ICE PHENOLOGY

AIM

To monitor the freeze and thaw dates (ice phenology) of water bodies in northern climates as a measure of how aquatic ecosystems are responding to climate change.

RATIONALE

The study of freeze-thaw cycles can aid in the understanding and prediction of how climate change is affecting northern waters. Seasonal changes in the ice cover of lakes and rivers will provide a good indicator of the health of Canadian ecosystems. For example, changes in the migration patterns and breeding seasons of birds, food supplies for fish and mammals, water temperature and water chemistry, can all be affected by ice phenology.

BACKGROUND

Canada's climate is changing in response to increased emissions of greenhouse gases, among other factors; we don't know enough about how the climate will change in different regions of Canada, or how ecosystems will react to the change. Accurately recording and analyzing "ice on" and "ice off" events (also known as ice phenology) offers one practical way to learn how climate change is affecting our environment.

Scientists are studying the natural freeze-thaw cycles of Canadian waters, because lake and river ice cover is being directly affected by climate change, in fact many scientists are concluding that the climate is indeed warming. Seasonal differences in the ice cover of lakes and rivers can have a serious impact on Canadian ecosystems. Ice cover also affects national trade, transportation, outdoor recreation, and tourism.

The specific dates when ice first covers, and then finally leaves the surface of Canadian waterbodies, have been reported regularly at a small number of locations scattered around our country. Researchers would like to study ice phenology information from many more locations across Canada because climate change impacts are not consistent across the country, and there are huge spatial gaps in present monitoring programmes such as IceWatch. Canada's IceWatch network, which encourages the recording of ice phenology data, is being administered nationally as part of the NatureWatch Programme. NatureWatch provides suites of monitoring protocols which encourage researchers, education centres, naturalists and other organisations or individuals to engage in monitoring indicators for environmental quality.

CHECKLIST OF MONITORING ACTIVITIES

- Choose a freshwater lake or river for ice phenology monitoring;
- Complete the site description sheet and select location of observation point;
- Watch for first freeze-up and last thaw;
- Record data and manage data sets;
- Send copy of data to EMAN Coordinating Office or submit observations online at http://www.icewatch.ca.

EQUIPMENT

- Ice Phenology Data Sheets
- Pen
- Binoculars
- Site Map (optional)
- Camera (optional)

LOCATION

Sites need to be easily accessible and free of hazards. In all cases once a site it chosen, *a site description sheet should be filled out*. Site characteristics need to be recorded and the observation point for ice phenology should be plotted. Photographs of the site may also be useful in describing the sample area.

- When selecting a waterbody for study, almost any lake or river is suitable for study. However, there are some freshwater systems that may not be the best candidates for recording freeze-thaw events. These include;
  - long, skinny lakes that run parallel to the prevailing winds (the are heavily influenced by air and wave movement);
  - Lakes and rivers that are heavily controlled by dams - or are affected significantly by upstream water control;
  - Fast flowing rivers or rivers with restrictions (e.g. beaver dams, log jams etc.) will affect the ice thickness and therefore ice breakup.
- Record information about the site and its location (latitude/longitude) using the site description datasheet.
- Once the waterbody is chosen establish a monitoring station or observation point that can be accessible in future years. From this observation point, select and clearly define an observation area or a part of the waterbody that will be observed for freeze-thaw cycles.
  - For small lakes the point should allow a view of almost the entire lake surface.
  - For large lakes, or lakes with convoluted shorelines, the observation point should allow a view of a readily identifiable portion of the lake surface as the observation area (*e.g.*, a bay, an arm of a separate basin, *etc*.).
  - For rivers the point should allow a view of a relatively straight portion of a gently flowing river that is free of restrictions.
  - The point should be located in an area that is unaffected by human influences (dams, sewage or industrial outlets) as they can affect ice thickness and freeze-up/breakup times.
  - The observation point should be located away from agricultural operations where aerators are used to keep open water available such as cattle watering areas, or fish farming operations.
- Fill in the observation area information on the Ice Phenology data sheet.
- **Forest Biodiversity Plots:** If you are completing ice phenology protocols as part of a forest biodiversity plot programme, choose a suitable lake or river that is adjacent to or in the vicinity of the forest biodiversity monitoring plot. Follow the location methods described above.

SAMPLING METHODS

Timing:

Daily observations should be recorded during the freeze-up and break-up periods. These dates will depend on the geographic location of the site.

Data Collection

On a daily basis during freeze-up and break-up periods, stand at the observation point and note the ice cover stage for the observation area. Ice cover stages are as follows:

- Ice on: Ice *completely covers* the area being observed (record 'ice on' each time the ice fully covers and recovers the area under observation).
- Ice off: Ice cover *disappears completely* from the area being observed. If ice recovers the area, record 'ice on' and 'ice off' when it melts again.
- Ice partial coverage is not recorded.

Record the date of observation, ice cover stage, and weather conditions (air temperature) on the attached Ice Phenology data sheet. Take a photograph of the observation area from the observation point at the time of the first observation each year and attach a copy to the data sheet. File paper and/or electronic copies where they can be located the next season.

DATA ANALYSIS

Chart the dates of the last complete ice cover date as well as the first ice break-up date. These dates can show a pattern over time in the decreasing or increasing of ice cover times in Canadian freshwater systems.

DATA MANAGEMENT AND SHARING

Hard copies of the data should be kept for future use. Submit online data at http://www.icewatch.ca. Hard copies can be sent to the Ecological Monitoring and Assessment Network (EMAN) in order to allow for regional, provincial and national comparison of ice phenology.

EMAN Coordinating Office
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REFERENCES

McCanny, S. 1998. Northern National Parks Monitoring Program: From Numbness to Numbers. Unpublished Parks Canada paper.

Molau, U. and P. Mølgaard [eds.]. 1996. International Tundra Experiment ITEX Manual. Danish Polar Centre. Copenhagen. 53pp. + appendices.

EMAN Ecosystem Monitoring Partnership

ICE PHENOLOGY DATA SHEET

SITE INFORMATION

WATERBODY NAME:	**SITE/OBSERVATION POINT NAME:**
OBSERVATION AREA NAME AND DESCRIPTION:	
LATITUDE/LONGITUDE:	**NEAREST NAMED PLACE:**
COUNTY/TOWNSHIP:	**PROVINCE:**
OBSERVER NAME(S):	**OBSERVER ADDRESS:** **TELEPHONE:**

DATE (mm/dd/yr)	ICE COVER STAGE	Air Temperature	COMMENTS (weather conditions, disturbances etc.)

Other Comments:

ICE COVER STAGE

ICE ON — Ice *completely covers* the area being observed (record ICE ON each time the ice fully covers and recovers the area under observation)

ICE OFF — Ice cover *disappears completely* from the area being observed. If ice recovers the area, record ICE ON and ICE OFF when it melts again.

ATTACH PHOTOGRAPHS OF OBSERVATION AREA HERE
(Digital photos can be uploaded and submitted to http://www.icewatch.ca)