

# Package ‘GLFC’

May 20, 2015

**Title** Great Lakes Fishery Commission

**Version** 0.0.0.9002

**Description** Functions developed for the Great Lakes Fishery Commission's sea lamprey control program, including estimation of the index of adult sea lamprey abundance.

**Depends** R (>= 3.1.3)

**Imports** plyr, maps, jvamic

**License** GPL

**LazyData** TRUE

**URL** <https://github.com/JVAdams/GLFC>

**Author** Jean V. Adams [aut, cre]

**Maintainer** Jean V. Adams <jvadams@usgs.gov>

## R topics documented:

Alcheck . . . . .	2
Alestimate . . . . .	2
Alprep . . . . .	3
Alreport . . . . .	4
Altarget . . . . .	5
estAIndex . . . . .	6
index2pe . . . . .	7
jackIndex . . . . .	8
lsIndex . . . . .	8
lsKeep . . . . .	9
trappedStreams . . . . .	9
<b>Index</b>	<b>10</b>

AIcheck

*Error Check the Adult Index Data***Description**

Check the adult sea lamprey trapping data (collected for estimation of the Adult Index) for errors.

**Usage**

```
AIcheck(streamDat, csvDir, outFile = NULL, otherTabs = NULL)
```

**Arguments**

streamDat	A data frame of old and new stream mark-recapture estimates used to estimate the lake-wide Adult Indices, typically the output from <a href="#">AIprep</a> . The data frame must include: year, lake, lake-stream ID lscore (see details), population estimate PEmr, coefficient of variation CVmr (100 identifying the index streams; maintain a logical identifying the streams that will continue to have ongoing trapping even if not part of the Adult Index; indexContrib a numeric, the stream population estimate that will be used in the Adult Index (NA for new); and complete a logical identifying streams and years for which the Adult Index has already been estimated (FALSE for new).
csvDir	A character scalar identifying the path where the rtf file will be stored, e.g., csvDir = "C:\temp\mydir".
outFile	Name of the output rtf file, default NULL, in which case the file will be named "YYYY Adult Index - error checking.doc" where YYYY is the latest year represented in streamDat.
otherTabs	A list of other tables to be printed in error check report, default NULL. The list names will be used as captions.

**Details**

Lake-stream IDs are combination of lake ID and stream ID e.g., 1.064 = lake ID + (stream ID)/1000.

**Value**

An error checking document as an rtf file (with the file type \*.doc, so that MS Word will open it automatically).

AIestimate

*Estimate Index of Sea Lamprey Adults***Description**

Estimate the Adult Index of sea lampreys in a single Great Lake.

**Usage**

```
AIestimate(streamDat, minNMR = 2)
```

## Arguments

streamDat	A data frame of old and new stream mark-recapture estimates used to estimate the lake-wide Adult Indices, typically the output from <a href="#">AIprep</a> . The data frame must include: year, lake, lake-stream ID lscore (see details), population estimate PEmr, coefficient of variation CVmr (100 identifying the index streams; maintain a logical identifying the streams that will continue to have ongoing trapping even if not part of the Adult Index; indexContrib a numeric, the stream population estimate that will be used in the Adult Index (NA for new); and complete a logical identifying streams and years for which the Adult Index has already been estimated (FALSE for new).
minNMR	An integer scalar greater than or equal to 2, the minimum number of mark-recapture estimates needed in a year to generate an index, default 2.

## Details

The annual Adult Index is simply the sum of stream population estimates for each year. Missing stream estimates are estimated by a lake-specific ANOVA model relating the log of the stream estimates to the main effects of each stream and each year, weighted by the inverse of the CV squared. The jackknifed range is produced by recalculating the index, leaving out one stream at a time, then scaling up the result to the same scale as the Adult Index based on all streams.

## Value

A list with 2 components: streamDat, a data frame of stream mark-recapture and Adult Index contributions for the incomplete rows in streamDat, with the same variables as streamDat; and lakeIndex, a data frame of annual lake-wide Adult Indices for the incomplete rows in (streamDat), with 5 columns: lake, year, the Adult Index index, and the lower and upper jackknifed range jlo and jhi.

---

AIprep	<i>Prepare the Adult Index Data</i>
--------	-------------------------------------

---

## Description

Read in the adult sea lamprey trapping data (collected for estimation of the Adult Index) and prepare it for estimation.

## Usage

```
AIprep(csvDir, csvNew, csvOld = NULL, streamInfo = trappedStreams,
       indexStreams = lsIndex, keepStreams = lsKeep)
```

## Arguments

csvDir	A character scalar identifying the path where the csv files are stored, e.g., csvDir = "C:\temp\mydir"
csvNew	A character scalar identifying the name of the csv file with stream mark-recapture estimates for which Adult Indices will be estimated (typically from the current year). The first row of the csv file should be column headers and must include: year, lake, lake-stream ID lscore (see details), population estimate PEmr, coefficient of variation CVmr ( $100\% * \sqrt{\text{variance}(\text{PEmr})} / \text{PEmr}$ ). See details.

csvOld	A character scalar identifying the name of the csv file with stream mark-recapture estimates for which Adult Indices have already been estimated (typically from previous years), with the same variables as in csvNew plus the previously estimated contribution indexContrib, default NULL. See details.
streamInfo	A data frame with stream information to be combined with the estimates data (csvNew and csvOld), default <code>trappedStreams</code> . Set to NULL if you don't want any stream information to be brought in.
indexStreams	Lake-stream IDs identifying index streams, default <code>lsIndex</code> .
keepStreams	Lake-stream IDs identifying streams which will continue to have ongoing trapping even if not part of the Adult Index, default <code>lsKeep</code> .

### Details

Lake-stream IDs are combination of lake ID and stream ID e.g., 1.064 = lake ID + (stream ID)/1000. For both estimate files (csvNew and csvOld), there should be no missing values in year, lake, or lscore. Both files may contain variables other than those required. Those with the same name as variables in streamInfo will be replaced. Others will be kept.

### Value

A single data frame that contains the information from all of the inputs, including new variables: index, a logical identifying the index streams; maintain a logical identifying the streams that will continue to have ongoing trapping even if not part of the Adult Index; indexContrib a numeric, the stream population estimate that will be used in the Adult Index (NA for csvNew); and complete a logical identifying streams and years for which the Adult Index has already been estimated (FALSE for csvNew).

---

AIreport

*Adult Index Report*


---

### Description

Create a draft template-style report of the Adult Index estimates of sea lamprey in the Great Lakes.

### Usage

```
AIreport(streamPEs, lakeIPes, targets, csvDir, outFile = NULL)
```

### Arguments

streamPEs	A data frame of "complete" stream mark-recapture estimates (meaning all contributions to the Adult Indices have already been calculated). The data frame must include: year, lake, lake-stream ID lscore (see details), population estimate PEmr, coefficient of variation CVmr (100 identifying the index streams; maintain a logical identifying the streams that will continue to have ongoing trapping even if not part of the Adult Index; indexContrib a numeric, the stream population estimate that will be used in the Adult Index (NA for new); and complete a logical identifying streams and years for which the Adult Index has already been estimated (should be all TRUE).
-----------	---

lakeIPes	A data frame of annual lake-wide Adult Indices with 8 columns: lake, year, the Adult Index index, its associated lower and upper jackknifed range jlo and jhi, and the corresponding expansion to a supposed population estimate, pe, pelo and pehi. The data frame may contain variables other than those required.
targets	A data frame with the calculated targets for the Adult Index and expanded PE of each Great Lake, with 3 columns: lake, targInd, and targPE, typically the output from <a href="#">AItarget</a> .
csvDir	A character scalar identifying the path where the rtf file will be stored, e.g., csvDir = "C:\temp\mydir".
outFile	Name of the output rtf file, default NULL, in which case the file will be named "YYYY Adult Index - draft report.doc" where YYYY is the latest year represented in streamDat.

### Details

Lake-stream IDs are combination of lake ID and stream ID e.g., 1.064 = lake ID + (stream ID)/1000.

### Value

A draft report document as an rtf file (with the file type \*.doc, so that MS Word will open it automatically).

---

AItarget	<i>Calculate Targets for the Adult Index</i>
----------	--

---

### Description

Calculate lake-wide targets for the Adult Index of sea lamprey populations in the Great Lakes from the mean of specified years.

### Usage

```
AItarget(lakeIndex, years = list(1994:1998, 1988:1992, 1989:1993, 1991:1995,
                                1993:1997), adjust = c(1, 1, 0.25, 1, 1))
```

### Arguments

lakeIndex	A data frame of annual lake-wide Adult Indices with 4 columns: lake, year, the Adult Index index, and the corresponding estimates expanded out to a supposed population estimate, pe. The data frame may contain variables other than those required.
years	A list of length 5 (for each Great Lake respectively: Superior, Michigan, Huron, Erie, and Ontario), each element an integer vector of length 5 specifying the 5 years during which there were acceptable sea lamprey wounding rates on lake trout, default list(1994:1998, 1988:1992, 1989:1993, 1991:1995, 1993:1997). These will be used to generate Adult Index targets.
adjust	A numeric vector of length 5 (for each Great Lake), specifying adjustments to be made to the calculated means to generate Adult Index targets, default c(1, 1, 0.25, 1, 1). Since Lake Huron did not have a time period with acceptable sea lamprey wounding rates, the target is set to 25% of the mean for 1989-1993.

**Value**

A data frame with the calculated targets for the Adult Index and expanded PE of each Great Lake, with 3 columns: lake, targInd, and targPE.

---

estAIndex	<i>Estimate Index of Sea Lamprey Adults</i>
-----------	---

---

**Description**

Estimate the Adult Index of sea lampreys in a single Great Lake.

**Usage**

```
estAIndex(indexStreams, streamPECurr, streamPEPrev = NULL, minNMR = 2)
```

**Arguments**

indexStreams	A numeric vector of lake-stream IDs identifying streams to be included in the index, e.g., 1.064 = lake ID + (stream ID)/1000.
streamPECurr	A data frame of stream mark-recapture estimates without any previously estimated Adult Indices (typically from the current year), with variables: year, lake, lake-stream ID lscore (see description under indexStreams), population estimate PEmr, coefficient of variation CVmr (100 in year, lake, or lscore. There should be only one value for lake in the data frame. The data frame may include additional variables, but they will be ignored.
streamPEPrev	A data frame of stream mark-recapture estimates with estimated Adult Index contributions (typically from previous years), with the same variables as in streamPECurr plus the previously estimated contribution indexContrib, default NULL. There should be no missing values in year, lake, or lscore. The data frame may include additional variables, but they will be ignored.
minNMR	An integer scalar greater than or equal to 2, the minimum number of mark-recapture estimates needed in a year to generate an index, default 2.

**Details**

The annual Adult Index is simply the sum of stream population estimates for each year. Missing stream estimates are estimated by a lake-specific ANOVA model relating the log of the stream estimates to the main effects of each stream and each year, weighted by the inverse of the CV squared. The jackknifed range is produced by recalculating the index, leaving out one stream at a time, then scaling up the result to the same scale as the Adult Index based on all streams.

**Value**

A list with 2 components: streamPE, a data frame of stream mark-recapture and Adult Index contributions for the current data (streamPECurr), with the same variables as streamPEPrev; and lakeIndex, a data frame of annual lake-wide Adult Indices for the current data (streamPECurr), with 5 columns: lake, year, the Adult Index index, and the lower and upper jackknifed range jlo and jhi.

**Examples**

```
# estimate the index initially for 1998-1999 data
str9899 <- data.frame(
  year=rep(1998:1999, c(3, 3)), lake=1,
  lscode=rep(c(1.1, 1.2, 1.3), 2),
  PEmr=c(15, 20, NA, 12, 22, 30),
  CVmr=c(50, 50, NA, 50, 40, 30))
istr <- c(1.1, 1.2, 1.3)
est9899 <- estAIndex(indexStreams=istr, streamPECurr=str9899)
est9899

# then estimate the index for 2000 data
str00 <- data.frame(
  year=2000, lake=1,
  lscode=c(1.1, 1.2, 1.3),
  PEmr=c(10, NA, 28),
  CVmr=c(50, NA, 32))
estAIndex(indexStreams=istr, streamPECurr=str00,
  streamPEPrev=est9899$streamPE)

# notice how this is different than
# estimating the index for 1998-2000 altogether
estAIndex(indexStreams=istr, streamPECurr=rbind(str9899, str00))
```

index2pe

*Factors to Scale Up the Adult Index to a Lake-Wide Population***Description**

Lake-specific conversion factors to scale up indices of adult sea lamprey abundance in the Great Lakes to lake-wide population estimates.

**Format**

A named vector of length 5 (for the 5 Great Lakes) with factors rounded to the nearest hundredth.

**Author(s)**

GLFC Trapping Task Force.

**Source**

Great Lakes Fishery Commission ([GLFC](#)) Sea Lamprey Control Board Meeting 14-02, 15-17 Oct 2014, Briefing Item 5 - Attachment 2, Transitioning to the New Adult Index in 2015.

---

 jackIndex

*Index with Jackknifed Range*


---

### Description

Given a collection of estimates contributing to an index, this function provides the estimated index (sum) of observations (across a row) and the jackknifed range of the index, the result of leaving out an entire column (e.g., a location) one at a time.

### Usage

```
jackIndex(m)
```

### Arguments

**m** A numeric matrix of estimates contributing to the index. Rows are observations (e.g., years). Columns are individuals (e.g., locations).

### Details

The index is simply the sum of the columns in **m** for each row. The jackknifed range is produced by recalculating the index, leaving out one column at a time, then scaling up the result to the same scale as the index based on all columns.

### Value

A numeric matrix with 3 columns, the index, and the lower and upper jackknifed range of the index.

### Examples

```
# 3 years of population estimates from four streams
streampe <- matrix(1:12, nrow=3, dimnames=list(1996:1998, letters[1:4]))
jackIndex(streampe)
```

---

 lsIndex

*Great Lakes Streams used in the Index of Adult Sea Lampreys*


---

### Description

IDs identifying streams to used to generate the Adult Index.

### Format

A list of 5 numeric vectors of lake-stream IDs for the 5 Great Lakes, e.g., 1.064 = (lake ID) + (stream ID)/1000.

### Author(s)

GLFC Trapping Task Force.



**Source**

Great Lakes Fishery Commission (GLFC) Sea Lamprey Control Board Meeting 14-02, 15-17 Oct 2014, Briefing Item 5 - Attachment 2, Transitioning to the New Adult Index in 2015.

---

lsKeep

---

*Great Lakes Streams with Commitment to Adult Sea Lamprey Trapping*


---

**Description**

IDs identifying streams which will continue to have ongoing trapping even if not part of the Adult Index.

**Format**

A list of 5 numeric vectors of lake-stream IDs for the 5 Great Lakes, e.g., 1.064 = (lake ID) + (stream ID)/1000.

**Author(s)**

GLFC Trapping Task Force.

**Source**

Great Lakes Fishery Commission (GLFC) Sea Lamprey Control Board Meeting 14-02, 15-17 Oct 2014, Briefing Item 5 - Attachment 2, Transitioning to the New Adult Index in 2015.

---

trappedStreams

---

*General Information on Great Lakes Streams Trapped for Adult Sea Lampreys*


---

**Description**

Location information on trapped streams (past and present).

**Format**

A data frame with 8 elements: lake (lake ID), lscore (lake-stream ID, lake + strcode/1000), country, strcode (stream ID), estr (stream ID for Empiric Stream Treatment Ranking), strname (stream name), lat (latitude), long (longitude).

**Author(s)**

GLFC Trapping Task Force.

**Source**

Great Lakes Fishery Commission (GLFC) spawner model data base, last updated 12 May 2015.

# Index

AIcheck, [2](#)  
AIestimate, [2](#)  
AIprep, [2](#), [3](#), [3](#)  
AIreport, [4](#)  
AItarget, [5](#), [5](#)  
  
estAIndex, [6](#)  
  
index2pe, [7](#)  
  
jackIndex, [8](#)  
  
lsIndex, [8](#)  
lsKeep, [9](#)  
  
trappedStreams, [4](#), [9](#)