LITTERATUR OM BIOLOGISKE ASPEKTER AV THERMISK FORURENSNING

Foreløpig oversikt samlet av

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Biologiske undersøkelser

Kjernekraftverk

INNHOLD

1. Innledning

Denne foreløpige oversikten refererer en del nyere litteratur om thermisk forurensning. En del mer generelle arbeider om temperatur som biologisk faktor er også tatt med. Hovedvekten er lagt på marint miljø, men en rekke arbeider fra ferskvann er tatt med, der disse antas å gi relevante data.

Referansene er i første rekke hentet fra Pollution Abstracts, årgangene 1970 - 1973. Dessuten er noen av de bibliografiene og oversiktsarbeidene som er nevnt under punkt 3.1 og 3.2 benyttet. Litteraturkartotek tilhørende enkelte forskere ved Havforskningsinstituttet er også benyttet.

På den korte tiden som var disponibel var det bare mulig å finne fram til og gå gjennom et lite utvalg av den refererte litteraturen. De fleste sitater bygger derfor på abstrakter eller sitater i andre arbeider. En rekke av arbeidene som er tatt med i referanselisten er ikke sitert i oversikten. Dette skyldes at det ikke var mulig å finne tilstrekkelige opplysninger om innholdet, eller at innholdet ikke var relevant til de punktene som er behandlet.

Referanselisten er ikke kontrollert mot World List of Scientific Periodicals. I oversikten har jeg brukt navn på første forfatter med et. al. der det var to eller flere forfattere til et arbeid.

2. Temperatureffekter, generelt.

En god og meget omfattende oversikt over temperaturens virkning i marine miljøer er gitt av Kinne (ed.) (1970 a). En rekke aspekter av temperatur som biologisk faktor er også gitt av Kinne (1963, 1964), Precht et. al. (1955) og Rose (ed.) (1967). I disse arbeidene er omfattende referanselister.

3. Bibliografier og generelle oversikter over virkninger av thermisk forurensning.

3.1 Bibliografier: American Soc. of Civil Engineers 1967
Coutant et. al. 1972
Jensen et. al. 1969
Kennedy et. al. 1967
Morgan et. al. 1970
Parker et. al. 1969 b
Raney et. al. 1967

3.2 Arbeider om generelle problemer og oversikter.

Adams 1969 b
Altman et. al. (eds.) 1966
Anon. 1970
Arnold 1962
Barnett 1972
Cairnes 1970, 1971, 1972
Clarke 1969
Drost-Hansen 1969
Coutant et. al. 1972
Gorsline (ed.) 1971
Hawkes 1968
Hubbs 1972
Jensen 1969, 1970
Klotter 1971
Koolen 1971
Krenkel et. al. (eds) 1969
Marble et. al. 1971
Mihursky et. al. 1967
Naylor 1965 b
Parker et. al. 1969 a
Ross 1970
Tarzwell 1972
Snyder et. al. 1971
Wurtz et. al. 1965

Garton et. al. 1970 og Adams et. al. 1969 gir en del undersøkelses-metoder og praktiske retningslinjer.

6 Evertebrata

6.1 Generelt

Den nyeste større oversikt over temperaturens innvirkning på evertebrata er gitt av Kinne (1970 b). Barnett et.al.(1969) og Hedgpet et.al. (1969) behandler benthos, Cory et.al.(1969) epifauna, Costlov et.al. (1969) meroplankton og Heinle (1969) zooplankton.
Jensen et.al.(1969) behandler akvatiske evertebrata generelt.
McFrlean et.al.(1969) gir metodikk for bestemmelse av øvre toleransegrenser
En rekke data finnes også hos Coutant et.al.(1972).

6.2 Toleranse, aklimatisering.

Cornelius (1972) behandler aklimatisering hos endel strand evertebrata.
Johannes (1970) viser at varmtvann er meget ødeleggende for korallrev.
Kennedy et.al.(1971) gir øvre toleransegrense for Mya arenaria, Macoma balthica og andre.
Precht et.al.(1955) behandler adaptasjon hos vekselvarme dyr.
Markowski (1959) gav data som tydet på at varmtvannsutslipp hadde liten betydning for evertebrata i brakkvann.

6.3 Reproduksjon.

Barnett (1972) viste at Tellina tennis ble lite påvirket, mens gytetiden ble forskyvd hos Nassarius reticulatus ved thermisk utslipp (England).

Perkins (1972) gir utviklingshastighet for Homarns americanus ved forskjellige temperaturer. Perukso (1970) behandler gyting hos Ostrea edulis, og Sanditer (1973) larveutvikling hos Palemonetis vulgaris.

Coutant (1969) gir en generell oversikt over temperatur og reproduksjon.

6.4 Vekst, metabolisme, ernæring.

Boëtius (1962) behandler temperatur og vekst hos Mytilus edulis.
Kennedy et.al.(1972) behandler respirasjon og metabolisme hos bl.a. Macoma balthica og Mya arenaria. Respirasjonen økte med temperaturen innen visse grenser. Økt metabolisme kunne gi sult om vinteren

da næringstilgangen var liten.

Holland et.al.(1971) og Leffer (1972) behandler vekst, ernæring og metabolisme hos Callinectes sapidus.
MacKenzie (1970) behandler ernæring hos Asterias forbesi.
Williams et.al.(1971) behandler vekst hos Nassarius.

7. Fisk

7.1 Generelt om fisk og temperatur

Brett, 1970 Fry, 1967

7.2 Generelt om fisk og thermisk forurensning.

Alabaster 1963
Allen et. al. 1970
Brett 1969
De Sylva 1969

7.3 Toleranse, aklimatisering.

Brett (1970), Altman et. al. (eds.) (1966), Coutant et. al (1972), Grodzinski (1971), Hoff et. al. (1966) og Oregon State University (1971) gir data om temperaturtoleransen til en rekke arter.

Charlon et. al. (1970) diskuterer betydningen av aklimatisering og maksimal temperatur-toleranse hos regnbueaure.

Ebel et. al. (1971) behandler sammenheng mellom nitrogentrykk og temperaturtoleranse hos regnbueaure og stillehavslaks.

Gause (1969) viser at en kommersielt viktig fisk, Cynicion macdonaldi, er i ferd med å bli utryddet p. g. a thermisk forurensning.

Marcy (1971) viser nesten total dødelighet av fisk som kommer inn i kjølesystemet til kraftanlegg.

Ponemarenko (1973) viser at økning i temperaturen øker overlevning av ung torsk (data fra Barentshavet.)

Waede (1954) behandler temperatur og salinitets resistans hos rød-spette og skrubbe.

7.4 Metabolisme, vekst, ernæring.

En grundig innføring gis av Brett (1970)

Bennet (1972) behandler temperaturens virkning på kondisjonsfaktor.

Boytsov (1971) viser at varmtvannsutslipp førte til lengre vekst-perioder hos endel ferskvannsfisk.

Marr (1966) behandler veksteffektiviteten hos embryo av laksefisk.

McCormick et. al. (1972) behandler vekst og overleving av Salvelinus fontinalis.

Edvards (1971), Molnar et. al. (1962) og Reichenbach - Klinke (1969) behandler fordøyelseshastighet.

Paloheimo et. al.(1966) undersøkte temperaturens betydning for metabolisme.

Saksena et. al. (1972) behandler vekst og overleving av Harengula larver i akvarium.

Shcherbukha (1971) viser at varmtvannsutslipp hadde vesentlig betydning for veksten av en rekke ferskvannsfisk.

Grimes (1971) fant ikke forandring av vekst hos fisk tatt ved utløpet fra kraftverk i Florida.

7.5 Reproduksjon

Alderdice et. al. (1971) behandler betydningen av temperatur og salt-holdighet for utviklingen av Clupea pallasi.

Brungs (1971) viser at fekunditet og antall gytinger pr. hunn avtok ved høy temperatur hos Pimephales promelas.

Christie et. al. (1973) viste at temperaturen hadde avgjørende betydning for reproduksjonen hos to amerikanske arter.

Dickson et. al. (in press.) viste at overlevningen av nordsjø-torsk larver var best ved lav temperatur. Lav temperatur gav senere klekking og bedre næringsforhold for larvene. Det gav også lavere metabolisme, så plommesekken varte lengre.

Dodge et. al. (1971) behandler temperaturens virkning på gyteperioden hos regnbueaure.

Hoss et. al. (in press) behandler skjebnen til larver som blir trukket inn i kjølevannssystem.

Hubbs et. al. (in press.) behandler hvilken betydning den temperaturen foreldrefiskene utsettes for har på temperaturtoleransen til eggene hos Menidia.

Irven (in press) viser at temperaturtoleransen hos tunge-larver økte med alderen.

Shchubukha (1971) viser at varmtvannsutslipp hadde liten effekt på kjønnsmodning av en del ferskvannsfisk.

Von Westenhagen (1970) behandler temperaturens betydning for embryonalutvikling og klekking hos torsk og flyndre.

7.6 Adferd

Gibbon et. al. (1972) viste at ferskvannsfisk endret adferd i en elv med thermisk forurensning.

McCauley et.al. (1971) behandler temperaturpreferanse hos regnbueaure.

Sylvester (1972) viste at forandring i temperatur kunne endre likevekten i predator-bytte relasjonen mellom Oncorhynchus kisutch og O. nerka.

Ware (1971) behandler predator adferd hos regnbueaure.

7.7 Fysiologiske aspekter

Data finnes i en rekke vanlige håndbøker.

Wattus (1972) behandlet respirasjon hos Plathychthys stellatus ved høy temperatur og lite O_2.

Wedemeyer (1973) behandler fysiologiske aspekter ved sublethal temperatur hos Salmo gairdneri og Oncorhynchns kisutch.

8. Virkninger på økosystemer

En rekke av de arbeidene som er satt opp under punkt 3. 2 gir data om økologiske forhold. De resultater som foreligger synes sterkt motstridende, og viser at de virkningene man finner på ét økosystem ikke kan overføres til andre. Det synes heller ikke mulig å forutsi virkningene på et gitt økosystem.

Adams et. al. (1970) hevder at virkningene av varmtvann var små på marint økosystem i California
Copeland et. al (1972) undersøkte estuarint system, og fant bl. a. følgende effekter: Økt regenerasjon av næring. Noe økt biomasse av alger, nekton og benthos om sommeren. Biomassen var mindre enn normalt om vinteren. Forholdet fotosyntese/respirasjon økte om våren og sommeren, men avtok gjennom vinteren, sammenlignet med områder uten thermisk forurensning.

Fenlow et. al. (1971) påviste økning i biomasse av Bosmina (ca. 25x) og Daphnia (ca. 1, 2 x) mens primærproduksjonen ble lite påvirket (limnisk miljø).

Grimas (1970 a, b) behandler økologiske virkninger av varmekraftverk i Sverige.

Naylor (1965 a) viste at den opprinnelige faunaen på en lokalitet i England ble forandret ved varmtvannsutslipp. Enkelte arter (f. eks. Carcinus) forekom i området, men formerte seg ikke, mens andre (f. eks. Ascidiella, Ciona) gikk sterkt fram.

Reeves (1970) fant små effekter på en marin lokalitet i Syd-California.

Økologiske virkninger behandles også av

Adams et. al. 1969
Adams 1969 a
Bell 1971
Cairnes 1970
Hawkes 1968
Levin et. al. 1972
Mihursky et. al. 1972
Marble et. al. 1971

9 Akvakultur

Det finnes en rekke arbeider om utnytting av varmeutslipp, i første rekken innen akvakultur. Bare et mindre utvalg er tatt med her.

En fyldig oversikt er gitt av:

Mathur et. al. (eds.) 1970
Walne 1970 og Richardson 1970 viser til meget gode resultater med oppdrett av tunge og rødspette.

Av generelle oversikter og arbeider med arter mindre aktuelle i norske farvann kan nevnes:

Ansell 1969
Coutant 1970
Gaucher 1970
Havelka 1970
Kirk 1972
Nash 1970
Pichering 1970
Thorslund 1971, 1972
Yang 1970 a, 1970 b
Yee 1971, 1972

10. Litteratur

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