Weights at most ages have decreased continuously since the early 1980's.	Potential increase in fishing mortality per tonne caught.	?
Length and Age at Maturity	Currently maturing at smaller lengths than in the early 1980's; no change in age at maturity.	Reduction in number of eggs deposited due to lower fecundity.	?
<b>Ecological Considerations</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
Predation	Proportion of herring in harp seal diet has increased in near shore areas since the 1980's; no other predation data available.	Increased mortality by harp seals; other changes in predation mortality unknown.	?
Water Temperature (at 10 m in Stock Cove, BB)	Mean annual temperature decreased from 5.5°C in 1990 to 3.5°C in 1992; increased gradually to 4.5°C in 2000.	May have reduced herring growth rates in the 1990's; lower temperatures may also adversely affect recruitment.	?
Water Salinity (at Station 27, off St. John's)	Mean annual salinities decreased from 1990 to 1991 and have remained at levels lower than in the 1980's.	Lower salinities may adversely affect recruitment.	?
<b>STOCK STATUS</b>	<b>Interpretation</b>	<b>Evaluation</b>	
Current	Population age structure is considered to be stable; however, current abundance is low, possibly lowest in 20 years.	-	-
Prospect	Current mature year classes considered to be weak; recruitment evident but unquantified.	?	?

-	Concern for Current Status or Prospect
?	Uncertainty of Interpretation
+	Positive Evaluation

Most available data indicate that this stock is at a low level. Future prospects depend upon recruitment of year classes since 1998, which are not yet quantified. Due to substantial decreases in commercial and research gillnet catch rates, stock status has changed since the last assessment in 2000, when it was classified as good.

**Appendix 3. St. Mary's Bay - Placentia Bay Performance Report to the Spring of 2002 (this table should not be considered in isolation from the text of the Stock Status Report due to the risk of erroneous interpretation of overall stock status).**

<i>The Fishery</i>	<b>Observation</b>		
Reported Landings	Landings in 2000 and 2001 were the same, 500 t; 25% of the TAC was taken in 2001; average landings of 1200 t during 1990's; peak landings of 4000 t in 1997 (since large mobile purse seine fishery in 1960's). To June 30, 2002 the catch was 1120 t, over double the catch in all of 2001.		
Total Removals	In addition to reported landings in 2001, an unknown amount of herring (considered to be less than 150 t) was caught in the gillnet bait fishery; there was minimal reported discard mortality in the purse seine fishery.		
Effort	Effort increased from the 1980's to the 1990's; purse seine effort peaked in 1997 and has since declined by 71%; gillnet effort peaked in 1998 and has since declined by 89%.		
Geographic Distribution of Fishery	The purse seine fishery, in March 2002, was concentrated along the eastern side of Placentia Bay. The 2002 gillnet fishery, from mid February to early June, was mostly in Placentia Bay.		
<b>Abundance Indices</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
Research Gillnet Catch Rates	Increased from 2001 to 2002; highest in 21 year time series; increasing trend since 2000.	Recent increase in abundance.	<b>+</b>
Acoustic Biomass Estimates	2000 estimate was lowest in time series; decreasing trend in 10 surveys since 1984.	Abundance in 2000 low; much lower than in the 1980's; more recent information not available, therefore no evaluation.	
Commercial Gillnet Catch Rates	Stable at low level from 1999 to 2001; increased from 2001 to 2002 to second highest in 7 year series.	Recent increase in abundance.	<b>+</b>
Gillnet Fisher Observations	Abundance in 2002 perceived to be below average and stable or increasing marginally.	Current abundance low and stable or increasing marginally.	<b>-</b>
Purse Seine Fisher Observations	Abundance in 2002 perceived to be above average and increasing.	Current abundance increasing and no cause for concern.	<b>+</b>
Recruitment (year classes since 1998)	1998 year class detected in research gill net catches; initially estimated to be weak.	Possibly poor recruitment.	<b>?</b>
<b>Biological Characteristics</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
2001 Age Compositions (ages 4+)	Dominated by the 1996 year class; representation of older fish, but few younger fish.	Fairly Broad population age structure. But concern regarding apparent lack of younger fish.	<b>?</b>
Weight at Age	Weights at most ages have decreased continuously since the early 1980's.	Potential increase in fishing mortality.	<b>?</b>
Length and Age at Maturity	Currently maturing at smaller lengths than in the early 1980's.	Reduction in number of eggs deposited due to lower fecundity.	<b>?</b>
<b>Ecological Considerations</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
Predation	No predation data available.		
Water Temperature (at 10 m in Arnold's Cove, PB)	Mean annual temperature decreased from 6.5°C in 1990 to 5.0°C in 1992; increased gradually to 7°C in 2000.	May have reduced growth rates in the 1990's; lower temperatures may also adversely affect recruitment.	<b>?</b>
Water Salinity (at Station 27, off St. John's)	Mean annual salinities decreased from 1990 to 1991 and have remained at levels lower than in the 1980's.	Lower salinities may adversely affect recruitment.	<b>?</b>
<b>STOCK STATUS</b>	<b>Interpretation</b>	<b>Evaluation</b>	
Current	Current abundance is increasing; population age structure is considered to be moderately stable.	<b>+</b>	<b>-</b> Concern for Current Status or Prospect
Prospect	One dominant year class considered to be moderate, at best; other mature year classes considered weak; unquantified recruitment.	<b>?</b>	<b>?</b> Uncertainty of Interpretation
			<b>+</b> Positive Evaluation

Most available data indicate that this stock is increasing due to one year class (1996). Prospects are questionable due to potential poor recruitment of year classes since 1998. Stock status has not changed since the last assessment in 2000, when it was classified as moderate to good.

**Appendix 4. Fortune Bay Performance Report to the Spring of 2002 (this table should not be considered in isolation from the text of the Stock Status Report due to the risk of erroneous interpretation of overall stock status).**

<i>The Fishery</i>	<b>Observation</b>		
Reported Landings	Landings increased from 850 t in 2000 to 1300 t in 2001; 47% of the TAC was taken in 2001; average landings of 200 t during 1990's; peak landings in 2001 (since large mobile purse seine fishery in 1960's). To June 30, 2002 the catch was 2711 t, over double the catch in all of 2001.		
Total Removals	In addition to reported landings in 2001, an unknown amount of herring (considered to be less than 400 t) was caught in the gillnet bait fishery.		
Geographic Distribution of Fishery	Effort in 1980's and 1990's was very low; gillnet effort peaked in 1997 and has since declined by 87%; there is no purse seine fishery in Fortune Bay; the current fishery is primarily by bar seine for which no effort information is available.		
Exploitation Pattern	The 2002 spring bar seine fishery was concentrated in the Long Harbour area; the gillnet fishery, from early April to late June, was distributed throughout Fortune Bay.		
<b>Abundance Indices</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
Research Gillnet Catch Rates	Decreased from 2001 to 2002; catch rates below average but still very high.	Recent decrease in abundance but still at a high level, relative to other stocks.	<b>+</b>
Acoustic Biomass Estimates	2001 estimate second lowest of 7 surveys since 1986; increasing trend until 1999.	Abundance in 2001 lower than in previous surveys and second lowest in series.	<b>-</b>
Commercial Gillnet Catch Rates	No trend; catch rates have fluctuated at high levels for several years.	Current abundance stable at a high level.	<b>+</b>
Gillnet Fisher Observations	Abundance in 2002 perceived to be above average and stable or decreasing marginally.	Current abundance high and stable or decreasing marginally.	<b>+</b>
Recruitment (year classes since 1998)	1998 and 1999 year classes detected in commercial bar seine catches; however, no estimates are available for these year classes.	Minimal evidence of recruitment; not quantified.	<b>?</b>
<b>Biological Characteristics</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
2001 Age Compositions (ages 4+)	Dominated by one age group (1996 year class); fish aged 11+ very well represented.	Population age structure is considered to be stable due to substantial contribution of older fish.	<b>+</b>
Weight at Age	Weights at most ages have decreased continuously since the early 1980's.	Potential increase in fishing mortality per tonne caught.	<b>?</b>
Length and Age at Maturity	Currently maturing at smaller lengths than in the early 1980's; age at maturity is older.	Reduction in number of eggs deposited due to lower fecundity.	<b>?</b>
<b>Ecological Considerations</b>	<b>Observation</b>	<b>Interpretation</b>	<b>Evaluation</b>
Predation	No predation data available.		
Water Temperature (at 10 m in Arnold's Cove, PB)	Mean annual temperature decreased from 6.5°C in 1990 to 5.0°C in 1992; increased gradually to 7°C in 2000.	May have reduced herring growth rates in the 1990's; lower temperatures may also adversely affect recruitment.	<b>?</b>
Water Salinity (at Station 27, off St. John's)	Mean annual salinities decreased from 1990 to 1991 and have remained at levels lower than in the 1980's.	Lower salinities may adversely affect recruitment.	<b>?</b>
<b>STOCK STATUS</b>	<b>Interpretation</b>	<b>Evaluation</b>	
Current	Current abundance due to one year class is at a high level relative to the 1980's; population age structure is considered to be stable.	<b>+</b>	<b>-</b> Concern for Current Status or Prospect
Prospect	One dominant year class considered to be moderate, at best; other mature year classes considered weak; unquantified recruitment.	<b>?</b>	<b>?</b> Uncertainty of Interpretation
			<b>+</b> Positive Evaluation

All available data indicate that this stock is at a high level due to low fishing mortality over the past fifteen years. Prospects are questionable due to potential poor recruitment of year classes since 1998. Stock status has not changed since the last assessment in 2000, when it was classified as moderate to good.